2012

2012-2013 Graduate Bulletin

Rochester Institute of Technology

R·I·T

GRADUATE BULLETIN

2012-2013

Rochester Institute of Technology
2012–13 University Calendar

Fall Quarter (2121*)

September 3
Day, evening, and online classes begin

September 8
Saturday classes begin

September 9
Last day to add/drop classes

September 10
First day to drop classes online via SIS; receive a "W" grade

October 26
Last day to drop classes online; receive a "W" grade

November 9
Last day and evening classes

November 10
Last Saturday and online classes

November 12, 13, 14, 15, 16, 17†
Final exams

November 18-25
Fall/Winter break

November 22-23
Thanksgiving
(University closed)

Winter Quarter (2122*)

November 26
Day, evening, and online classes begin

December 1
Saturday classes begin

December 2
Last day to add/drop courses

December 3
First day to drop classes online via SIS; receive a "W" grade

December 21
Last day and evening classes before break

December 22
Last Saturday and online classes before break

December 24, 2012–January 6, 2013
Holiday break

December 24, 2012–January 1, 2013
University closed

January 2
University re-opens

January 7
Day, evening, and online classes resume

January 12
Saturday classes resume

February 1
Last day to drop classes online; receive a "W" grade

February 15
Last day and evening classes

February 16
Last Saturday and online classes

February 18, 19, 20, 21, 22, 23†
Final exams

February 24- March 3
Winter/Spring break

Spring Quarter (2123*)

January 24-March 12, 2013
Spring registration

March 4
Day, evening, and online classes begin

March 9
Saturday classes begin

March 10
Last day to add/drop courses

March 11
First day to drop classes online via SIS; receive a "W" grade

April 26
Last day to drop classes online; receive a "W" grade

May 10
Last day and evening classes

May 11
Last Saturday and online classes

May 13, 14, 15, 16, 17†
Final exams

May 17
Academic Convocation and Commencement Ceremonies

May 18
Commencement Ceremonies

May 19 - May 27
Spring/Summer break

May 27
Memorial Day
(University closed)

Summer Quarter (2124‡)

May 28 (Tuesday)
Day, evening, and online classes begin

June 1
Saturday classes begin

June 3 (Monday)
Last day to add/drop summer courses

June 4 (Tuesday)
First day to withdraw online via SIS; receive a "W" grade

July 4 (Thursday)
Independence Day
(University closed)

July 22
Last day to withdraw online; receive a "W" grade

August 5 (Monday)
Last day and evening classes

August 3
Last Saturday and online classes

August 6, 7, 8, 9, 10†
Final exams

* *New PeopleSoft SIS Term Codes*

† *Day students can access their individual exam schedules online through SIS. Students attending evening, Saturday and on-line courses should check with their instructors regarding their final exam schedules.*

‡ *Check infocenter.rit.edu for summer short session (1-5 week) course dates.*

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Rochester Institute of Technology

Semester Conversion

Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. Students beginning academic programs in the fall of 2012 will begin in the current quarter system and complete their degrees in the new semester-based calendar.

Academic advisers will guide students through the semester conversion. Advisers will work with each student individually to develop an Individual Advising Plan. These plans will outline each student's remaining graduation requirements (courses and cooperative education) as they transition from quarters to semesters.

For reference, every program in this bulletin includes charts that illustrate the typical course sequence for each program in both quarters and semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. Students are encouraged to consult their academic adviser (graduate program adviser) with questions regarding planning and course selection.

For more information on the quarter-to-semester conversion, please visit www.rit.edu/conversion.

About This Bulletin

This *Graduate Bulletin* does not constitute a contract between the university and its students on either a collective or individual basis. It represents RIT's best academic, social, and financial planning at the time of publication. Course and curriculum changes, modifications of tuition, fee, dormitory, meal, and other charges, plus unforeseen changes in other aspects of RIT life, sometimes occur after the *Graduate Bulletin* has been printed but before the changes can be incorporated in a later edition of the same publication. Because of this, Rochester Institute of Technology does not assume a contractual obligation with its students for the contents of this *Graduate Bulletin*. RIT promotes and values diversity within its workforce and provides equal opportunity to all qualified individuals regardless of race, color, creed, age, marital status, gender, religion, sexual orientation, gender identity, gender expression, national origin, veteran status, or disability.

Rochester Institute of Technology
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Graduate Bulletin 2012–13
Produced by the Office of University Publications

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Why Get Your Graduate Degree from Rochester Institute of Technology?

Choices

RIT is one of the nation's top comprehensive universities and sets the national standard for career-oriented education in many technological, scientific, and professional areas of study. With more than 70 graduate programs in high-growth and high-tech career fields including business, computer science and information technology, engineering, science, and art, RIT offers the choices you want in graduate education.

Graduate study options include master's and doctoral degrees, as well as advanced graduate certificates. RIT offers several ways to obtain your graduate degree, including part-time study, evening programs, online learning, accelerated executive education programs, and one-year master's degree options.

Quality

RIT is chartered by the legislature of the state of New York, and is accredited by the well recognized Middle States Association of Colleges and Schools. In addition, many of our individual programs and departments have professional accreditation from business and industry organizations.

At RIT, you'll interact with faculty members who have extensive teaching experience and are internationally respected for their contributions in their professional fields. RIT enrolls more than 17,500 students from across the United States and 110 foreign countries.

Selected faculty and student awards, honors, and partnerships

- Ford Foundation Grants
- Fulbright Scholars
- Edmund S. Muskie Fellows
- Excellence in Engineering Education Award
- National GEM Fellows
- Ronald McNair Scholars
- Pulitzer Prizes
- Student Academy Awards
- National Science Foundation Awards
- National Endowment for the Humanities Awards
- New York Foundation for the Arts Fellowship
- Alfred P. Sloan Foundation Grants

Reputation

Fueled by significant support from government, industry, and private donors, RIT offers a unique, career-oriented graduate education tailored to meet your individual needs.

RIT is the 15th largest private university in the United States, and is consistently recognized by leading college guides, industry publications, and the media. RIT has been cited by *U.S. News & World Report* as the most comprehensive university in the north for academic reputation.

More than 106,000 alumni worldwide include business, industry, and government leaders. Hundreds of top companies and government agencies—from global giants to startup companies—rely on RIT as a source for filling full-time positions and providing ongoing employee development.

Results

RIT graduates are highly sought after by companies of all sizes in virtually every industry in the U.S. and abroad. More than 600 companies visit RIT annually to recruit students, and employment and advancement opportunities for our graduate students remain strong.

Graduate students take advantage of government and industry-sponsored programs and research projects to broaden their experience and increase their visibility with potential employers. Research projects and experiential education often result in permanent employment offers and opportunities for our graduates. Some of our graduate students currently work for such companies as Bausch & Lomb, Boeing, Google, Johnson & Johnson, Microsoft, NASA, Toyota, and Xerox.

You want a degree that will be recognized and valued in today's competitive marketplace, and RIT delivers.

Graduate Education at RIT

RIT, founded in 1829, is a privately endowed university in suburban Rochester, NY. It is comprised of nine colleges and two degree-granting units:

College of Applied Science and Technology

E. Philip Saunders College of Business

B. Thomas Golisano College of Computing and Information Sciences

Kate Gleason College of Engineering

College of Health Sciences and Technology

College of Imaging Arts and Sciences

College of Liberal Arts

Center for Multidisciplinary Studies

National Technical Institute for the Deaf

College of Science

Golisano Institute For Sustainability

For additional information, contact us at:
Rochester Institute of Technology
Office of Graduate Enrollment Services
58 Lomb Memorial Drive
Rochester, NY 14623-5604
(585) 475-2229
gradinfo@rit.edu
www.rit.edu/grad

Message from the Dean of Graduate Studies

The graduate learning experience at RIT is focused and intensive. RIT graduate programs provide a conceptual structure and organization of knowledge in the chosen subject—an understanding essential to leading technological change in the professions. They also build an educational base for life-long learning and for the generation of new knowledge and new insights through research.

The programs themselves are centered in fields that combine both theoretical knowledge and practical applications, especially those which can provide the graduate with a unique niche in the marketplace. Thesis topics often relate directly to situational concerns, rather than theoretical discourse. Many programs require a thesis or project, and encourage other avenues for professional experience, such as cooperative education and internships in government and industry.

Students often use employers as primary sources for research and special projects. This application-oriented approach attracts faculty who value problem-solving skills in students. Whether a thesis, project, or professional portfolio is required of them, our students are encouraged to incorporate both independent study and experiential learning into their programs. Graduate students also may assist in undergraduate education, as teaching, research, or laboratory assistants.

A philosophy supported by campus resources

RIT's international reputation as an applied technological university with a unique connection to the arts and humanities gives graduate students the advantage of working with sophisticated technology and in laboratories found on and off campus. For example, students in microelectronic engineering have access to clean-room facilities that meet industry standards. Students majoring in computer graphics design access digital media using a variety of systems and software, including Macintosh, IBM, Silicon Graphics, and Media 100 digital video editing. Our telecommunications technology workstations have been donated by an industry eager to hire students experienced with equipment used in their own laboratories.

Technology also has brought together students in design, crafts, photography, and printing. In RIT's Electronic Still Photography Laboratory, these disciplines have merged through electronics.

Regardless of the program, RIT encourages and promotes technological innovation in all areas.

Specialized and diverse programs

While technology is integral to all graduate programs, the essence of RIT graduate education is found in the diversity of programs, course offerings, and learning options. Our reputation as an advanced university is matched by our commitment to offering programs designed to meet the specialized needs of employers. A dozen international corporations—including Eastman Kodak Co., Konica, Agfa Gevaert, Xerox Corp., and Fuji Photo Film Co.—have sponsored the building of laboratories in the Chester F. Carlson Center for Imaging Science, which houses the nation's most comprehensive imaging science programs. Enriched by the perspective provided by the National Technical Institute for the Deaf, one of RIT's colleges, we offer full access to deaf and hard-of-hearing students seeking graduate-level academic programs.

Across campus, graduate students engage in exciting research and stimulating dialogues with faculty and such distinguished visitors as George Bush, Bill Clinton, Joe Torre, Jesse Jackson, Maya Angelou, Annie Leibovitz, Jerry Uelsmann, Cornel West, and Greg Heisler. The E. Philip Saunders College of Business draws prominent figures from the business world—including U.S. Steel CEO Thomas Usher and Robert Bartley, editor and vice president of *The Wall Street Journal*—through the William D. Gasser Distinguished Lectureship in Business.

The university continues to receive international recognition for the quality of its graduate programs. In a recent ranking of national photography programs, *U.S. News & World Report* named RIT's School of Photographic Arts and Sciences in the top five. This publication has also consistently ranked RIT in the top 20 in its master of fine arts category.

Convenient and flexible programs

RIT's diversity also extends to the manner in which courses and programs are scheduled. Many of our graduate programs are available on a part-time, online, or evening basis and are designed for working professionals. Examples of programs offered through online learning include networking and systems administration; environmental, health and safety management; telecommunications engineering technology; imaging science; microelectronics manufacturing engineering; and health systems administration. These programs allow students access to an RIT education without attending classes on campus.

In addition, RIT's executive MBA program offers professionals an opportunity to earn a master's degree by studying on campus Friday and Saturday, every other week, or through online learning. Professionals from California to England visit RIT every year for executive leader master's degree programs in service management, hospitality and tourism management, health systems administration, and packaging science, which combine on-campus residencies with classes using distance-learning technology.

The RIT philosophy and mission

RIT's mission is the education of men and women for work and life in a democratic, inclusive, and global society. It is integral to the university's mission to be a dynamic center of higher education—one in which technology, the arts and sciences, and other dimensions of human knowledge and civilization are valued, cultivated, and applied.

Throughout its history, the university has been at the forefront in preparing students for professional careers in the STEM disciplines (science, technology, engineering and mathematics). RIT structures itself as an educational resource for all who seek to be competent and enthusiastic lifelong learners, whether they are young adults or professionals seeking to upgrade their skills by studying for an advanced degree. Our goal is that all graduates will understand the ethical, humanitarian, and aesthetic challenges of a diverse workplace and an international community.

The university's educational philosophy emphasizes not only theory—the natural foundation of knowledge—but also the practical workplace application of theories. This dual emphasis is prized by employers and offers graduates upward career mobility and the flexibility for changes in career direction. Another asset of an RIT education is cooperative education, offering students in selected programs the opportunity for paid, professional work experience while completing their degrees.

History of graduate education

Starting in 1955 with the master of fine arts degree, RIT continually has created new graduate programs to meet employers' and students' requests for education in particular functional areas. When surveys in the 1960s indicated the need for sophisticated statistical knowledge, a master of science degree in applied and mathematical statistics was created. More recently, the Golisano Institute for Sustainablity began doctoral and master's degrees in sustainability. Other graduate programs have taken similar routes, and all nine RIT colleges exhibit continuous concern for the emerging needs of the business, industrial, and scholarly communities.

To support RIT's continuing endeavor to provide education in emerging career fields, the university has six doctoral programs in the fields of astrophysical sciences and technology, color science, computing and information sciences, imaging science, microsystems engineering, and sustainability. These degrees are six of more than 70 graduate degrees now offered by the university.

Sponsored research projects

Externally sponsored projects are a vital and integral component of RIT's educational and research activity. Faculty and students undertake sponsored projects for a variety of important reasons: to add to the body of knowledge, for professional development, and to strengthen academic programs. Sponsored projects enhance the university's academic programs, broaden its research resources, provide opportunities for student participation in research, strengthen university-industrial partnerships, and serve the wider community.

Moreover, grants and contracts enhance existing resources and provide new opportunities for faculty, staff, and students. External funding comes from federal and state agencies, private foundations, and corporations. RIT's major sponsors include the National Science Foundation, the National Institutes of Health, the U.S. Department of Education, the Department of Defense, the National Aeronautics and Space Administration, and New York state.

Additional information is available through the Office of Sponsored Research Services at (585) 475-7985, research@rit.edu, or on their website at www.research.rit.edu.

Accreditation

RIT is chartered by the New York state legislature and accredited by:

The Commission on Higher Education
Middle States Association of Colleges and Schools
3624 Market Street
Philadelphia, PA 19104-2680
(215) 662-5606

and

New York State Education Department
Office of College and University Evaluation
5 North Mezzanine
Albany, NY 12234
(518) 474-2593

In addition to institutional accreditation, many of RIT's academic programs have been granted accreditation by appropriate professional accreditation bodies. Where applicable, specific mention of accreditation is included in program descriptions. Students wishing to review documents describing accreditation should contact the Office of the Vice President for Academic Affairs.

The *Graduate Bulletin* provides comprehensive information on all graduate programs at RIT. I encourage you to explore its contents to find the educational and research opportunities you seek. I look forward to welcoming you to our campus, and wish you success in your chosen program of study.

Hector E. Flores

Dean, Graduate Studies

Graduate Programs of Study

		Degree and HEGIS Code								
		Adv. Cert	Ph.D.	MBA	ME	MFA	MS	MST	M. Arch	Page #
Business and Management										
Business Administration	Business			0506						41
Business Administration–Accounting	Business			0502						49
Elements of Health Care Leadership*	Health Sciences and Technology	1202								165
Executive MBA†	Business			0506						47
Facility Management*	Applied Science and Technology						0599			10
Finance	Business						0504			50
Health Information Resources‡	Health Sciences and Technology	1202								
Health Systems Administration*	Health Sciences and Technology						1202			162
Health Systems Finance*	Health Sciences and Technology	1202								165
Hospitality-Tourism Management†	Applied Science and Technology						0510.10			15
Human Resource Development†	Applied Science and Technology	0515					0515.00			18
Innovation Management	Business						0506			51
Management	Business						0513			52
Manufacturing Leadership	Engineering						0599			117
Project Management*	Division of Academic Affairs (Center for Multidisciplinary Studies)	0506								236
Senior Living Management*‡	Health Sciences and Technology	0599								166
Service Leadership and Innovation	Applied Science and Technology	0510					0599			16
Strategic Training	Division of Academic Affairs (Center for Multidisciplinary Studies)	0515								20
Computer and Information Sciences										
Computer Engineering	Engineering						0999			112
Computer Science	Computing and Information Sciences						0701			65
Computing Security and Information Assurance	Computing and Information Sciences						0799			70
Computing and Information Sciences	Computing and Information Sciences		1701							68
Database Administration‡	Computing and Information Sciences	0799								80
Game Design and Development	Computing and Information Sciences						0799			66
Human-Computer Interaction	Computing and Information Sciences						0799			71
Information Assurance*	Computing and Information Sciences	0799								72
Information Technology*	Computing and Information Sciences						0699			74
Interactive Multimedia Development	Computing and Information Sciences	0699								81
Learning and Knowledge Management Systems‡	Computing and Information Sciences	0799					0799			
Medical Informatics	Computing and Information Sciences/ Univ. of Rochester Medical Center						1217			76
Networking and Systems Administration*‡	Computing and Information Sciences	0702								78
Networking and System Administration*	Computing and Information Sciences						0702			77
Networking Planning and Design	Computing and Information Sciences	0702								79
Software Development and Management‡	Computing and Information Sciences						0799			82
Software Engineering	Computing and Information Sciences						0999			
Technical Information Design*‡	Division of Academic Affairs (Center for Multidisciplinary Studies)	0605								237
Professional Studies (Individualized Program)										
Professional Studies*	Division of Academic Affairs (Center for Multidisciplinary Studies)						4999			235
Education and Liberal Arts										
Applied Experimental and Engineering Psychology	Liberal Arts						2099			216
Visual Arts–All Grades (Art Education)	Imaging Arts and Sciences							0831		178
Communication and Media Technologies	Liberal Arts						0605.00			219
Criminal Justice	Liberal Arts						2209			221
Human Resource Development †	Applied Science and Technology	0515					0515			18
School Psychology	Liberal Arts	0826.02					0826.02			218
Science, Technology and Public Policy	Liberal Arts						2102			222
Secondary Education of Students Who Are Deaf or Hard-of-Hearing	NTID						0803			241

Graduate Programs of Study

		Degree and HEGIS Code								
		Adv. Cert	Ph.D.	MBA	ME	MFA	MS	MST	M. Arch	Page #
Engineering and Technology										
Applied Statistics*	Engineering						1702			110
Architecture	Sustainability Institute/CIAS								0202	297
Computer Engineering	Engineering						0999			112
Electrical Engineering	Engineering						0909			113
Engineering Management	Engineering				0913					114
Environmental, Health and Safety Management*	Applied Science and Technology						0420			9
Industrial Engineering	Engineering				0913		0913			115
Manufacturing and Mechanical Systems Integration	Applied Science and Technology						0913			11
Manufacturing Engineering‡	Engineering				0913					
Manufacturing Leadership	Engineering						0599			117
Materials Science and Engineering	Engineering/Science	0915					0915			254
Mechanical Engineering	Engineering				0910		0910			118
Microelectronic Engineering*	Engineering						0999			120
Microelectronics Manufacturing Engineering*	Engineering				0999					121
Microsystems Engineering	Engineering		0999							122
Packaging Science†	Applied Science and Technology						4999			13
Product Development	Engineering						0599			124
Statistical Quality*	Engineering	1702								130
Sustainable Engineering	Engineering				0999		0999			126
Systems Engineering‡	Engineering				0913					128
Telecommunications Engineering Technology*	Applied Science and Technology						0925			14
Photography, Fine Art, and Graphic Communication										
Ceramics and Ceramic Sculpture	Imaging Arts and Sciences					1009				174
Computer Graphics Design	Imaging Arts and Sciences					1009				179
Digital Print and Publishing	Imaging Arts and Sciences	0605								
Film and Animation	Imaging Arts and Sciences					1011				182
Fine Arts Studio	Imaging Arts and Sciences					1002		1002		178
Glass	Imaging Arts and Sciences					1009				175
Graphic Design	Imaging Arts and Sciences					1009				180
Imaging Arts	Imaging Arts and Sciences					1011				185
Industrial and Interior Design	Imaging Arts and Sciences					1009				181
Medical Illustration	Health Sciences and Technology					1299				164
Metalcrafts and Jewelry	Imaging Arts and Sciences					1009				176
Non-Toxic Intaglio Printmaking	Imaging Arts and Sciences	1009								179
Print Media*	Imaging Arts and Sciences						0699			182
Visual Arts–All Grades (Art Education)	Imaging Arts and Sciences								0831	178
Woodworking and Furniture Design	Imaging Arts and Sciences					1009				177
Science, Mathematics, and Imaging Science										
Applied and Computational Mathematics	Science						1799			250
Applied Statistics*	Engineering						1702			110
Astrophysical Sciences and Technology	Science		1912				1912			256
Bioinformatics	Science						0499			248
Chemistry	Science						1905			252
Clinical Chemistry‡	Health Sciences and Technology						1223			161
Color Science	Science		1999.20				1999.20			259
Environmental Science	Science						0420			249
Imaging Science*	Science		1999.20				1999.20			263
Materials Science and Engineering	Engineering/Science	0915								254
Statistical Quality*	Engineering	1702								295
Statistical Methods for Product and Process Improvement*	Engineering	1702								129
Sustainability	Sustainability Institute		4904							295
Sustainability Systems	Sustainability Institute						4904			296
Vibrations	Engineering	0910								131

* Online learning option available.
† Executive education option available.
‡ This program is not admitting new students in 2012-13.

Doctoral Study at RIT

Doctoral programs at RIT are multidisciplinary, cutting-edge, and unique. Our highly interdisciplinary programs were developed out of RIT's unique areas of strengths in imaging, computing, science, engineering, and sustainability. Our long history of providing education focused on emerging technologies has led to the development of doctorate level programs that draw upon our expertise and experience in these dynamic disciplines of study.

Our six doctorate programs focus on the discovery and application of technology to solve problems in society. The interdisciplinary nature of the programs means students will work alongside more than 50 Ph.D. faculty members who are experts in a wide range of fields that are influenced by imaging, computing, science, engineering, and sustainability.

Programs of study

RIT offers six doctoral degrees in areas where RIT shares national and international recognition. Our programs are cross-college collaborations that support interdisciplinary research.

Astrophysical sciences and technology: Students in the astrophysical sciences and technology program will experience a comprehensive curriculum and a broad range of research opportunities that span forefront topics, such as supermassive black holes, dark energy, gravitational waves, supernovae, massive stars, the Galactic center, star formation, clusters of galaxies, Active Galactic Nuclei, astro-informatics, computational astrophysics, and instrument and detector development. This doctoral program not only focuses on discovery and analysis, but also on the development of the technologies—including the instruments, analysis, and modeling techniques—that will enable the next major strides in astrophysics.

Color science: Color science is defined as the quantification of color and its perception. It is used in the design and production of most man-made materials including textiles, paints, and plastics, and to specify the properties of diverse natural materials such as skin, plants, and soil. It also provides the scientific foundation for color imaging and has enabled advances in digital photography, electronic display systems, and color printing. The degree program revolves around the activities of the Munsell Color Science Laboratory within the Center for Imaging Science, the pre-eminent academic laboratory in the U.S. devoted to the study of color science. For more than 25 years its faculty and staff have trained students and conducted cutting-edge research in the field. Graduates of the program are in high demand, and enjoy a 100 percent placement rate since the inception of the program.

Computing and information sciences: This use-inspired basic research degree is designed to produce independent scholars, well-prepared educators, and cutting-edge researchers poised to excel in their work within interdisciplinary environments and industries. The degree highlights two of the most unique characteristics of the Golisano College—the breadth of its program offerings and its scholarly focus on discovering solutions to real-world problems by balancing theory and practice.

The program focuses on the theoretical and practical aspects of cyberinfrastructure as applied to specific problems across multiple domains. It is a blend of the intra-disciplinary computing knowledge areas and interdisciplinary domain areas.

Imaging science: Imaging was named one of the top twenty engineering achievements of the 20th Century by the National Academies. Imaging has transformed our ability to see and understand a range of phenomenon, keeping us healthy, protecting our security, monitoring the earth, exploring the universe, uncovering and preserving our heritage, enhancing communication, and facilitating our every day lives. The imaging science doctoral program is designed to provide a fundamental understanding of the physical, electro-optical, mathematical, computational, and statistical foundations of imaging science that are necessary to create, optimize, and apply imaging systems.

Microsystems engineering: The integration of entire systems into micron-scale devices and the sensing technology to interface these devices to the real world is the core emphasis of the microsystems engineering doctoral program. These systems are at the core of the next generation of technology. Within the past decade, microsystems (micro-optical, micro-electrical, and micro-mechanical systems) have emerged as a critical technology worldwide and this dynamic field is positioned for outstanding growth in the future.

Sustainability: The first program in the world to focus on sustainable production, the doctorate in sustainability focuses on sustainable production systems—systems that create goods and services using processes that are non-polluting; conserving of energy and natural resources; economically viable; and safe and healthful for workers, communities, and consumers. This program also serves to advance research and education in alternative-energy development, sustainable design, green product development, industrial ecology, and pollution prevention.

Leaders in research

Research is a driving force in the university, engaging more than 2,700 students in hands-on research opportunities in each of our colleges. These opportunities combine classroom learning with laboratory discovery, which enhances each student's education and builds powerful skills that are applicable in a wide range of career paths.

At the core of our doctoral programs is a focus on research, which is intensive and demanding. It is this successful resolution of societal problems that leads to deep professional and personal fulfillment as new discoveries are made and applications are developed. Ph.D. students from a range of academic backgrounds work with world-renowned faculty who are leaders in their fields of study. A focus on teamwork, research, and the intersection of the disciplines gives students the opportunity to collaborate with others, share ideas, and develop innovative solutions using emerging technologies.

We build on our strengths when creating doctoral programs, emphasize research across disciplines, and rely on our interdisciplinary faculty to produce the next generation of educators and researchers with the ability to develop solutions to real world problems.

RIT Research Centers and Organizations

RIT is home to more than 50 interdisciplinary research centers, institutes, and organizations that bring together faculty and students from across the university. These entities explore a wide range of topics and cover everything from business and entrepreneurship to biomedical sciences, nanolithography, printing, social computing, remanufacturing, microsystems fabrication, environmental sustainability, and visual perception.

- Analog Devices Integrated Microsystems Laboratory
- Astrophysics Science and Technology
- Biomedical Imaging/MRI
- Biomedical Imaging/Ultrasound
- Center for Advanced Device Research
- Center for Advancing the Study of Cyberinfrastructure
- Center for Applied and Computational Math
- Center for Biosciences Education and Technology
- Center for Computational Relativity and Gravitation
- Center for Education Research Partnerships
- Center for Electronic Manufacturing and Assembly
- Center for Excellence in Lean Enterprise
- Center for Innovation and Entrepreneurship
- Center for Integrated Manufacturing Studies
- Center for Nanolithography Research
- Center for Quality and Applied Statistics
- Center on Access Technology
- Chester F. Carlson Center for Imaging Science
- Digital Imaging and Remote Sensing Laboratory
- Image Permanence Institute
- Imaging Products Laboratory
- International Center for Hearing and Speech Research
- IT Collaboratory
- Laboratory for Advanced Communication Technology
- Laboratory for Computer-Human Interaction
- Laboratory for Digital Image Restoration
- Laboratory for Environmental Computing and Decision Making
- Laboratory for Graphical Simulation, Visualization and Virtual Worlds
- Laboratory for Imaging Algorithms and Systems
- Laboratory for Intelligent Systems
- Laboratory for Printing Materials and Process
- Laboratory for Social Computing
- Laboratory for Wireless Networks and Security
- Manufacturing Technologies Program
- Multidisciplinary Vision Research Laboratory
- Munsell Color Science Laboratory
- NanoPower Research Laboratory
- National Center for Remanufacturing and Resource Recovery
- Print Research and Imaging Systems Modeling Laboratory
- Printing Applications Laboratory
- Printing Industry Education Program
- Research and Teacher Education Center
- RF/Analog Mixed Signal Laboratory
- RIT Venture Creations Incubator
- Semiconductor and Microsystems Fabrication Laboratory
- Sloan Printing Industry Center
- Sustainable Systems Research Center
- Systems Modernization and Sustainment Center
- Thermal Analysis and Microfluidics Laboratory

College of Applied Science and Technology

H. Fred Walker, Dean

www.rit.edu/cast

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Programs of study

*Executive leader option: These programs are available in a non-traditional, accelerated format, designed for working professionals with significant work experience.

Online learning option available.

The diverse, graduate-level programs offered by the College of Applied Science and Technology represent RIT's commitment to curricular innovation, program flexibility, and academic rigor. The college is committed to advancing the state of the education we provide through the latest technology, management theories, and educational philosophies.

Admission requirements

The colleges make all decisions regarding graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarship

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

The college's faculty bring a unique blend of academic credentials, scholarship, and significant industrial experience into the classroom. Ongoing participation as professional consultants and researchers allows them to integrate the latest innovations, theories, and content into their classes. This blend creates a learning environment where both theoretical knowledge and application are important.

Facilities

The college's facilities include state-of-the-art laboratories in support of courses that address current and future applications in the areas of electrical, computer, and telecommunications engineering technology; manufacturing and mechanical engineering technology; and packaging science. In addition to laboratories in computer networking and telecommunications, the college also offers a circuits studio, and mechanics and materials labs.

The Center for Integrated Manufacturing Studies gives graduate students the opportunity to test new technologies for actual companies seeking solutions to real problems. Continual upgrades to our computer laboratories mean we have technology that is considered the industry standard.

Most importantly, the academic leadership of our programs is world-renowned. In addition, our close ties to business and industry mean our course content is relevant and practical for tomorrow's managers, whether they oversee computer-integrated manufacturing or a resort hotel. Graduates are eagerly sought out by employers. We have a high placement rate that assures graduates can pick the best positions for their personal and professional development.

Study options

Most graduate programs offer a variety of study options, including full-time, part-time, and online study. Please refer to each individual program for specific information regarding these options.

Environmental, Health and Safety Management, MS

http://www.rit.edu/cast/cetems/
John Morelli, Department Chair
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Joseph Rosenbeck, Graduate Program Director
(585) 475-6469, jmrcem@rit.edu

Program overview

The last decade has seen significant changes in how organizations view and manage environmental, health, and safety (EHS) issues. Increasingly, companies are capitalizing on the synergies among these three areas by managing them together, creating a need for professionals who are cross-trained in all three functions. The emergence of voluntary standards and codes of conduct, including international standards, coupled with the need to manage costs and limit resources has resulted in a trend to go beyond regulatory compliance. Now, companies work toward sustainability through the use of environmental, health, and safety management systems, which are integrated into key business processes.

The master of science degree in environmental, health, and safety management was developed by experienced professionals and designed to provide students with a solid foundation in both the technical and managerial aspects of developing, designing, and implementing environmental, health, and safety systems. The program utilizes an integrated systems focus to ensure that students can:

- identify and leverage the regulatory, voluntary, and business drivers for environmental, health, and safety programs;
- design and implement effective management systems and programs;
- design and implement performance measurement processes to verify effectiveness; and
- demonstrate how an effective environmental, health, and safety management system adds value to the organization.

The program is primarily designed for EHS professionals or those planning a career move into the field.

Curriculum

The MS program in environmental, health and safety management consists of 48 quarter credit hours of graduate study. The program is available in both classroom and online learning formats, with some courses only available online. The curriculum consists of a sequence of core courses, professional electives, and a graduate thesis or project. Students have the option of completing an applied research graduate project or a traditional graduate thesis.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Environmental, health and safety management (thesis and project options), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS	
		THESIS OPTION	PROJECT OPTION
0102-740	Organizational Behavior and Leadership	4	4
0630-720	EHS Management*	4	4
0630-725	EHS Accounting and Finance	4	4
0630-740	EHS Management System Design	4	4
0630-760	Integrating EHS into Business Management	4	4
0630-790	EHS Internal Auditing	4	4
0630-755	Research Methods	4	4
0630-890	Thesis Planning	4	--
0630-891	Graduate Project	--	4
0630-899	Graduate Thesis	4-8	--
	Graduate Professional Electives	8-12	16
Total Quarter Credit Hours		**48**	**48**

* Requires onsite executive leader session.

Environmental, health and safety management (thesis, capstone, and exam options), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
ESHS-720	EHS Management	3
ESHS-755	Corporate Social Responsibility	3
ESHS-710	Research Methods	3
ESHS-740	EHS Management System Design	3
ESHS-760	Integrating EHS Management	3
	Professional Electives	6
ESHS-715	Graduate Writing Strategies	3
ESHS-780	EHS Management System Evaluation	3
Choose one of the following:		6
ESHS-797	Graduate Project*	
ESHS-795	Comprehensive Exam†	
ESHS-788, 790	Thesis Planning, Thesis	
Total Semester Credit Hours		**33**

* The graduate project option require students to complete one additional professional elective.
† The comprehensive exam option require students to complete two additional electives.

Admission requirements

To be considered for admission to the MS program in environmental, health and safety management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university or college,
- Have a minimum undergraduate grade-point average of 3.0 (B) over the junior- and senior-level years;
- Have completed at least 20 quarter credit hours (or 14 semester hours) of college-level science course work, with at least 4 quarter credit hours (or 3 semester credit hours) in each of the following categories: chemistry, biology, and physics. (Applicants with appropriate professional certification who do not meet the minimum level of science course work will be evaluated on a case-by-case basis to determine if they are eligible for admission.),
- Have completed at least one college-level course in statistics,
- Submit two professional recommendations,
- Submit two writing samples to demonstrate written communication skills,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a clearly written one-page statement of purpose,
- Submit a current resume or curriculum vitae, and
- Complete a graduate application.

- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 570 (paper-based) or 88 (Internet-based) is required. Scores from the International English Language Testing System (IELTS) will be accepted in place of the TOEFL exam. Minimum acceptable scores will vary; however, the absolute minimum score for an unconditional acceptance is 6.5. It is recommended that international students begin the program in the fall quarter.

Generally, applicants are expected to have formal academic training or documented experience in the areas of environmental management (air, water, solid, and hazardous waste), occupational health, and occupational safety. Academic and experiential gaps in these areas may be addressed through professional electives and additional courses. Applicants without this experience may be required to complete a graduate cooperative education placement during their program of study.

Graduate Record Examination scores are not required; however, applicants may submit test scores to support their candidacy.

Additional information

Transfer credit

Up to 12 quarter credit hours of relevant graduate course work may be transferred into the program with the permission of the department.

Flexible learning options

The program is available on campus or through online learning, and may be completed in four quarters of full-time study, or in six quarters of part-time study. With adviser approval students can tailor an individual program of study by complementing core and foundation courses with professional electives that match their academic and career interests. Students completing the degree through online learning are required to come to campus once for an executive leader session.

Facility Management, MS

http://www.rit.edu/cast/cetems/

John Morelli, Department Chair
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Joseph Rosenbeck, Graduate Program Director
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Program overview

The physical assets of an organization are typically one of its largest financial holdings. The strategic planning, development, and maintenance of these assets are critical to an organization's long term financial health and stability.

Facility managers need to be knowledgeable about business management, strategic planning, environmental management, interior and architectural design, construction management, information technology, real estate, engineering, safety labor relations, and quality of life aspects in the work environment. It's a broad-based field that requires individuals to have breadth and depth in their education and, eventually, their work experience.

The facility management program prepares graduates to work in a management capacity where they will oversee the planning, design, operations, and maintenance decommissioning of facilities. Graduates will be able to intelligently communicate facility issues with corporate officers, customers, contractors, vendors, and employees.

The master of science degree in facility management was developed by a panel of experienced facility management professionals and designed to provide students with a solid foundation in both the technical and managerial aspects of the field. The curriculum was developed using educational standards established by the International Facility Management Association (IFMA) and is accredited by IFMA.

Curriculum

The MS in facility management consists of 52 quarter credit hours of graduate study. The program is available predominately in the online learning format, although some courses and electives are available as on-campus classes. The curriculum consists of a sequence of core courses, professional electives (chosen from the program or from other departments), and a graduate project. Project topics should complement the student's interests and professional position, and are generally considered applied in nature.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Facility management, MS degree, typical course sequence (quarters)

COURSE	QUARTER CREDIT HOURS	
0101-703	Accounting for Decision Makers	4
0102-740	Organizational Behavior and Leadership	4
0630-750	Project Management	4
0632-700	Principles and Practice in Facility Management	4
0632-720	Environmental, Health and Safety Management for Facility Management	4
0632-760	Space Planning in Facility Management	4
0632-800	Operation and Maintenance of Facilities I	4
0632-810	Operation and Maintenance of Facilities II	4
0632-830	Real Estate of Facilities	4
0632-850	Digital Communication and Analytical Tools in Facility Management	4
0630-891	Graduate Project	4
	Professional Electives	8
Total Quarter Credit Hours		**52**

Facility management (thesis, capstone, and comprehensive exam options), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	SEMESTER CREDIT HOURS	
First Year		
ESHS-710	Research Methods	3
ESHS-715	Graduate Writing Strategies	3
ESHS-725	EHS Accounting and Finance	3
ESHS-750	Project Management	3
FCMG-660	Principles and Practice in Facility Management	3
FCMG-720	EHS in Facility Management	3
FCMG-740	Real Estate in Facility Management	3
FCMG-760	Operations and Maintenance in Facility Management	3
	Professional Elective	3
Choose one of the following:		6
	Graduate Project*	
	Comprehensive Exam†	
FCMG-788, 790	Thesis Planning, Thesis	
Total Semester Credit Hours		**33**

* The graduate project option requires students to complete one additional professional elective.

† The comprehensive exam option requires students to complete two additional electives.

Admission requirements

To be considered for admission to the MS degree in facility management, candidates must fulfill the following requirements:

- Hold a bachelor's degree from an accredited university or college. Generally, applicants are expected to have formal academic training or documented experience in the areas common to facility management (i.e., engineering technology, engineering, construction management, interior design, architecture, technology, business). Academic and experiential gaps in these areas may be addressed through program electives.
- Have a minimum undergraduate GPA of 3.0 overall, or a minimum GPA of 3.0 for course work completed in the junior and senior years.
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work.
- Submit two writing samples to demonstrate written communication skills.
- Submit a current resume or curriculum vitae with sufficient detail to identify specific work experience, tasks, and level of responsibility.
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required. Scores from the International English Language Testing System (IELTS) will be accepted in place of the TOEFL exam. Minimum acceptable scores will vary; however, the absolute minimum score for an unconditional acceptance is 6.5. It is recommended that international students begin the program in the fall quarter.

GRE scores normally are not required. Applicants who do not meet the above requirements, however, may be required to submit scores to support their candidacy.

Students who do not meet the academic admission requirements may be asked to complete certain undergraduate courses as a bridge for the required content knowledge. The graduate program director will design a bridge program specific to each individual student's needs based on the evaluation of academic records and documented work experience.

Some students' work experience may exempt them from one or more of the core courses. In these cases, students may substitute other course work, with the permission of the graduate program director and in accordance with RIT policy.

Applicants without any documented, relevant work experience in the facility management profession may be required to complete a graduate cooperative education placement.

Additional information

Flexible learning options

The program can be completed on-campus or through distance learning in four quarters of full-time study, or six quarters of part-time study. With adviser approval students can tailor an individual program of study by complementing core courses with professional electives that match their academic and career interests. Students will complete a graduate project that integrates facility management concepts into applied research to solve real world problems.

Transfer credit

With department approval, up to 12 quarter credit hours of graduate course work may be transferred into the program if the course work is appropriate.

Manufacturing and Mechanical Systems Integration, MS

http://www.rit.edu/cast/mmetps/ms_manu_mech.php

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Program overview

The master of science program in manufacturing and mechanical systems integration is a multidisciplinary degree offered by the department of manufacturing and mechanical engineering technology and packaging science, in collaboration with the E. Philip Saunders College of Business, the Kate Gleason College of Engineering, and the B. Thomas Golisano College of Computing and Information Sciences. This program is designed for individuals who wish to achieve competence in the effective integration of the computing, manufacturing, design, quality, and management functions found in many manufacturing enterprises. Students take a set of common core courses and then elect a concentration in automated manufacturing, electronics packaging, management, product design, quality improvement, or software development.

Curriculum

The program consists of 52 quarter credit hours and is comprised of core courses, a concentration, electives, and a capstone project or thesis. Students may be required to take additional prerequisite courses depending on their background and elected concentration. The program adviser may approve the waiver of courses in the pre-requisite group from graduation requirements, depending on students' academic and employment backgrounds. Full-time students are eligible for two co-op blocks (three months for each block) after completing three quarters (nine months) of study at RIT.

Electives

Each student must take two graduate-level elective courses according to his or her concentration. Courses selected must be: any course from another concentration, any course from another graduate program (if approved by the program adviser and faculty member teaching the course), and any independent study course if approved by the student's academic adviser.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Manufacturing and mechanical systems integration, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0617-850	Flexible Manufacturing and Assembly Systems	4
0307-782	Quality Engineering	4
0617-631	Computer Aided Engineering	4
0101-794	Cost Accounting in the Manufacturing Environment	4
0106-744	Project Management	4
	MMSI Concentration Courses	20
	Approved electives	8
	Choose one of the following	
	MMSI Capstone Project in CIM	4
	MMSI Thesis	4
Total Quarter Credit Hours		**52**

Manufacturing and mechanical systems integration (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MFET-650	Manufacturing and Mechanical Systems Fundamentals	3
CQAS-670	Designing experiments for Process Improvement	3
PACK-702	Graduate Writing Strategies	3
	MMSI Concentration Course 1	3
CQAS-682	Lean Six Sigma Fundamentals	3
ACCT-703	Accounting for Decision Makers	3
	MMSI Concentration Course 2	3
MFET-788	Thesis Planning	3
Second Year		
DECS-714	Project Management	3
	MMSI Concentration Course 3	3
	Elective	3
MFET-790	Thesis	3
Total Semester Credit Hours		**36**

Manufacturing and mechanical systems integration (capstone option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MFET-650	Manufacturing and Mechanical Systems Fundamentals	3
CQAS-670	Designing Experiments for Process Improvement	3
PACK-702	Graduate Writing Strategies	3
	MMSI Concentration Course 1	3
CQAS-682	Lean Six Sigma Fundamentals	3
ACCT-703	Accounting for Decisionmakers	3
	MMSI Concentration Course 2	3
	Elective	3
Second Year		
DECS-714	Project Management	3
	MMSI Concentration Course 3	3
	Elective	3
Choose one of the following:		3
MFET-797	Capstone Project	
CQAS-683	Lean Six Sigma Project	
Total Semester Credit Hours		**36**

Concentrations (quarters)

COURSE		QUARTER CREDIT HOURS
Automated manufacturing		
0617-833	Robotics in CIM	4
0617-870	Manufacturing Automation Controls	4
0610-830	Instrumentation and Computer Aided Data Acquisition	4
0303-710	Systems Simulation	4
0303-729	Advanced Systems Integration	4
Electronics packaging		
0617-855	Electronics Packaging Fundamentals	4
0617-856	Advanced Concepts in Electronics Packaging	4
0307-721	Statistical Process Control	4
0307-770	Design of Experiments for Engineers and Scientists	4
0307-862	Reliability Statistics I	4
Management		
0101-703	Financial Accounting Systems	4
0102-742	Introduction to Technology Management	4
0106-743	Operations Management and Process Improvement	4
0106-749	Manufacturing Strategy and Tactics	4
0307-781	Quality Management	4
Product design		
0610-630	Tolerance Design	4
0610-710	Product Development and Integration	4
0610-820	Concept Design and Critical Parameter Management	4
0610-830	Instrumentation and Computer Aided Data Acquisition	4
0610-870	Robust Design	4
Quality improvement		
0307-721	Statistical Process Control	4
0307-731	Statistical Acceptance Control	4
0307-781	Quality Management	4
0307-801	Design of Experiments I	4
0307-802	Design of Experiments II	4
Software development		
0610-830	Instrumentation and Computer Aided Data Acquisition	4
4002-710	Object Technologies	4
4002-720	Data Object Development	4
4002-733	Fundamentals of Computer Communication	4
4002-750	Distributed Systems	4

Concentrations (semesters)

COURSE		SEMESTER CREDIT HOURS
Product Development		
MCET-620	Robust Design and Production Systems	3
MCET-670	Concept Design and Critical Parameter Management	3
MCET-720	Product and Production System Development and Integration	3
Automated Manufacturing		
MFET -685	Robots and CNC in Integrated Manufacturing	3
MFET 670	Manufacturing Automation Controls	3
ISEE -710	Systems Simulation	3
Electronics Packaging		
MFET-655	Electronics Packaging Fundamentals	3
MFET-765	Advanced Concepts in Electronics Packaging	3
TCET-740	Fiber Optics Telecommunicatuions Technology	3
Management Systems		
MGMT-742	Technology Management	3
	Operations and Supply Chain Management	3
MGMT-740	Organizational Behavior and Leadership	3
Quality Management		
CQAS-621	Statiscial Quality Control	3
NCET-620	Robust Design	3
CQAS-741	Regression Analysis	3

Admission requirements

To be considered for admission to the MS program in manufacturing and mechanical systems integration, candidates must fulfill the following requirements:

- Hold a baccalaureate degree (or equivalent) from an accredited academic institution in the field of engineering, engineering technology, computing, or business. Students with degrees in other disciplines will be considered on an individual basis.
- Have a minimum grade-point average of 3.0. Applicants with a lower GPA will be evaluated on a case-by-case basis and may be admitted on a probationary basis. These students will have to secure a B or better average in the first three graduate courses to be considered for full admission.
- Have completed college-level course work in computer programming, and probability and statistics,
- Submit two professional recommendations,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,

- Submit a clearly written, one-page statement of purpose, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL) and the Graduate Record Exam (GRE). A minimum score of 550 (paper-based) or 79-80 (Internet-based) on the TOEFL is required. A score of 1,200 (V&Q) and an analytical writing score of 3.5 or higher are required on the GRE. Applicants with low GRE scores may be admitted conditionally; they may be required to take additional English language tests and, if required, English language courses along with a reduced MS program course load.

Packaging Science, MS

http://www.rit.edu/mmetps
Deanna Jacobs, Graduate Program Director
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Program overview

The MS program in packaging science is designed to meet the needs of both professionals who have been employed in the field and for students who wish to pursue a graduate program immediately upon earning a BS degree.

Although an undergraduate curriculum in packaging science is preferred as preparation for the MS program, graduates from certain other disciplines can successfully pursue the program if certain introductory packaging science courses are coupled with appropriate work experience.

Curriculum

The program requires the completion of 48 credit hours comprised of five required core courses, elective courses, plus a thesis or a project. Faculty advisers assist students in selecting the thesis or project option and the corresponding plan of study is approved by the graduate program chair.

Elective courses

All elective courses are approved by the student's adviser and must meet degree requirements. In certain circumstances, with pre-approval by the graduate adviser and where individual need indicates appropriateness, a limited number of 500-level undergraduate courses may be used to fulfill elective credit. Undergraduate courses used as electives may not exceed 12 quarter credits in total. Students, with adviser permission, may include 8 quarter credits of Independent Study (0607-978) as part of their elective credits. However, independent study may not be used toward the 20 quarter credits of required packaging core course work. Courses selected for elective credit can be combined to create specialties in areas such as packaging science, print media, or service management with program chair approval.

Thesis/Project option

The thesis option requires 8 quarter credit hours while the project option includes a 4 quarter credit hour project plus one additional elective course.

The thesis develops and tests a hypothesis by scientific method and is grounded in a theoretical framework. Individuals who can capture, interpret, and apply information by this method can add value to their role as contributors in the workplace. The thesis option is for students seeking to pursue career options that offer a greater opportunity for further research or advanced study in the field of packaging science. It is meant to provide depth of study, emphasizing the research process.

The project has a practical, application-oriented grounding in literature. It is considered secondary research or the compilation of existing information presented in a new way. The project option is for students who desire advanced study in packaging science, but who do not intend to pursue a research career or further studies beyond the master's level.

The student's graduate committee will make the final decision regarding the project and whether it meets the program's requirements as a graduate project or thesis.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Packaging science, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0607-701	Research Methods	4
0607-730	Packaging and the Environment	4
0607-742	Distribution Systems	4
0607-763	Packaging for End-Use	4
0607-783	Packaging Dynamics	4
Choose five of the following electives:		20
0607-721	Packaging Administration	
0607-731	Advanced Packaging Economics	
0607-750	Graduate Seminar	
0607-752	The Legal Environment	
0607-770	Advanced Computer Applications	
0607-799	Advanced Packaging Design	
Choose one of the following:		
	Graduate Project*	4
0607-890	Thesis	8
Total Quarter Credit Hours		**48**

* For students who chose the graduate project option, an additional elective course must be completed.

Packaging science, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
PACK-701	Research Methods	3
PACK-742	Distribution Systems	3
PACK-702	Graduate Writing Strategies	3
PACK-730	Packaging and the Environment	3
PACK-763	Packaging for End Use	3
	Packaging Elective	9
Second Year		
PACK-783	Advanced Packaging Dynamics	3
	Packaging Elective	3
Choose one of the following:		
PACK-790	Research Thesis	6
PACK-797	Graduate Project*	3
Total Semester Credit Hours		**36**

* For students who chose the graduate project option, an additional elective course must be completed.

Admission requirements

To be considered for admission to the MS program in packaging science, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a minimum 3.0 (B) grade-point average in their final two years of undergraduate degree work,
- Submit two letters of recommendation,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work, and
- Complete a graduate application.

Graduate Record Exam scores are not required. However, in cases where there may be some question of the capability of an applicant to complete the program, applicants may wish to submit scores to strengthen their application.

Students who do not have an equivalent bachelor's degree in packaging science will be evaluated and the appropriate undergraduate bridge courses will be prescribed. These courses may not be used for credit toward the MS degree.

Applicants are required to have one semester of physics (mechanics focus), one semester of calculus, one year of chemistry (including organic chemistry), statistics, and basic computer literacy.

Additional information

Advising

Students entering the program will be appointed a thesis adviser and will work with the program coordinator to develop a program of study. Students follow an outlined curriculum to complete their degree requirements, and with adviser approval, choose packaging electives to enhance their career objectives.

Executive leader option

The executive leader option is an intensive program for industry professionals that focuses on the application of packaging technology in the supply chain. The structure of the program provides individuals with an opportunity to obtain an MS degree without interrupting their employment.

The executive leader option consists of one two-week summer session on campus, course work completed online, and a research project, which may be conducted over two consecutive summers. In addition to the stated application requirements, admission to the executive leader option requires the endorsement of senior management/administrative personnel from the applicant's employer. Candidates are encouraged to align the program's research project goals with current job responsibilities.

Telecommunications Engineering Technology, MS

http://www.rit.edu/ectet

Michael Eastman, Department Chair
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Program overview

The telecommunications industry has driven technological innovation and provided outstanding career opportunities for people with the right technical and leadership skills. New services offered through the Internet, mobility offered by wireless technology, and extreme capacity offered by fiber optics, as well as the evolution of policy and regulation, are shaping the telecommunication network of the future. RIT offers a unique program focused on telecommunications that develops the advanced level of skill and knowledge needed by future leaders in the industry.

The master of science degree in telecommunications engineering technology is for individuals who seek advancement into managerial and leadership roles in a dynamic telecommunications environment. This program can be completed through either online or on-campus study.

Curriculum

The MS in telecommunications engineering technology requires 48 quarter credit hours of study. The program includes six core courses that introduce essential fundamental concepts and skills. Each student is required to complete a graduate project/thesis planning seminar and either a capstone project or a master's thesis. The remaining credits consist of technical electives or other approved graduate courses.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Telecommunications engineering technology, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0614-720	Telecommunications Concepts	4
0614-722	Principles of Telecommunciations Networks	4
0614-780	Telecommunications Policy and Regulation	4
0614-732	Fiber Optic Telecommunication Technology	4
0614-763	Wireless Telecommunication Systems	4
0614-774	WAN/LAN Planning and Design	4
	Technical Electives	16
0614-890	Graduate Thesis/Project Planning	2
Choose one of the following:		6
0614-893	Capstone Project*	
0614-892	Thesis	
Total Quarter Credit Hours		**48**

* The capstone project option requires students to complete one additional technical elective.

Telecommunications engineering technology, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
TCET-710	Principles of Telecommunication	3
TCET-730	Telecommunications Policy and Issues	3
TCET-750	Wireless Infrastructure and Policy	3
TCET-670	Applied Research Methods	3
TCET-740	Fiber Optic Telecommunications Technology	3
TCET-720	Telecommunications Concepts	3
TCET-760	Network Planning and Design	3
TCET-680	Graduate Writing Strategies	3
Second Year		
	Electives	6
Choose one of the following:		6
TCET-790	Thesis	
	Capstone project*	
Total Semester Credit Hours		**36**

* The capstone project option requires students to complete one additional elective.

Technical electives

COURSE		
Network design		
0614-761	Telecommunications Network Engineering	4
0614-836	Next Generation Networks	4
Fiber optic telecommunications		
0614-832	Fiber Optic Telecommunications Networks	4
Wireless communications		
0614-764	Telecommunication Systems	4
0614-783	Telecommunication Transmission Systems	4

Additional Information

Transfer credit
A maximum of 12 quarter credit hours may be transferred from an accredited institution to this program.

Other approved electives
Students may take up to three graduate electives from other graduate programs subject to the approval of the program chair. Many students choose to include management courses from the E. Philip Saunders College of Business.

Master's project/thesis
Each student is required to take the thesis/project planning seminar and complete either a graduate project or master's thesis. Students who elect the graduate project must take an additional course from the technical electives or other approved electives.

Research and cooperative education
Students in the program have the opportunity to apply for research projects or a cooperative education experience. While not a requirement of the program, these opportunities increase the value of the program and the marketability of its graduates.

Admission requirements

To be considered for admission to the MS program in telecommunications engineering technology, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering technology, engineering, or a related degree from an accredited institution,
- Submit two professional recommendations,
- Have a minimum cumulative GPA of 3.0 (B),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88-89 (Internet-based) are required. Applicants with a lower TOEFL score may be admitted conditionally and may be required to take a prescribed program in English and a reduced program course load. International applicants from universities outside the United States must submit scores from the Graduate Record Examination (GRE).

While GRE scores are not required for applicants submitting transcripts from American universities, they are recommended for those whose undergraduate grade-point average is below 3.0.

Hospitality-Tourism Management, MS

http://www.rit.edu/cast/htm/graduate/
Carol Whitlock, Interim Department Chair and Graduate Program Director
(585) 475-2353, cbwism@rit.edu

Program overview

The hospitality-tourism management program prepares students to step into numerous mid-level service management and training director positions. The program is focused on service and innovation, as well as leadership functions within many service and corporate settings and at post-secondary academic institutions.

Curriculum

The program's curriculum introduces major concepts associated with all aspects of service management, whether they are applied specifically to the hospitality-tourism industry or the wider service industry. Among the general concepts investigated are service strategy delivery (understanding and co-creating customer value, innovation and creativity, service leadership, service design and metrics development, and change in service organizations), and human resource capital development (human capital strategies).

To earn the MS degree, students must complete a minimum of 48 quarter credit hours. The curriculum is a combination of required core courses in service innovation, a concentration, and elective courses chosen by the student to meet career interests and objectives. Students may choose one of three options to complete the program: a capstone project, a research thesis, or a comprehensive exam. Course offerings generally are scheduled for evenings and most are available online to facilitate part-time students.

Core courses
The core courses facilitate the paradigm shift from manufacturing to service and move the focus from traditional organizational structures to an organization where employees must provide several functions, sometimes simultaneously. This multifunctional approach provides a new avenue to examine service organizations and explore such issues as teamwork, learning organizations, organizational change, performance metrics, and customer relationship management.

Each course not only introduces the service philosophy, but also examines the real differences in hospitality-service management outcomes necessitated by the adoption of a new service paradigm. In so doing, these courses set the stage for the professional "cluster" courses.

Thesis/Capstone/Exam options
Students must complete a thesis, capstone project, or comprehensive exam as a culminating experience allowing for demonstration of competencies for theory and application material for the discipline. Students will be advised by the program adviser and/or program faculty as to which option is most appropriate in fulfilling a student's career and educational objectives. In the program the default is to complete a capstone project. A thesis or comprehensive exam may be completed in place of the capstone, with the approval of the faculty adviser and program director.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Hospitality-tourism management, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0625-750	Elements of Service Management: A Systems Approach	4
0624-825	Strategic Process of Service Firms	4
0625-849	Service Performance Metrics	4
0625-790	Research Methods	4
0625-708	Library Research	1
0626-755	Graduate Writing	3
0626-735	Human Capital Strategies	4
0624-846	Travel Marketing Systems	4
0624-867	Tourism Planning and Development	4
Choose one of the following:		4
0624-770	Service Leadership	
0625-844	Breakthrough Thinking, Creativity, and Innovation	
	Hospitality-Tourism Electives	8
	Capstone Project*	4
Total Quarter Credit Hours		**48**

* Typically, students complete a capstone project as a culminating experience for the program. However, with department approval, students may complete a thesis or a comprehensive exam. For those who select the exam, students are required to also complete Breakthrough Thinking, Creativity and Innovation (0625-844).

Hospitality and tourism management, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HSPT-700	Research Methods	3
HSPT-702	Graduate Writing Strategies	3
SERQ-710	Evolving Contexts In Service	3
HSPT-730	Strategic Hospitality And Tourism Branding	3
HSPT-740	Economic Performance Analysis for Hospitality and Tourism	3
HSPT-750	Processes and Assessment of Hospitality and Tourism Industries	3
	Electives	9
	Graduate Project*	3
Total Semester Credit Hours		**30**

* Typically, students complete a capstone project as a culminating experience for the program. However, with department approval, students may complete a thesis or a comprehensive exam. For those who select the exam, students are required to also complete one additional elective course. Students who complete a thesis take 6 semester credit hours of electives instead of 9.

Electives

Elective courses provide students with an opportunity to individualize their graduate programs in line with their career and professional interests. With the approval of the department chair, students are allowed to take a selection of elective courses from outside the hospitality-tourism management program. Courses may be taken from the hospitality and service management program, the human resource development program, the E. Philip Saunders College of Business, and the Kate Gleason College of Engineering. Students are cautioned to observe course prerequisites in their selections.

Of the 8 quarter credit hours of electives, students are relatively free to select courses that they feel best meet their needs. All elective courses must be graduate-level. If previous course work exists, a maximum of 12 credit hours from another university may be considered for transfer. A maximum of 8 quarter credit hours may be taken as independent study or practicum courses. Students completing a capstone project or the comprehensive exam will need to complete one additional elective (4 quarter credit hours).

Admission requirements

To be considered for admission to the MS program in hospitality-tourism management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher. Foundation course work with a GPA of 3.0 or higher (if required),
- Submit two professional recommendations,
- Participate in an on-campus interview (when possible),
- Submit a current resume, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 550 (paper-based) or 89 (Internet-based) is required. All international students will also take the Michigan Test of English Proficiency upon arrival, unless otherwise waived and may be required to take a prescribed program in English and a reduced program courseload based on Michigan and or TOEFL test results.

After a review by the program chair, applicants whose prior undergraduate work has been in areas other than hospitality-tourism may be required to complete additional courses. Students may choose elective courses with the approval of the program.

Additional information

Part time study

The program may be completed on a full- or part-time basis. The length of time required to earn the degree varies according to the student's undergraduate preparation and the number of graduate courses taken per quarter.

Service Leadership and Innovation, MS

http://www.rit.edu/cast/servicesystems/service-leadership-and-innovation.php

Linda Underhill, Graduate Program Chair
(585) 475-7359, lmuism@rit.edu

Program overview

Service leadership and innovation is a 48 quarter credit hour program designed to provide students with the capability to transform their service organizations. Service is no longer a subset of manufacturing era thinking. The program includes core courses, professional electives and concentrations, and a comprehensive exam. Students, with permission may complete a capstone capstone project or thesis in place of the exam.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Service leadership and innovation, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0625-708	Library Research	1
0624-770	Service Leadership	4
0625-750	Elements of Service Management: A Systems Approach	4
0625-790	Research Methods	4
0624-825	Strategic Process of Service Firms	4
0626-735	Human Capital Strategies	4
0625-849	Service Performance Metrics	4
0626-755	Graduate Writing	3
	Professional Electives	12
0625-895	Comprehensive Exam*	0
0625-794	Integrated Problem Solving	4
0625-844	Breakthrough Thinking, Creativity and Innovation	4
Total Quarter Credit Hours		**48**

* Students typically complete the Comprehensive Exam (0625-895), Intergrated Problemsolving (0625-794), and Breakthrough Thinking, Creativity and Innovation (0625-844). However, with department approval, students may request to complete a capstone project plus Breakthrough Thinking, Creativity and Innovation (0625-844), or a thesis (which requires no additional course work).

Service leadership and innovation, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SERQ-700	Research Methods	3
SERQ-702	Graduate Writing Strategies	3
SERQ-710	Evolving Contexts in Service	3
SERQ-720	Service Scenarios and Strategy Development	3
SERQ-722	Customer Centricity	
SERQ-723	Service Analytics	3
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
Second Year		
	Concentration Courses	9
SERQ-795	Comprehensive Exam*	0
SERQ-711	Service Design and Implementation	3
SERQ-794	Integrated Problem Solving	3
Total Semester Credit Hours		**36**

* Students typically complete the Comprehensive Exam (SERQ-795), Intergrated Problemsolving (SERQ-711), and Breakthrough Thinking, Creativity and Innovation (SERQ-770). However, with department approval, students may request to complete a capstone project plus Breakthrough Thinking, Creativity and Innovation (SERQ-770), or a thesis (which requires no additional course work).

Electives

Electives may be chosen from human resource development, hospitality-tourism management, or technical electives. Electives must be approved in advance and students must meet all prerequisite requirements.

Concentrations

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
Engineering services		
SERQ-740	Service Leadership Tools and Techniques	3
Choose two or three of the following:		
ISEE-771	Engineering of Systems I	3
ISEE-723	Global Facilities Planning	3
CQAS-682	Lean Six Sigma Fundamentals	3
Service systems		
SERQ-730	Managing Not-For-Profit, Public Sector Projects	3
SERQ-732	Service Quality Process in the Not-For-Profit, Public Sector	3
SERQ-735	Data Mining in Not-For-Profit, Public Sector	3

Students may customize a concentration with the approval of the department. Please note: customized concentrations cannot include additional business-related courses.

Admission requirements

To be considered for admission to the MS in service leadership and innovation, candidates must fulfill the following requirements:

- Hold a baccalaureate degree (or equivalent) from an accredited institution,
- Submit official transcripts (in English) of all previously completed undegraduate and graduate course work,
- Submit two professional recommendations,
- Submit a current resume,
- Have an undergraduate GPA of 3.0 or above, or evidence of relevant professional performance,
- Have completed foundation course work with a GPA of 3.0 or higher (if required), and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 550 (paper-based) or 79 (Internet-based) are required. Scores from the International English Language Testing System (IELTS) are accepted in place of the TOEFL exam. Minimum acceptable scores will vary; however, the absolute minimum score for an unconditional acceptance is 6.5.

Additional information

Study options

The program is flexible and can be completed through either full- and part-time study. Courses are offered in the evenings, on weekends, or through a weeklong format. Many of the program's courses may be completed online. Full-time students may complete the program within three quarters, or one academic year.

The executive leader option may be completed in one academic year for candidates whose schedules can accommodate two courses per quarter. The program typically begins in the fall quarter, enabling a class of students to progress through the program together as a group.

Thesis/Capstone/Exam options

All students must complete a thesis, capstone project, or comprehensive exam as a culminating experience allowing for demonstration of competencies for theory and application material for the discipline. Students will be advised by the program adviser and/or program faculty as which option is most appropriate based on career goals and objectives. In the program the default is to complete the comprehensive examination upon completion of required and elective course work unless a student seeks to complete a thesis or capstone project. This alternative strategy is possible if the faculty adviser and department chair agrees with the student in their ability to complete this strategy.

Service Leadership and Innovation, Adv. Cert.

Program overview

The advanced certificate in service leadership and innovation offers service professionals cutting-edge skills, abilities, and applied service knowledge. The certificate will heighten the student's capacity to function in today's highly competitive and quickly evolving service environment.

Curriculum

The advanced certificate is made up of five courses that help students master the following concepts:

- understand service performance system design and implementation parameters,
- understand and use service value delivery system structures and processes,
- comprehend the evolving strategic environment of service-sector businesses,
- establish and use service-system elements/dimensions,
- build service metrics from feedback processes,
- understand and implement customer relationship management, and
- construct innovative approaches to service and managing those changes.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program modification
Effective fall 2013, the program in service leadership and innovation will be modified and the title changed to service systems. This change will not affect currently matriculated students.

Service leadership and innovation, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0625-750	Elements of Service Management: A Systems Approach	4
0624-825	Strategic Process of Service Firms	4
0625-842	Customer Relationship Management	4
0625-844	Breakthrough Thinking	4
0625-849	Service Performance Metrics	4
Total Quarter Credit Hours		**20**

Service systems, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SERQ-710	Evolving Contexts in Service	3
SERQ-720	Service Scenarios and Strategy Development	3
SERQ-730	Managing Not-for-Profit, Public Sector Projects	3
SERQ-732	Service Quality Process in the Not-for-Profit, Public Sector	3
SERQ-735	Data Mining in the Not-for-Profit, Public Sector	3
Total Semester Credit Hours		**15**

The certificate may be completed as a stand-alone credential, serve as an entry point for the MS program, or be used to fulfill the requirements for a professional concentration in RIT's MS program in professional studies.

Admission requirements

The advanced certificate is open to qualified students who meet the requirements for graduate study. Certificate courses are introductory to graduate courses in each area and thus require no prerequisite course work. Qualified students may use individual courses or the certificate in other RIT graduate programs with the appropriate approvals.

Human Resource Development, MS

http://www.rit.edu/cast/servicesystems/human-resources-development.php

Linda Underhill, Graduate Program Chair
(585) 475-7359, lmuism@rit.edu

Program overview

The master of science degree in human resource development prepares students to influence the human assets of an organization to positively impact organizational outcomes.

The program requires students to build competencies in effective employee and talent development practices as used by world-class organizations, outcome and evidence-based training and learning, instructional design and delivery, career development, and workforce development. The curriculum combines a competency-focused program with solid scholarship, writing, and analytical skills required of today's human resource professional.

Applicants to this program are often experienced human resource practitioners eager to build new competencies in training, instructional design, talent management, and employee development; managers who want to encourage employees to reach their potential; and individuals interested in starting a career in the human resource field. Courses are offered in the evening and online.

Curriculum

The degree requires completion of a minimum of 48 quarter credit hours and can usually be completed in four consecutive quarters. However, the majority of students attend part time and take three years to complete the program.

Students choose electives that best meet their career interests. Courses may be taken in other graduate-level programs at RIT, with permission. A maximum of 12 credit hours (not counted toward another degree) may be considered for transfer credit from another college or university.

Upon matriculation, each student is assigned an adviser. Together, the student and adviser develop a plan of study. For specific questions about courses and a plan of study, the adviser or program chair should be consulted.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Human resource development, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0625-708	Library Research	1
0625-790	Research Methods	4
0626-755	Graduate Writing	3
0626-780	Human Resource Management I	4
0635-781	Human Resource Management II	4
Choose two of the following:		8
0626-710	Theories of Organizational Development	
0626-720	Theories of Career Development	
0626-730	Strategic Employee Development	
	Professional Electives	16
0625-895	Comprehensive Exam*	0
0625-794	Integrated Problem Solving	4
0625-844	Breakthrough Thinking, Creativity and Innovation	4
Total Quarter Credit Hours		**48**

* Students typically complete the Comprehensive Exam (0625-895), Intergrated Problemsolving (0625-794), and Breakthrough Thinking, Creativity and Innovation (0625-844). However, with department approval, students may request to complete a capstone project plus Breakthrough Thinking, Creativity and Innovation (0625-844), or a thesis (which requires no additional course work).

Human resource development, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
HRDE-700	Research Design and Methods	3
HRDE-702	Graduate Writing Strategies	3
HRDE-710	Foundations in Human Resource Development	3
HRDE-711	Program Evaluation and Design	3
HRDE-712	Performance Analysis and Development	3
	Concentration Courses	12
	Elective	3
	Integrated Problemsolving	3
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
HRDE-797	Comprehensive Examination*	0
Total Semester Credit Hours		**36**

* Students typically complete the Comprehensive Exam (HRDE-797), Intergrated Problemsolving, and Breakthrough Thinking, Creativity and Innovation (SERQ-770). However, with department approval, students may request to complete a capstone project plus Breakthrough Thinking, Creativity and Innovation (SERQ-770) or a thesis (which requires no additional course work).

Concentrations

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
Organizational learning		
HRDE-720	Theories of Organizational Development	3
HRDE-722	Talent Development	3
HRDE-721	Organizational Learning and Knowledge Management	3
HRDE-723	Group Dynamics and Leadership	3
Training and development		
HRDE-730	Theories of Adult Learning	3
HRDE-731	Team Process and Facilitation Skills	3
HRDE-732	Learning Transfer	3
HRDE-733	Instructional Design and Technology in HRD	3
Global HRD		
HRDE-740	Strategic HRD for global organizations	3
HRDE-741	Global HRD leadership	3
HRDE-742	Change leadership development	3
HRDE-743	Training for global organizations	3

A customized concentration of three courses may be developed, but requires department approval. A customized concentration cannot include additional business-related courses.

Admission requirements

To be considered for admission to the MS program in human resource development, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited college or university,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a cumulative GPA of 3.0 or above (or evidence of relevant professional performance),
- Submit two letters of reference,
- Submit a writing sample designated by the department,
- Participate in an interview with a faculty member (when possible), and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 79 (Internet-based) are required.
  Upon arrival at RIT, international students may be asked to take an English Language Proficiency exam. Those who do not meet the minimum standard may be required to take additional English language courses.

All required admission materials must be submitted and reviewed by faculty prior to the completion of 12 quarter credit hours of graduate work in the program.

Strategic Training, Adv. Cert.

Program overview

Senior leaders in the most successful businesses agree that leveraging the human capital of an organization is vital to survival in today's competitive business climate. This requires businesses to align employee development plans with strategy and provide targeted learning experiences to ensure they equip their workforce to perform at the peak of their capability, attract the best and brightest candidates, and retain the most qualified employees.

The advanced certificate in strategic training provides professionals in fields such as human resources and business management with the competencies required to develop highly effective learning materials that drive strategic employee development, boost performance, and manage the employee development efforts of an organization.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program modification
Effective fall 2013, the program in strategic training will be modified and renamed training design and assessment. This change will not affect currently matriculated students.

Strategic training, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0626-716	Performance-based Training	4
0626-730	Strategic Employee Development	4
Choose two of the following:*		8
3088-732	Managing Technical and Scientific Communication	
3088-721	Creating Technical Proposals	
0626-719	Design Non-Traditional Learning Programs	
0626-717	Design of Interactive Training	
0626-718	Design On-the-Job Training	
Total Quarter Credit Hours		**16**

* Additional electives may be used with permission of an adviser.

Training, design and assessment, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HRDE-715	Human Performance Design and Development	3
HRDE-730	Theories of Adult Learning	3
HRDE-733	Instructional Design and Technology	3
HRDE-755	Program Assessment and Evaluation	3
Second Year		
Choose one of the following:		3
HRDE-756	Training Design	
HRDE-758	Design for Online Learning	
Total Semester Credit Hours		**15**

Admission requirements

To be considered for admission to the advanced certificate in strategic training, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a minimum undergraduate GPA of 3.0,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a current resume,
- Submit a personal statement,
- Submit two letters of recommendation, and
- Complete a graduate application.

Additional information

Study options

The certificate's two core courses, as well a number of electives, are available through online learning. Depending on the choice of electives, the entire certificate may be completed online.

College of Applied Science and Technology

H. Fred Walker, BS, MBA, California State University; MS, Ph.D., Iowa State University—Dean; Professor

Linda A. Tolan, NCC, BS, State University College at Geneseo; MS, Rochester Institute of Technology; Ph.D., Andrews University—Senior Associate Dean, Professor

Maureen S. Valentine, PE, BSCE, Tufts University; MECE, Virginia Polytechnic Institute—Associate Dean; Professor

Sean T. Bennett, BS, Clarkson University; M.Ed., State University College at Brockport; Ed.M., Harvard University—Assistant Dean

School of Engineering Technology

Civil Engineering Technology

Amanda Bao, BS, MS, Tianjin University (China); Ph.D., University of Colorado at Boulder—Assistant Professor

Harry G. Cooke, PE, BS, Northwestern University; MSCE, University of Texas; Ph.D., Virginia Polytechnic Institute—Associate Professor

G. Todd Dunn, PE, BS, Dartmouth College; MSCE, University of California—Associate Professor

Robert H. Easton, PE, BS, United States Military Academy; MSCE, Iowa State University—Professor Emeritus

Abdullah Faruque, PE, B.Sc., Bangladesh University of Engineering and Technology; M.A.Sc., Ph.D., University of Windsor (Canada)—Assistant Professor

Frank Hanna, B.Sc., M.Sc., University of Baghdad (Iraq); Ph.D., University of Wales College of Cardiff (UK)—Associate Professor

William C. Larsen, PE, BS, MSCE, Dartmouth College—Professor Emeritus

Robert E. McGrath Jr., PE, BCE, Rensselaer Polytechnic Institute; MSCE, Syracuse University—Professor Emeritus

Mark Piterman, MCE, Odessa Marine Engineers Institute (Ukraine)—Professor Emeritus

Scott B. Wolcott, PE, BS, MS, State University of New York at Buffalo—Undergraduate Program Coordinator; Professor

Teresa Wolcott, BS, State University of New York at Buffalo; MS, Rochester Institute of Technology—Lecturer

Environmental Management and Safety

Josh Goldowitz, BS, State University of New York at Binghamton; MS, University of Arizona—Professor

Lisa Greenwood, BS, Rochester Institute of Technology; MS, University of New Haven—Lecturer

John Morelli, PE, BS, Syracuse University; MS, Ph.D., State University of New York College of Environmental Science and Forestry—Department Chair; Professor

Joseph M. Rosenbeck, CSP, MS, BS, Central Missouri State University—Graduate Program Director; Professor

Jennifer L. Schneider, CIH, BA, Roberts Wesleyan College; MS, University of Rochester; Ph.D., University of Massachusetts—Professor

Facility Management

Jeffrey Rogers, PE, CPE, BS, Virginia Polytechnic Institute and State University; MS, University of Florida; ME, Old Dominion University; Ph.D., University of Virginia—Associate Professor

Electrical, Computer, and Telecommunications Engineering Technology

W. David Baker, BSEE, Monmouth College; MS, Rochester Institute of Technology—Professor Emeritus

Jeanne Christman, BS, Clarkson University; MS, University of Texas at Dallas—Assistant Professor

Richard C. Cliver, BS, Rochester Institute of Technology; MSEE, University of Rochester—Associate Professor

Steven A. Ciccarelli, BS, MS, Rochester Institute of Technology—Electrical Engineering Technology Program Chair; Associate Professor

Thomas Dingman, BS, MS, Rochester Institute of Technology—Professor Emeritus

Michael Eastman, BS, MSCS, Rochester Institute of Technology—Department Chair; Professor

Ronald Fulle, BA, State University College at Oswego; MS, University of Colorado at Boulder—Associate Professor

Chance M. Glenn, BS, University of Maryland at College Park; MSEE, Ph.D., Johns Hopkins University—Associate Professor

Clark Hochgraf, BS, State University of New York at Buffalo; Ph.D., University of Wisconsin at Madison—Associate Professor

James J. Hurny, BSEE, Carnegie Institute of Technology; MBA, MS, Rochester Institute of Technology—Associate Professor

Mark J. Indelicato, BEEE, Manhattan College; MS, Polytechnic University—Associate Professor

William P. Johnson, BA, Kings College; BSEE, MSEE, Syracuse University; JD, University at Buffalo Law School—Professor

Warren L. G. Koontz, BSEE, University of Maryland; MSEE, Massachusetts Institute of Technology; Ph.D., Purdue University—Professor Emeritus

David Krispinsky, BE, MSE, Youngstown State University—Associate Professor

Eldred L. Majors, BS, Rochester Institute of Technology—Lecturer

Drew Maywar, BS, MS, Ph.D., University of Rochester—Assistant Professor

Antonio F. Mondragon, BS, Universidad Iberoamericana (Mexico); MSc, Universidad Nacional Autonoma de Mexico (Mexico); Ph.D., Texas A&M University—Assistant Professor

David M. Orlicki, BS, Michigan State University; MS, Rochester Institute of Technology; Ph.D., Massachusetts Institute of Technology—Lecturer

Carol Richardson, BSEE, University of Wyoming; MSEE, Union College—Professor Emerita

Jacob Schanker, PE, BEE, MEE, City College of the City University of New York—Lecturer

George H. Zion, BS, MS, Rochester Institute of Technology—Professor

Manufacturing and Mechanical Engineering Technology/Packaging Science

Ronald F. Amberger, PE, BME, Rensselaer Polytechnic Institute; ME, Pennsylvania State University—Professor Emeritus

Dianne M. Amuso, BS, Western New England College; MS, Rensselaer Polytechnic Institute—Lecturer

Scott J. Anson, PE, BSME, MSME, Ph.D., State University of New York at Binghamton—Manufacturing Engineering Technology Program Chair; Associate Professor

Beth A. Carle, BSE, University of Pittsburgh; MS, Ph.D., University of Illinois; EIT Professional Certification—Associate Professor

Elizabeth M. Dell, BSME, General Motors Institute; MS, University of Michigan—Paul A. Miller Professorship; Associate Professor

Robert D. Garrick, BSEE, GMI Engineering and Management

Institute; MBA, Rochester Institute of Technology; MS, University of Rochester; Ph.D., University of South Carolina—Assistant Professor

Martin Gordon, PE, BSME, MSME, MBA, State University of New York at Buffalo—Associate Professor

Christopher M. Greene, BS, Syracuse University; MS, Ph.D., Binghamton University—Assistant Professor

Daniel P. Johnson, BS, MS, Rochester Institute of Technology—Department Chair; Professor

Seung H. Kim, BS, Hanyang University (South Korea); MS, Ph.D., University of Illinois—Associate Professor

James H. Lee, PE, BS, California Polytechnic State University; MS, Ph.D., Texas A&M University—Assistant Professor

William Leonard, AAS, State University College at Canton; BS, MS, Rochester Institute of Technology—Mechanical Engineering Technology Program Chair; Associate Professor

Ti-Lin Liu, MS, Tsinghua University (China)—Associate Professor

Carl A. Lundgren, BS, Rensselaer Polytechnic Institute; MBA, University of Rochester—Professor

Robert A. Merrill, PE, BS, Clarkson College; MS, Northeastern University—Professor

Michael J. Parthum Sr., BS, MS, Rochester Institute of Technology—Electrical/Mechanical Engineering Technology Program Chair; Associate Professor

S. Manian Ramkumar, BE, PSG, College of Technology-Bharathiar (India); ME, Rochester Institute of Technology; Ph.D., State University of New York at Binghamton—Professor

Michael J. Slifka, AAS, Niagara County Community College; BS, MS, Rochester Institute of Technology—Assistant Professor

John A. Stratton, PE, BS, Rochester Institute of Technology; MS, Rensselaer Polytechnic Institute—Professor Emeritus

Larry A. Villasmil, BSME, Universidad del Tachira (Venezuela); MSME, Ph.D., Texas A&M University—Assistant Professor

Packaging Science

Changfeng Ge, BSME, MSME, Tongji University (China); Ph.D., University of Dortmund (Germany)—Associate Professor

Daniel L. Goodwin, BS, MS, Ph.D., Michigan State University—Professor

Deanna M. Jacobs, BS, State University College at Plattsburgh; MA, State University College at Geneseo; MS, Rochester Institute of Technology—Graduate Program Director; Professor

Thomas Kausch, BS, MS, Rochester Institute of Technology—Instructor

Karen L. Proctor, BS, Michigan State University; MBA, Rochester Institute of Technology—Professor

School of International Hospitality and Service Innovation

David H. Crumb, BS, Florida State University; MBA, Michigan State University—Associate Professor

Francis M. Domoy, BS, MA, State University of New York at Buffalo; Ph.D., Michigan State University—Chair Emeritus; Professor

John-Paul Hatala, BA, Laurentian University (Canada); MS, Elmira College; Ph.D., University of Toronto—Assistant Professor

Lorraine E. Hems, BS, Nazareth College of Rochester; CS, CWE—Lecturer

Jon Horne, BA, Colorado State University; MA, University of Phoenix; MS, Rochester Institute of Technology—Assistant Professor

James Jacobs, MS, Troy State University; Ph.D., State University of New York at Buffalo—Senior Lecturer

Richard M. Lagiewski, BS, MS, Rochester Institute of Technology—Senior Lecturer

Warren G. Sackler, BA, Michigan State University; MA, New York University—Associate Professor

Edward A. Steffens, BS, MBA, Rochester Institute of Technology—Associate Professor

Linda Underhill, RD, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Interim Chair; Associate Professor

Carol B. Whitlock, RD, BS, MS, Pennsylvania State University; Ph.D., University of Massachusetts— Interim Chair; Professor

Department of Service Systems

Bogdan Yamkovenko, MS, Ph.D., Louisiana State University—Assistant Professor

John-Paul Hatala, BA, Laurentain University (Canada); MSED, Elmira College; Ph.D., University of Toronto—Assistant Professor

Jon Horne, BA, Colorado State University; MA, University of Phoenix; MS, Rochester Institute of Technology—Assistant Professor

James Jacobs Jr., BA, Purdue University; MS, Troy State University; Ph.D., State University of New York at Buffalo—Senior Lecturer

Jennifer Matic, BA, Grand Valley State University; MS, Rochester Institute of Technology—Lecturer

Linda Underhill, RD, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Interim Chair; Associate Professor

Quarter Courses

2012–2013 Academic Year

Packaging Science

0607-701 **Research Methods in Packaging**
Discussion of procedures, methods and requirements for carrying out the research project. Students pursue advanced study and research in the following areas: distribution packaging, package systems development, product and/or package damage in the physical distribution environment, materials, quality preservation, production and mechanical properties of packaging materials and systems. **Credit 4**

0607-721 **Packaging Administration**
Study of the role of packaging operations in the corporate enterprise. Positioning of the packaging function in the corporation, managerial practice, interpersonal relationships and control techniques are considered. Individualized instruction, case analysis and/or research papers supplement classroom instruction. **Credit 4**

0607-730 **Packaging and the Environment**
Considerations of packaging in a social context. Factors that enhance secondary use, recycling, recovery of resources and proper disposal are discussed. Package design in relation to solid waste disposal and materials and energy shortages are considered. Other topics of current social interest are discussed. Primarily a discussion class for graduate students. Open to graduate non-majors. (0607-321, 322 or equivalent) May not also get credit for 0607-530. **Class 4, Recitation 1, Credit 4**

0607-731 **Advanced Packaging Economics**
An advanced study of the firm's economic behavior in relationship to activities within the packaging function. Included are packaging costs, production theory and case studies demonstrating general trends in the packaging industry. Individual instruction, case study and/or research paper required, as appropriate to the student's level or interest. **Credit 4 (Plus additional time to be arranged)**

0607-738 **Selected Topic in Packaging Science**

0607-742 **Distribution Systems**
Study of the shipping and handling environment encountered by goods in packages during distribution to the product user. Materials handling, warehousing and the impact of the distribution environment on shipping container design and development are considered. Case study or individual research appropriate to student's interest. **Class 4, Recitation 1, Credit 4**

0607-750 **Graduate Seminar**
Course concentrates on topic of current interest, depending on instructor, quarter offered and mix of students. Content to be announced prior to registration dates. **Credit 4**

0607-752 **The Legal Environment**
An intensive study of federal, state and local regulation that affects packaging. Individualized study and research on an interest basis. **Credit 4**

0607-763 **Packaging for End-Use**
An intensive study of package design requirements specific to use of a product at specified end points. Individual design and development of a package system and its specifications, appropriate to the needs of the product and the consumer/user. **Credit 4**

0607-770 **Advanced Computer Application**
Study of the application of computer techniques and data processing for packaging applications: specification development, test simulation, optimum sizing of package systems, process control and similar applications will be presented. Computer program development and individual research on an interest basis. **Credit 4**

0607-783 **Advanced Packaging Dynamics**
The study of instrumentation systems for analysis, evaluation and application of shock and vibration test methods and data to package system design and development for specific products. A research paper is required. **Credit 4, Class 3, Lab 2**

0607-798 **Independent Study**
Student-initiated study in an area of specialized interest, not leading to a thesis. A comprehensive written report of the investigation is required. Cannot be used to fulfill core requirements. **Credit variable (maximum of 8)**

0607-799 **Advanced Packaging Design**
Advanced package design projects selected in consultation with the instructor. Individual study appropriate to area of interest and background of student. (Consent of department) **Credit variable 1–4**

0607-890 **Graduate Thesis**
An independent research project to be completed by the student in consultation with the major professor. A written thesis and an oral defense of the thesis are required. (Consent of department) Number of credits required for students entering beginning Summer 2009 is 8 credits and must have instructor approval prior to registration. Students who entered program prior to summer 2009 must complete 12 credit thesis and have instructor permission prior to registration. **Credit variable (maximum of 12)**

0607-895 **Graduate Project-Packaging Science**
This course is to fulfill the graduate requirement under the non-thesis option for the MS in packaging science. Approval for students in IPKG-6 must be obtained from the graduate coordinator before registering for this course. A formal paper and an oral presentation of the project results are required. **Credit 4**

0607-899 **Executive Leader Portfolio**
The portfolio credit option is for the Executive Leader students only and is designed to evaluate extensive prior experience. Students must provide extensive documentation of at least 5 years of experience in the packaging industry after completion of the appropriate baccalaureate degree. The content for the portfolio and the number of credits sought are determined in conjunction with the graduate coordinator. Final review and award of credit are then completed through the graduate coordinator and the Program Chair. **Credit 1–10**

0607-999 **Packaging Science Graduate Co-Op**
Work experience in packaging science position appropriate to selected major in graduate program. Position to be obtained through interviewing process with the assistance of Cooperative Education and Career Services Office. **Credit 0**

Manfacturing and Mechanical Engineering Technology

0610-710 **Product Development and Integration**
This course is the first of three classes covering topics, processes and best practices in product development. Using Design for Six Sigma (DFSS) as a motivating philosophy, the course introduces the student to concepts and techniques in the early stages of the product development process, including capturing the voice of the customer, critical parameter management, the phase-gate approach, and system integration for total product life cycle performance. The course provides an overview of DFSS goals, its development process, CDOV (Concept-Design-Optimize-Verify), and technology process (IDOV, Innovate-Develop-Optimize-Verify), as well as strategies in product commercialization. **Credit 4**

0610-750 **Applied Systems Dynamics**
Students learn how to approach and solve real-world dynamic systems problems primarily involving mechanical and electrical components. Design, analysis and control issues and methodology are discussed in the context of real systems like automobiles and machine tools. Labs will include computer simulation and physical testing. (Graduate standing) **Credit 4**

0610-820 **Critical Parameter Management**
This course focuses on Design for Six Sigma processes such as translating the voice of the customer into technical requirements, defining functions to fulfill the requirements, generating concepts to physically fulfill the functions, and the evaluation and selection of superior product and subsystem concepts that are safe to take to commercialization. Students are introduced to topics such as quality function deployment, concept generation, Pugh's concept selection process, and design failure modes and effects analysis. **Credit 4**

0610-830 **Instrumentation and Computer-Aided Systems**
This course integrates modern methods of acquiring, processing, and analyzing data. The goal is to generate value added information to the critical parameter management process during new product development. The course focus is on the measurement of product or process critical functional responses that are direct indicators of the true physical functions that control product quality. Students will acquire a strong set of skills in hands-on development, design, construction and operation of manual and computer-aided data acquisition systems. Topics include applications for data base management and application for empirical model building, robust design, tolerance design and statistical process control. Students will be introduced into using Lab View for data acquisition and control. **Credit 4**

0610-870
Robust Design for Products and Systems
In this advanced course, students explore methods, such as Taguchi arrays, that support the optimization and verification phases of the Design for Six Sigma development process. Topics covered include additivity, signal-to-noise ratios, analysis of means, ANOVA, and the role of robust design methods in reducing variability for products, processes, and systems. **Credit 4**, **Credit 4**

Telecommunications Engineering Technology

0614-720 Telecommunications Concepts
The course provides the student with a solid understanding of Digital and Time Division Multiplexing and Modulation schemes used in the transmission of information in a variety of networks, both packet and circuit switched. Traffic engineering and Quality of Service concepts are covered as well as a number of network protocols and signaling platforms such as MPLS and SIP. (BS in engineering technology, engineering, or a related degree) **Lecture 4, Credit 4**

0614-722 Principles of Telecommunications Network
The course provides the student with a solid understanding of local access and backbone network, architecture, equipment and technology related to the Public Switched Telephone (PSTN), Cable (MSO), Access and Converged/IP networks. Passive Optical Networking and Hybrid Fiber Coax technology is also covered. (BS in engineering technology, engineering, or a related degree) **Lecture 4, Credit 4**

0614-732 Fiber Optic Telecommunications Technology
This course will present the student with the basic components of fiber optic telecommunications systems including optical fiber, light sources and transmitters, photodetectors and receivers, optical amplifiers and passive optical components. Fiber optic telecommunication is one of the most dynamic and important technologies in the telecommunications field. The fundamental driving forces, notably including the growth of wideband access to the Internet, are still in place and the demand for telecommunications capacity continues to increase exponentially. (Physics or engineering course including basic optics and electromagnetic waves, calculus, and differential equations) **Lecture 4, Credit 4**

0614-761 Telecommunications Network Engineering
This course covers accepted network design principles and methodologies as they apply to circuit, packet, frame, cell and synchronization networks. Course topics are transmission engineering, traffic engineering models, timing and synchronization, design of voice and data networks, and electrical grounding concepts. (Telecommunications Concepts 0614-720, Principles of Telecommunications Networks 0614-722, Telecommunications Network Protocols 4055-746) **Class 4, Credit 4**

0614-763 Wireless RF Telecommunications Systems
The fundamental principles that govern wireless mobile and fixed radio frequency communication systems are studied in this course. At the end of this course, students will understand the radio frequency mobile wireless environment, the common wireless systems, and the regulatory aspects related to deployment of the wireless infrastructure. (An undergraduate/graduate course in communication systems (such as 0609-534) and current facility with technical mathematics and calculus) **Credit 4**

0614-764 Telecommunications Systems
The fundamental principles that govern the communication of information are introduced. At the end of this course students will understand signal spectral analysis and the principles of digital and analog modulation formats. Topics in the course are spectral analysis techniques, modulation schemes, and noise and bit error rates. (Calculus and differential equations) **Class 4, Credit 4**

0614-774 WAN/LAN Planning and Design
This course teaches the art and science of metropolitan and wide area network design for both modern delay (data) networks and traditional blocking (voice) networks; the greatest emphasis is on modern delay networks. Both qualitative and quantitative approaches are used as the student progresses through the network analysis, architecture and network design processes. An advanced WAN Fiber Optic design tool, such as OPNET Transport Planner is utilized in a required graduate project. (0614-720 and 0614-722) This course is not appropriate for graduate RIT MSTET credit if the student has completed the undergraduate RIT course Network Planning and Design (0614-574) with an A or B grade within the past five years. **Class 4, Credit 4**

0614-780 Telecommunications Policy Issues
This course provides an introductory overview of domestic and international telecommunications policy and issues with special emphasis on domestic policy, regulation and law. Current issues, trends and standards are also investigated. This course is not appropriate if the student has completed the RIT undergraduate course, Introduction to Policy and Issues (0614-480), with an A or B or an equivalent course at another university in the past five years. **Class 4, Credit 4**

0614-783 Telecommunication Transmissions Systems
The fundamental principles that govern wired and wireless transmission systems are introduced. At the end of this course students will be able to apply transmission system theory to the analysis and design of copper, fiber-optic, and wireless transmission systems. Topics in the course are Transmission Lines, link budgets, satellite communications, and an introduction to cellular engineering and mobile radio transmission. (Calculus, differential equations, and an undergraduate course in electronic communications systems that teaches the concepts of modulation and demodulation and the electronic components in transmitters and receivers) **Class 4, Credit 4**

0614-832 Fiber Optic Telecommunications Network
This course is focused on the operation of the elements of fiber optic telecommunications networks and the structure and operation of optical telecommunications networks. Students will be able to design optical networks to meet specified capacity, flexibility, and reliability requirements at the end of the course. (Fiber Optic Telecommunications Technology 0614-732) **Lecture 4, Credit 4**

0614-836 Next Generation Networks
The course provides graduate TET students the opportunity to research and report on "Next Generation Networks." The course consists of professor led discussions on one type of Next Generation Network followed by each student researching two additional Next Generation Network types. A case study approach is utilized. After completing the research and written paper regarding one's selected topic/case, each student will present to all other students in the class. As a result, every student will not only benefit from their own research of two topics/cases but also be informed of other Next Generation Network issues by other students. (Students with an engineering technology or engineering BS degree and/or graduate students who have completed ALL core MSTET requirements are welcome) **Class 4, Credit 4**

0614-864 Wireless RF Telecommunications Systems
The fundamental principles that govern the application of wireless mobile and fixed radio frequency communication systems are studied in this course. At the end of this course students will understand the radio frequency mobile wireless environment, the common wireless systems, and the zoning/public policy aspects related to deployment of the wireless infrastructure. (Telecommunication Systems 0614-764 and Calculus and Differential Equations) **Lecture 4, Credit 4**

0614-890 Graduate Thesis/Project Plan
This course is a ten-week preparation that will allow the student to develop a detailed description and plan of work along with preliminary data and research. The objective of this preparation is to give focus to the proposed thesis/project. Student will conduct literature reviews, prepared bibliographies, identify and plan methodologies, identify deliverables, prepare schedules, become familiar with report formats and literacy guides, and gain a clear understanding of the expectation of faculty and the discipline. The student will be assigned a primary faculty adviser. **Credit 2**

0614-892 Graduate Thesis
The graduate thesis is an independent research or development project that provides new knowledge, data, processes, software or other assets that benefit the field of telecommunications. A formal written thesis and an oral defense are required. (0614-890, Thesis/Project Planning Seminar) **Credit 6**

0614-893 Graduate Project
Graduate projects are an applied research project that reflects the student's ability to utilize professional skills to design and develop a project that demonstrates the use of telecommunications technology, tools, or applications. A formal written document and demonstration are required. (0614-890, Thesis/Project Planning Seminar) **Credit 2**

0614-899 Independent Study
Study or laboratory work on a telecommunications or closely related topic. (Approval of the instructor and the telecommunications engineering technology program chair are required.) **Credit 2-4**

0614-999 Graduate Co-Op
One quarter of appropriate work experience in a telecommunications related industry. It is expected that a student will normally take no more than two quarters of cooperative education in the course of the MSTET program. **Credit 0**

Manufacturing and Mechanical Systems Integration

0617-730 Data Management and Communication
This is a course in communication and data management. The first part of this course will focus on data communication. Fundamental concepts of computer systems will be explored. This information will be a precursor to such topics as parallel and serial communication, synchronous and asynchronous communication, point-to-point, and broadcast networks. Additional discussion will include application of network applications in CIM such as EDI. The second part of this course will discuss elementary data management topics such as data storage and retrieval, the use of commercial DBMS's and the relational model. It will also discuss data representation in CIM; the melding of representation schemes used by CAD systems and CNC/DNC machine tools. **Class 4, Credit 4**

0617-811 Design Manufacturing and Assembly
The basics of Manufacturing Processes (I and II) are expanded and applied to the design process. Design is taken from early courses that deal with function and theories of failure and now is considered from the viewpoint of manufacturability. Part concepts will be considered for various manufacturing processes to determine which process will yield the lowest cost part that meets all product functional requirements. Cost will consider the sum of both piece part, associated tooling, and assembly costs. (0617-420 and 0610-220, or instructor permission. Students are encouraged to have: 0617-436 Engineering Economy, and 0617-472 Tool Engineering, or equivalent courses, or experience.) **Credit 4**

0617-850 Flexible Manufacturing Assembly
The course enables students to make basic calculations to design and analyze manufacturing and assembly systems. Topics include the design of manual assembly systems, transfer lines and flexible manufacturing systems. Quality systems are discussed including SPC, TQM and Six Sigma. Quality case studies are discussed and associated problems solved. Specific design and production problems are solved using QFD and FMEA techniques. Manufacturing (and company) control systems are discussed including MRP I, MRP II, ERP, the Toyota Production System, Lean Enterprise Model and Next Generation Manufacturing. The combination of Lean and Six Sigma tools is introduced and used to solve problems associated with a manufacturing case study. (Graduate standing or instructor permission) **Class 4, Credit 4**

0617-855 Electronic Packaging Fundamentals
This course will provide a thorough understanding of the technology, components, equipment, design and manufacturing process for surface mount electronics manufacturing. As an introductory course, it will provide the students with a strong foundation needed for advanced work in the surface mount technology (SMT). The laboratory demonstrations will provide the students an orientation and familiarization of the manufacturing equipment and process for printed circuit board assembly. **Class 4, Credit 4**

0617-856 Advanced Concepts in Electronics Packaging
This course provides an in-depth study of thermal, mechanical, material, manufacturing and reliability aspects of SMT and advanced packaging. The lecture topics will include design and manufacturing standards, thermal modeling and management, mechanical properties of materials, failure mechanisms, materials processing, high-density interconnection, advanced component packaging, technology trends, reliability testing, inspection. **Class 3, Lab 2, Credit 4**

0617-870 Manufacturing Automation Control
This course deals with the principles and application of programmable logic controllers (PLC). Topics include PLC hardware, programming and application of PLCs in a computer integrated manufacturing (CIM) environment. Students will also be exposed to man machine interface (MMI) and PLC networks. (Manufacturing Processes) **Class 3, Lab 2, Credit 4**

0617-896 Project Management in CIM
A project related to CIM, System Integration or electronics packaging research area to be monitored and advised by one faculty or one faculty with an industry representative. This project work may serve as the capstone experience for the MMSI degree. (Completion of required courses in MMSI curriculum) **Credit 4**

0617-897 MS Thesis
Interdisciplinary thesis on CIM System Integration electronics packaging research area to be monitored and advised by committee of two faculty or one faculty with an industry representative. This thesis work may serve as the capstone course of the MMSI degree. (Defense of thesis requires completion of all required courses.) **Credit 0-4**

0617-898 Graduate Seminar
Special Offering of advanced graduate level topics. These topics are developed and taught on a special offering basis and will vary from year to year. **Credit 1–4**

0617-899 Graduate Independent Study
Faculty directed study of appropriate topics on a tutorial basis. This course is generally used to allow an individual to pursue topics in depth under faculty sponsorship. **Credit 1–4**

0617-999 Manufacturing Grad Co-Op
Work experience in manufacturing position appropriate to selected major in graduate program. Position to be obtained through interviewing process with the assistance of Cooperative Education and Career Services Office. **Credit 0**

Computer Engineering Technology

0618-700 Introduction to Digital Electronics
An introductory course in digital electronics intended for K–12 technology teachers based on "Project Lead the Way" curriculum. Emphasis will be placed on both theoretical and practical skills needed to teach high school classes in this field. Laboratory assignments will include the computer simulation of circuits, the wiring of prototype circuits. The lecture will touch on the printed circuit board design and implementation of digital circuits. **Class 4, Lab 4, Credit 6**

Hospitality-Tourism Management

0624-770 Srvice Leadership Exam and Implementing Change
This is a capstone course that examines various personal and personnel leadership functions as applied to the delivery of service excellence. Current literature is used to explore the interrelationship of various conceptual paradigms. The goal is to enhance individual's understanding and to augment his or her ability to interact in the service environment, and to critically understand strategies founded in continuous learning, change and learning organizations. Concepts discussed include: relationship management, empowerment, team building, corporate culture and opportunity management. **Credit 4**

0624-780 Financial Management for Hospital-Tourism Firms
Financial performance forecasting at both the individual and multi-unit levels of operation is examined. Emphasis on financing, including operating leverage, short- and long-term financing alternatives and tax considerations within a service organizational context. **Credit 4**

0624-825 Strategy Process of Service Firms
An analysis of the organizational structure, operational procedures, corporate policies, financial growth and related factors of service firms. The course traces the evolution of various companies to reveal individual growth strategies. Service discovery, building service relationships, and understanding service as experiences are necessary skills that will be learned and used. **Credit 4**

0624-826 Tourism Policy Analysis
An analysis of the goals and objectives for tourism development in geographic areas of different size. Topics include employment, income redistribution, cultural impact, labor supply and tourism resource base. Specific policies for touristic regions are compared for effectiveness and overall cost benefits. Local, state, national and international examples are included. **Credit 4**

0624-827 Tech Transfer in Hotel Industry
Survey of computer information systems for planning and control in hospitality and tourism operations. Various software and hardware packages are examined in relation to planning and control functions. **Credit 4**

0624-828 Meeting Planning Development
An examination of the role of professional meeting planners as they function in the corporate, association and educational environments. Both corporate and independent meeting planners will be assessed. Methods of planning and programming for meeting will be surveyed and evaluated. A review of the economic impact of conferencing and support service functions will be undertaken. Negotiation skills are examined. **Credit 4**

0624-840 Service Quality Management
Total Quality Management (TQM) philosophy is applied to the hospitality-tourism industry. Underlying principles, TQM tools and techniques and case studies are used to bridge the gap between theory and practical application. **Credit 4**

0624-843 Resort Develeopment
Market segmentation; methods in marketing research; creating a menu, an environment, a theme for a defined market; improving the market share through quality control, innovation, promotions, public relations, menu engineering and community involvement; premarketing, creating a new image; marketing to increase profitability. Case studies and project. **Credit 4**

0624-844 **Hospitality Resource Management**
This course is designed to analyze the inputs associated with the development of hospitality firms. Labor markets, financial instruments, tourism infrastructures, real estate markets and educational support systems will be assessed in order to determine the development of hospitality firms. **Credit 4**

0624-846 **Travel Marketing Systems**
Includes the identification of markets, product pricing strategies and mixes of communication as they relate to the tourism distribution system. The efficiencies of various channel configurations and their resultant organizational patterns are evaluated. **Credit 4**

0624-848 **Convention and Exhibit Management**
The organization and operation of exhibit/convention space is examined from the meeting planner's perspective. Emphasis is given to use of exhibits to enhance both program and attendance. A detailed review of the factors necessary for successful exhibits and exhibitor relations is conducted with emphasis on the various methods employed to encourage participation. Budget controls and financial reporting systems are analyzed. The decision-making process on use of the exhibit as an income producing segment of conferencing is stressed. **Credit 4**

0624-867 **Tourism Planning and Development**
Tourism planning defines the frames of reference used in making choices concerning the development of tourism facilities and use of space. Topics include: tourism income and expenditure; pricing policy; taxing authorities; ownership patterns; financing and leakage potentials of the various tourism infrastructures. This course focuses on the planning and development of tourism as it is "packaged" through its distribution channels. **Credit 4**

0624-868 **Legal Issues and Evaluation**
An examination of the instruments used to confirm meeting arrangements. Focus is on informal instruments (letter of agreement) and formal documentation (contract). A survey of legal decisions impacting the liability of the planner and their impact on the meeting function is conducted. The performance of meeting planners and their interrelationships and interdependencies with external support staffs are assessed. **Credit 4**

0624-890 **Practicum in Hotel Training**
An opportunity for the student to apply skills learned in previous courses in a work or laboratory setting. A proposal must be approved by the director of the program prior to enrolling in the course. **Credit variable 1–6**

0624-893 **Comprehensive Review and Examination**
A written comprehensive exam is one of the non-thesis options available to complete the MS degree. Students will take a written examination and must receive a passing grade of at least 80% to be successful. Students failing the course will receive an incomplete and have one opportunity to retake the exam. Students have access during the quarter they are registered for the exam to self-directed learning resources covering the fundamental theories, foundation principles, and applications of each of the core subjects. Policy details and further information about the Comprehensive Examination is available from the department of Hospitality and Service Management. (GPA of 3.0 or higher; faculty adviser approval) **Credit 4**

0624-896 **Graduate Project**
This course number is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in hospitality/tourism management. The candidate must obtain the approval of the director of the program and, if necessary, an appropriate faculty member to supervise the paper before registering for this course. A formal written paper and an oral presentation of the project results are required. (Faculty approval needed) **Credit variable 1–3**

0624-898 **Thesis**
Thesis based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the reduction of theory into practice. A formal written thesis and oral defense are required. The candidate must obtain the approval of the director of the program and, if necessary, an appropriate faculty member to guide the thesis before registering for the thesis. (Faculty approval needed) **Credit variable 1–6**

0624-899 **Independent Study**
An opportunity for the advanced student to undertake independent investigation in a special area under the guidance of a faculty member. A written proposal is to be forwarded to the sponsoring faculty member and approved by the director of the program prior to registering for this course. The independent study must seek to answer questions outside the scope of regular course work. **Credit variable 1–6**

Service Leadership and Innovation

0625-750 **Elements of Service Management: Sysems Approach**
A general systems framework is used to explore the major components of service management using a variety of service sectors - health care, banking, insurance, real estate and hospitality-tourism. The course examines the interactions, interdependencies, and interactivity of service systems - to learn about the synergistic effects of the current changeable markets. In addition to this organizational focus above, the course begins the process of examining the learning organization from a professional and personal focus. Lastly, the course provides insights and practical applications to the evolving e commerce environment and to lean service principles. **Credit 4**

0625-790 **Introduction to Grad Research: Options**
This course is designed to introduce the general nature of applied research and evaluation applicable to service industries and to contemporary trends in the field. The course focuses on the nature, types, procedures and applications of research; specifically those attributes needed to prepare a graduate research proposal: problem definition, review of literature, methodology, analysis of findings and recommendations. A graduate research proposal is required at the completion of the course. **Credit 2**

0625-794 **Integrative Problem Solving**
Students will demonstrate synthesis and integration of the theories and foundation principles of their discipline. This will be achieved through application of core knowledge in a series of progressive problem situations culminating in a comprehensive examination. To be successful students must receive a passing grade of at least 80% in the course. Students will have one additional opportunity to register for and pass the integrative problems solving course if their initial attempt result in a failing grade. (No more than 12 semester hours of coursework remaining to complete the program; completion of all core courses in their program; be currently enrolled in the program; possess a program GPA of 3.0 or higher; no outstanding incomplete grades, nor can the student be on academic/disciplinary probation; department approval to compete this exit strategy) **Class 4, Credit 4 (W, Su)**

0625-841 **Benchmark and Cont. Process Improvement**
This course examines the benchmarking process as a means of achieving continuous service improvement. Among the topics discussed are proactive management, measuring performance, out-of-the-box thinking, internal, competitive, industry, and best-in-class benchmarking. The critical success factors at each stage of benchmarking in service industries are investigated. **Credit 4**

0625-842 **Customer Relationship Management**
The Customer Relationship Management (CRM) course develops the learners ability to help their organization manage its interactions with its customers across multiple channels, maximize revenue opportunities, build foundations to increase customer satisfaction and drive customer retention and loyalty. **Credit 4**

0625-843 **Empowered Teams**
This course focuses on the service organization's internal customers- the employee and middle management. It examines the prerequisites, transformation, and assumptions needed to decentralize the service firm and implement self-directed, empowered teams. Among the issues examined are accepting more responsibility for the service performance assuming accountability for customer satisfaction, and planning with the "customer-in" decision-making framework. **Credit 4**

0625-844 **Breakthrough Thinking: Creativity and Innovation**
Learning to solve problems, create profound decisions, and continuously change our organizations has always been a function of leadership. Today's fast-paced global business environment requires that we utilize equally insightful, aggressive, and distinctly new processes to change. This course examines the global phenomenon and builds in the learner new methods to achieve leadership in an age of change - breakthrough thinking, creativity, and innovation. The learner will become adept at true value innovation in a knowledge/service economy. **Credit 4**

0625-845 **Relationship Management in Service Firms**
This course examines the nature of managing the on-going relationships that characterize the service process. Relationships both internal and external to the organization are considered. Organizational implications of developing service recovery systems are also investigated. **Credit 4**

0625-847 **Reengineering Serv Envir**
This course focuses on the process orientation of concentrating on and rethinking end-to-end service activities that create value for customers. It challenges traditional organizational viewpoints and reexamines the assumptions underlying the appropriateness of rigid divisions of labor, elaborate control systems and managerial hierarchy within service firms. **Credit 4**

0625-849 **Service Performance Metrics**
This course examines the various self-assessment processes associated with improving service quality. The seven Malcolm Baldrige National Quality Award categories, the eight President's Award for Quality and Productivity categories (Federal Quality Institute), and the ISO 9000 categories are examined. These guidelines are oriented towards systems and are used to probe relationships that reach across departments and disciplines, with the goal of achieving and maintaining total quality service management. **Credit 4**

0625-890 **Practicum in Service Management**
An opportunity for the student to apply skills learned in previous courses in a work or laboratory setting. A proposal must be approved by the director of the program before enrolling in the course. **Credit 1–6**

0625-895 **SLI-Comprehensive Exam**
A written comprehensive exam is one of the non-thesis options available to complete the MS degree. Students will take a written examination and must receive a passing grade of at least 80% to be successful. Stu dents failing the course will receive an incomplete and have one opportunity to retake the exam. Students have access during the quarter they are registered for the exam to self-directed learning resources cove ring the fundamental theories, foundation principles, and applications of each of the core subjects. Policy details and further information about the comprehensive examination is available from the department of hospitality and service management. (GPA o f 3.0 or higher; faculty adviser approval)
Credit 4

0625-896 **Graduate Project**
The course number is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in Service Management. The candidate must obtain the approval of the Graduate Coordinator and if necessary, an appropriate faculty member to supervise the paper before registering for this course. A formal written paper and an oral presentation of the project results are required. **Credit variable 1–4**

0625-898 **Research Thesis**
Thesis based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the reduction of theory into practice. The candidate must obtain the approval of the Graduate Coordinator and if necessary, an appropriate faculty member to supervise the paper before registering for this course. A formal written paper and an oral presentation of the project results are required. **Credit variable 1–6**

0625-899 **Independent Study**
An opportunity for the advanced student to undertake independent investigation in a special area under the guidance of a faculty member. A written proposal is to be forwarded to the sponsoring faculty member and approved by the Graduate Coordinator prior to registering for this course. The independent study must seek to answer questions outside the scope of regular coursework. **Credit variable 1–6**

Human Resource Development

0626-701 **Business Acumen**
This course provides students with an understanding of how different business types create wealth and helps them build literacy in key business terms and concepts. Students in this course examine different business models, research industry trends, and explore the impact of human resource decisions on business strategy, costs and results. The course is designed for individuals in non-financial roles. It prepares them to collaborate effectively with senior leaders to make sound human capital decisions utilizing economic, financial, and organizational data. **Credit 4**

0626-702 **Leveraging Technology**
Knowledge of HR technology (how to leverage technology for HR practices and use e-HR/Web-based channels to deliver value to customers) has become an increasingly important competency for HR practitioners. As companies strive to reduce costs, improve performance, align employee development efforts with business strategy, and adapt more quickly to changes in the marketplace, literacy with technology becomes more essential. Students in this course review the effective application of technology to improving HR efficiency. They are given hands on experience with software tools ranging from performance management, assessment, and competency development to electronic job postings and employee self-serve. Students learn to collaborate effectively with IT professional and senior executives to make technology-related decisions. **Credit 4**

0626-703 **Facilitation Skills**
Facilitation skills rank among the most critical competencies for HR practitioners today. HR practitioners are required to facilitate a variety of events from meetings and strategic planning sessions to new employee orientations and conflict mediation discussions. This course provides the HR practitioner with the skills required to effectively plan for and facilitate a variety of events. Individuals in other disciplines will benefit from this course as well. **Credit 4**

0626-704 **Competitive Staffing and Selection**
This course examines how to create a large, diverse and qualified pool of applicants that meet an organization's work force plans and which the organization can quickly tap into should an opening occur. In addition, the course provides a highly effective model for selection to ensure right fit and explores effective strategies to aid engagement and retention of newly hired employees. Students in this course learn to use technology and other tools to improve the quality of hiring and selection process outcomes. They evaluate best practices in staffing and selection and learn to address typical business problems in these areas. **Credit 4**

0626-705 **Competency-Driven Organization**
Without specific employee capabilities, organizations cannot achieve their strategic goals. These capabilities, often referred to as competencies, are the unique mix of skills, knowledge, experience, and personal characteristics necessary to perform effectively today and be prepared for future challenges. By defining those competencies necessary to drive the mission and strategy of an organization, HR practitioners and others can attract and hire the right people, reward the right behaviors, and invest in developing talent where there are competency gaps. Students in this course learn to define organization-wide and job specific-competencies. They apply those competency definitions to a range of employee practices from hiring and selection to performance management and succession planning. They evaluate best practices in competency modeling and application. **Credit 4**

0626-707 **Applied Data Analysis**
Explores statistical concepts and procedures as applied to typical human resource, training and career counseling situations. Participants apply a computer program to the analysis of data. **Credit 4**

0626-710 **Theory of Organization Development**
This course introduces the student to organization development theories and their application in an organizational setting. Consideration is given to the psychological, sociological, and historical constructs upon which the field is based. Students will be come familiar with the philosophical foundations for the key theories as well as the practical work of key theorists. This course will also examine how theories of organization development are being applied in organizations to foster change, innovation, and the revitalization of the organization. **Credit 4**

0626-720 **Theories of Career Development**
This course introduces students to traditional and emerging career development theory and its application to workplace issues. Theories such as trait and factor, type, developmental, psycho-dynamic, work adjustment, life span, social learning, and career decision-making are covered using a systems theory approach. Additional topics include organizational and strategic career development, application of theory to modern problems and issues, and contemporary issues in career development. The course is participative and draws heavily on case studies, role-playing, self-assessment and group work to understand the theory and workplace application issues. **Credit 4**

0626-724 **Legal Environment in HR**
Students in this course will examine the fundamentals of local, state, and federal employment laws with an emphasis on private companies and public employers in New York State. Particular attention is be given to the application of various laws as they relate to the Human Resource professional. Laws examined range from hiring, firing, workplace safety, privacy, harassment. Labor relations issues examined include the proposed Free Choice Act, union elections and the grievance/arbitration process. Students will gain a greater understanding of the various laws and regulations that govern the worksite and the importance Human Resource professionals play in the ability of a company to succeed. (Human Capital Strategies) **Credit 4**

0626-726 **Psych Assessment and Measurement in HRD**
This course introduces the fundamentals of assessment and measurement tools used in human resource and organizational development activities. An overview of a variety of instruments will be studied and administered. Reading, lecture and class activities will include theory of test development, criteria for administration, validity, reliability, and assessing best instruments for use. **Class 4, Credit 4**

0626-727 **Human Resource Metrics**
This is an introductory-level survey course on performance measurement in human resource management. The course focuses on identifying the financial impact of human resource programs and practices. We examine concepts, principles, and techniques of measurement used in various areas of human resource management, including absenteeism, employee separation, employee health, wellness, and welfare, work life programs, employee engagement and job performance, workforce planning, recruitment and selection, training and career development, and employee engagement and productivity. (12 credits of human resource management and/or human resource development coursework or permission of the instructor) **Credit 4**

0626-730 **Strategic Employee Development**
This course provides individuals with a framework needed to successfully design learning interventions that drive performance improvements in their organizations. They examine adult learning principles and learning styles as well as best practices in organizational learning, employee development, and alternative delivery strategies. They identify how to link learning initiatives with corporate strategy and gain commitment to those initiatives from senior leaders. **Credit 4**

0626-735 **Human Capital Strategies**
This course examines how to develop a human capital strategy to acquire, retain, and engage the best available talent required for current and future success. It examines tools and techniques for human capital planning, sourcing, retention, and development. Students in this four-credit course examine benchmark practices from all industry types to derive effective strategies for their own organizations. They develop a human capital strategy and complete an integrated set of projects to implement selected components of the strategy. **Credit 4**

0626-755 **Graduate Writing Strategies**
Taught in conjunction with Research Methods, students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition, students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Credit 4**

0626-777 **Internship**

0626-780 **Human Resource Management I**
Suitable for managers as well as human resource staff, this course examines the formal systems in an organization which ensure the effective and efficient use of human talent to accomplish organizational goals. Major topics include job analysis, job descriptions, employee recruitment employee selection, and performance management. **Credit 4**

0626-781 **Human Resource Management II**
The bottom-line business of human resources must be the delivery and or development of human capital that enable the enterprise to become more competitive, to operate for maximum effectiveness, and to execute its business strategies effectively. HR embodies organizational programs and processes that can enhance individual competencies and organizational capabilities. This course will prepare individuals to evaluate HR programs/processes and redesign these to meet the changing needs of the organization. **Credit 4**

0626-782 **Human Resource Management Practices**
This course focuses on Human Performance Management, or the effective use of human resources in order to enhance organizational performance and drive business results. The elements necessary to become a high performance organization and the unique role of the HR professional in performance management are important elements of study. Students in the course explore a range of Human Resource Management practices that are drawn from many disciplines including, behavioral psychology, instructional systems design, organizational development, and human resources management. They learn to design and manage a variety of performance management interventions and work collaboratively with managers and employees. **Credit 4**

0626-790 **Change Leadership**
As organizations undergo continual change, HR leaders play a central role enabling their organizations to anticipate, plan and profit from change. Such change leadership requires competencies of identifying and framing challenges, researching solutions, creating and implementing action plans. Through study and practice, students will gain knowledge and skills to lead their organizations to desired futures. (Completion of at least 24 hours of study including the following four courses: Human Capital Strategies, Business Acumen, Strategic Employee Development, and Human Performance Management Practices plus any two electives) **Credit 4**

0626-877 **Internship**
The internship is an opportunity to gain relevant skills for those that have limited work experience. This course consists of two parts: at least 140-200 hours of professional accomplishments in an appropriate setting participation in an online seminar and completion of assignments relevant to the on-site internship experience. Students will work with their advisers to complete all necessary arrangements. Students should plan to meet with their advisers at least two months before planning to take the internship. Proposals for the internship must be approved and on file before registration. **Credit 1–6**

0626-890 **Independent Study**
Provides for independent study or research activity in subject matter areas not included in any existing course in the degree program, but having specialized value to students. Proposals approved by a supervising faculty member and the program chairperson are required prior to registration. This course may be taken more than once, but for no more than a total of 6 credit hours. **Credit 1–6**

0626-891 **Selected Topics**
Selected Topics are innovative courses not reflected in the curriculum. Titles will appear in the course listing each quarter. The course may be taken more than once as topics change. **Credit 4**

0626-894 **Comp Review and Examination**
A written comprehensive exam is one of the non-thesis options available to complete the MS degree. Students will take a written examination and must receive a passing grade of at least 80% to be successful. Students failing the course will receive an incomplete and have one opportunity to retake the exam. Students have access during the quarter they are registered for the exam to self-directed learning resources covering the fundamental theories, foundation principles, and applications of each of the core subjects. Policy details and further information about the Comprehensive Examination is available from the department of Hospitality and Service Management. (GPA of 3.0 or higher; faculty adviser approval) **Credit 4**

0626-895 **Graduate Thesis**
The graduate thesis is a research based activity that integrates and related theory with practice. The student will complete an independent research or development project that provides new knowledge, insights or direction for the human resource development field. A formal proposal and proposal defense, a written thesis that satisfies all department and RIT requirements, and an oral defense of the findings are required. (0630-755 Research Methodology Foundations, an approved proposal and program chair permission)

Environmental, Health and Safety Management

0630-710 **Special Topics-Remedial Investigations and Corrective Actions**
Delineates and describes the sequence of events required in remedial investigations (RI), feasibility studies and corrective actions at hazardous waste sites. Explains the process flow logistics, concepts and rationale behind each RI action. Investigates the strategies, technologies and methodologies commonly in use for site investigation characterization and corrective action. Explores current issues "how clean is clean" and "Superfund" liability. Students learn to develop conceptual site characterization plans; effective solicitations for RI proposals; review and evaluate work plans, procedures operations plans, and contingency plans. **Class 4, Credit 4**

0630-711 **Occupational Health**
This course is an intensive foundation course that provides students with an overview of the fundamentals of industrial hygiene. Emphasis will be placed on the toxicological effects of various industrial substances on the body; monitoring and personal sampling for these substances and personal protection against such substances. (College biology and College chemistry or department permission Students who have completed 0630-450/451 or 0630-610 may not take this course.) **Class 4, Credit 4**

0630-712 **Occupational Safety**
This course is an overview of the safety management tools utilized in today's industry. Students are expected to have a foundational knowledge of safety management techniques upon completion of this course. Topics examined include recordability and safety indices; incident investigation; guarding; electrical and material handling; welding, fire prevention; excavation; medical surveillance and worker's compensation; inspection techniques and auditing; committees; incentives, and voluntary programs. Students will be required to research a leading edge safety topic. (College level physics or department permission. Students who have completed 0630-454 or 0630-611 may not take this course.) **Class 4, Credit 4**

0630-713 **Solid and Hazard Waste Management**
An intensive foundation course for students who lack academic preparation or practical experience in solid and hazardous waste management. Introduces principles, strategies, technologies and regulations for reducing, recycling, handling, treating, storing and disposing of solid and hazardous waste. (College level chemistry or department permission. Students who have completed 0630-350 or 0630-620 Solid and Hazardous Waste Management may not take this course.) **Class 4, Credit 4**

0630-714 Industrial Wastewater Management
An intensive foundation course for students who lack academic preparation or practical experience in wastewater management. Identifies and characterizes the sources of industrial wastewater and examines the related environmental impacts, regulatory implications, and technical and cost considerations of treatment and disposal methodologies. (College chemistry or department permission.. Students who have completed 0630-622 or 0630-352 may not take this course.) **Class 4, Credit 4**

0630-715 Air Emissions Management
This is an intensive foundation course which will present an overview of industrial air emissions management. The course will teach students how to identify and categorize industrial air pollutants and their sources. Applicable state and federal laws and regulations will be covered. Air emissions reduction strategies will be covered, along with control technologies, testing, monitoring, and reporting requirements. By the end of the course, students will be able to develop a comprehensive facility air emissions management plan. (College level chemistry or department permission Students who have completed 0630-354 or 0630-622 may not take this course). **Class 4, Credit 4**

0630-720 Environmental Health and Safety Management
This course presents an overview of environmental, health and safety management, and provides students with an introduction to management systems for EHS operations. Explores the motivations and strategies for environmental, health and safety management, identifies EHS management components and presents the fundamentals of developing EHS visions and policies. This course includes an on campus executive leader session. (Matriculation into the EHS management MS degree program or department permission).**Class 4, Credit 4**

0630-725 Environmental Health and Safety Accounting and Finance
Pollution and accidents impose costs-not just remedial costs, but also time, lost opportunities, long term liabilities and even company image. These costs are often overlooked by current accounting practices. This course will train students to make good business decisions when all the EHS costs of economic decision, as well as the economics of EHS decisions, are taken in consideration. The course will focus on decisions made at the company level. Methods will be taught to identify and quantify the full-costs of projects and activities. A more accurate approach towards EHS accounting will result in a safer environment and increased competitiveness. (Matriculation into the EHS management or facility management MS degree program or department permission)**Class 4, Credit 4**

0630-740 Environmental Health and Safety Management System Design
This course examines the design and development of environmental, health and safety management systems to implement an organization's vision, mission and policies. Provides strategies for determining what needs to be measured in order to assess performance and ensure continual improvement. Discusses metrics and EHS management system intervention; significant team project work as well as individual work (0630-720 or department permission) **Class 4, Credit 4**

0630-750 Environmental Health and Safety Project Management
This course focuses on unique factors in environmental, health and safety project management. It covers the nine major areas of project management: integration, scope, time, cost, quality, human resources, communication, risk and procurement. Discusses modern project management techniques, including program evaluation and review techniques (PERT), critical path method (CPM), and various budgeting and resource allocation techniques. Includes an introduction to Microsoft Project for Windows software. Applies project management concepts and software to simulated EHS and FM projects. (Matriculation into the EHS management or facility management MS degree program or department permission.) **Class 4, Credit 4**

0630-755 Research Methodology Foundations
This course prepares students to plan and conduct research using methodologies commonly employed in the environmental, health and safety management disciplines. Included are: literature reviews; case studies; in-depth interviews; and quasi-experimental design. Students will be instructed in the requirements that must be met in order to comply with the Department of Health and Human Services (DHHS) regulations for the protection of human research subjects. This course will also prepare students to identify common approaches to the use of the works of others, and introduce them to associated resources. Students will learn to use the Chicago Manual of Style formats for citing references. (Matriculation into the EHS management or facility management MS degree program or department permission.) **Class 4, Credit 4**

0630-760 Integrating Environmental Health and Safety into Business Management
This course examines strategies for integrating EHS systems and processes into business management. Using case studies, the course explores the interrelationships between EHS and total quality management, reporting, financial value, and approaches for sustainable business development. Students will be prepared to select appropriate quality tools to improve EHS processes; identify opportunities, strategies and tools for integrating EHS into business management; and identify best practices in EHS/business integration. (0630-720 or department permission) **Class 4, Credit 4**

0630-765 Product Stewardship
This course examines the principles of product stewardship. The ethical, legal, liability and economic issues which product manufacturers face will be covered. In addition, students will be exposed to the methods used to identify and manage product environmental, health and safety (EHS) in today's world. The concept of sustainability will be covered and students will learn the principles of product life cycle assessment. Students will also learn and use specific EHS analysis techniques. Case studies will also be reviewed and students will complete a group or individual capstone project. (Open to all graduate engineering technology, packaging, EHS management students or with department permission.) **Class 4, Credit 4**

0630-770 Risk Assessment and Management Communication
This course presents an overview of risk assessment methodologies and history, along with current practices and developing trends. It takes a close look at strategies for reducing and managing EHS risks, and provides an introduction to the elements of internal and external risk communication. Students will gain skills in evaluating risk assessment and identifying associated strengths and weaknesses with respect to the EHS management needs of their respective organizations. Students will be prepared to design and implement risk reduction and management plans for EHS-related activities and will be able to identify essential risk-related elements that need to be communicated internally and externally. (0630-720 and course work in occupational health or department permission) **Class 4, Credit 4**

0630-780 Environmental Health and Safety Law
This course provides a detailed examination of the EHS legal and regulatory framework, with emphasis on developing compliance strategies. Addresses strategies for advocating and negotiating flexible permits, enforcement matters and other legal requirements. Students will be prepared to discern the intent and applicability of EHS laws and regulations, prepare summary documents incorporating legal concerns and concepts, understand different approaches to negotiations, and work effectively with attorneys to achieve desired objectives. (0630-720 or department permission) **Class 4, Credit 4**

0630-790 Environmental Health and Safety Internal Auditing
This course reviews the development of EHS auditing, and examines the differences and uses of internal and external EHS compliance and management systems audits. It also addresses the issues and elements for designing and managing an internal EHS audit program. Exercises provide opportunities to apply audit program development skills and techniques 0630-740 or department permission. **Class 4, Credit 4**

0630-799 Independent Study
Students will have the opportunity to pursue relevant environmental, health and safety topics related to their work or professional interests at an advanced level. Students will gain added depth and/or specialized skill in a specific EHS area. (Department permission) **Credit 1–4**

0630-810 Special Topics
This course discusses new and developing EHS topics in selected areas, such as Workers Compensation, environmental economics, incident management, design for the environment, life-cycle assessment, industrial hygiene monitoring and measurement, regulatory strategy and compliance alternatives. (Department permission) **Credit 1–4**

0630-890 Thesis Planning
In this course EHS Management graduate students will rigorously develop their thesis research ideas, conduct literature reviews, prepare bibliographies, identify and plan methodologies, identify deliverables, prepare schedules, become familiar with report formats and the proper use of literary guides, and gain a clear understanding of the expectations of the faculty and the discipline. Each student will be required to prepare a complete committee approved thesis research proposal as the final requirement of this course. (0630-755 Research Methods and permission of adviser) **Credit 4**

0630-891 Graduate Project
Graduate projects are applied research reflecting the student's ability to utilize skills to design, develop and/or evaluate an environmental, health and safety related project or management decision. A manuscript suitable for publication in an appropriate journal and an oral presentation are required. (Permission of adviser) **Credit 1–4**

0630-899 Graduate Thesis
The graduate thesis is a formal research document that empirically relates theory with practice. A formal written thesis and oral defense are required. (0630-890 and permission of adviser) **Credit 1–8**

0630-999 Graduate Co-Op
Students will have the opportunity to gain appropriate work experience and applied knowledge of the profession working in one or more EHS areas. The graduate committee determines whether enrollment for one or more co-op quarters will be required. **Credit 0**

Facility Management

0632-700 Principles and Practice in Facility Management
Presents the overall practical methodology of facility management including organizational, managerial, ethical, and legal principles for the delivery of facility services. Topics discussed include: relationship, between the facility unit and the overall corporate structure; history of FM; regulatory and legal issues; corporate culture; contracts; purchasing and procurement; and management of projects and personnel. (Matriculation into the facility management MS degree program or department permission) **Credit 4**

0632-720 Environmental Health and Safety Magement Facility Management
According to the International Facility Management Association the primary goal of facility managers is the management of safe, humane and functional work environments in the context of sound ecological practices. This course will provide students with a solid foundation in environmental, health and safety management which will enhance their ability to develop and implement practices that promote and protect health, safety, security, the quality of work life, the environment and organizational effectiveness pertaining to facilities. Topics examined include: EHS moral, legal and economic issues, EHS related laws and regulations (OSHA, EPA, ADA), principles of accident causation and prevention, EHS management systems, fire protection and life safety codes, emergency preparedness, ergonomics, indoor air quality, mold, solid and hazardous waste, recycling, sustainable design, other environmental related issues, environmental This course is open to all facilities management graduate students or by permission of department. (Matriculation into the facility management MS degree program or department permission) **Class 4, Credit 4**

0632-760 Space Planning in Facility Management
This course provides the technical and strategic tools for space planning in a facility. Topics such as knowledge of long range planning, organization of sites/structures/interiors, building types, cost estimating techniques, contracts and specifications, construction management and documentation, and relocation management will be covered. (Matriculation into the facility management MS degree program or department permission) **Class 4, Credit 4**

0632-800 Operation and Maintenance I
This is a first course in operations and maintenance of facilities and provides a basic understanding of the physical plant. Students will learn about common systems within facilities including HVAC, communications, building's structural components, and exterior elements. (Matriculation into the facility management MS degree program or department permission) **Class 4, Credit 4**

0632-810 Operation and Maintenance II
This is the second course in the O&M sequence and involves the activities and functions that support the facility. (Matriculation into the facility management MS degree program or department permission) **Class 4, Credit 4**

0632-830 Real Estate of Facilities
Managing Property assets as an investment and profit center is an important aspect of facility management. Emphasis will be placed on: real estate master planning; properly acquisition and disposal; leasing practices and management; real estate marketing and analysis; feasibility analysis; taxation; real estate finance; urban planning and development; site evaluation and selection; occupancy and use constraints; regulations and incentives. (Matriculation into the facility management MS degree program or department permission) **Credit 4**

0632-850 Digital Communications Analysis Tools in Facility Management
Information Technology systems are critical to supporting an organization's business. This course will clover the basic logistical requirements for operating and supporting local area networks as well as internet connections, digital security, common application software, and CAD systems. In addition, instruction will be provided on FM software for energy management, project management, asset management, and space planning. (Matriculation into the facility management MS degree program or department permission) **Class 4, Credit 4**

FCMG-797 Graduate Project
This course provides an opportunity for students to demonstrate their capabilities developed through their course of study to design, develop and/or evaluate a facility management related project culminating in a written report or manuscript and presentation. In addition, students will also submit any work products that they create as part of their project. (ESHS-710 Research Methods, ESHS-715 Graduate Writing Strategies and department permission) **Class 3, Credit 3 (F, S)**

Environmental Health and Safety Management

0633-712 Fire Protection
Introduces fundamentals concepts in protection of industrial workers and property from fire and explosion. Fire chemistry, control of ignition sources in industry, and properties of combustible materials are discussed. A major facility review project is completed. Fire detection and extinguishments are covered along with building construction for fire prevention, life safety, fire codes and related topics. (Open to EHS management, engineering technology, or industrial engineering graduate students or department permission) **Class 4, Credit 4**

0633-726 Occupational Health II
Covers exposure measurement, control processes, sampling strategies, environmental. health., and inspection/audit protocol skill building for different process types. Culminates in a one-week block of emerging issues in occupational/ public health. The laboratory portion features actual field sampling using a wide range of industrial hygiene instruments and statistical sampling analysis. Laboratory reporting requires professional written and oral communication of results. (0630-711 or department permission) **Lec. 3, Lab 2, Credit 4**

0633-730 Mechanical and Electrical Controls and Stand
Discussion of machinery safety with emphasis on hazard analysis, risk estimation, safeguarding techniques and electrical considerations. Particular attention will be paid to applicable OSHA regulations, ANSI, NFPA and EN standards as they relate to wood, metal, films and automation. A portion of the course will change regularly to reflect emerging issues in industry. (Open to EHS management or engineering technology, industrial engineering graduate students or department permission.) **Class 4, Credit 4**

Semester Courses

Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Packaging Science

PACK-701 Research Methods
Discussion of the procedures, methods and requirements for carrying out the research project. Students pursue advanced study and research in the following areas: distribution packaging, package systems development, product and/or package damage in the transport environment, materials, quality preservation, sustainability, mechanical properties of packaging materials and systems. A research paper is required. **Class 3, Credit 3 (F)**

PACK-702 Graduate Writing Strategies
Taught in conjunction with Research Methods students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Credit 3**, **Class 3 (F, S)**

PACK-730 Packaging and the Environment
Consideration of packaging in a social context. Factors that enhance secondary use, recycling, recovery of resources and proper disposal are discussed. Package design in relation to solid waste disposal and materials and energy shortages are considered. Other topics of interest are discussed. Primarily a discussion class for graduate students. Open to graduate non-majors. **Class 3, Credit 3 (S)**

PACK-742 Distribution Systems
The course develops knowledge and application skills of the distribution packaging. Topics covered are packaging used in distribution systems, integrated packaging supply chain, modeling and analysis of the distribution systems and score card in packaging supply chain. Emphasis are given to estimate and predict the packaging protection and to optimize the packaging distribution using various tools. The lab focuses on development and evaluation of a distribution packaging. The projects are designed to assess the packaging performance in distribution systems. **Class 2, Lab 2, Credit 3 (S)**

PACK-763 Packaging for End Use
An intensive study of package design requirements specific to use of a product at specified end points. Individual design and development of a package system and its specifications, appropriate to the needs of the product and the consumer/end user and meets the demands of the supply chain. (PACK-461 Packaging Development or equivalent or permission of instructor) **Class 2, Lab 4, Credit 3 (S)**

PACK-783 Packaging Dynamics
The study of instrumentation systems for analysis, evaluation and application of shock and vibration test methods to develop protective package designs and effective product/package interaction. A research paper is required. **Class 3, Lab 2, Credit 3 (S)**

PACK-790 Research Thesis
A thesis is based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the extension of theory into practice. A written proposal which is defended and authorized by the faculty adviser/committee followed by a formal written thesis and oral presentation of findings are required. Typically the candidate will have completed Research methods, Data analysis and Graduate writing strategies prior to enrolling in this course and will start the thesis process as soon as they have completed these courses to allow them to finish the thesis when they have finished their coursework. The candidate must obtain the approval of their Graduate adviser who will guide the thesis before registering for this course. **Credit 1–6 (F, S, Su)**

PACK-795 Comprehensive Examination
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. Students will demonstrate a fundamental knowledge of the theories and foundation principles. This course will include a review of the main concepts of each of the core subjects and at the conclusion of the course the student will take a written examination and must receive a passing grade of at least 80% to be successful. Students will have one additional opportunity to pass this examination if their initial attempt results in a failing grade. (Faculty adviser approval required) **Credit 0 (F, Su)**

PACK-797 Graduate Project
The purpose of this course is to provide students the opportunity to conduct research, develop a plan and evaluation components and submit the project as a demonstration of final proficiency in the program. The topic selected by the student will be guided by the faculty teaching the class and it will require the student to coalesce and incorporate into the final project a culmination of all their course work in the program to date. **Class 3, Credit 3 (S)**

Manufacturing and Mechanical Engineering Technology

MCET-620 Robust Design and Production Systems
In this advanced course, students explore methods, such as Taguchi arrays, that support the optimization and verification phases of the Design for Six Sigma development process. Topics covered include the experimental design process, additivity, static and dynamic signal-to-noise ratios, analysis of means, and ANOVA. The role of robust design methods in reducing variability for both products and processes and in integrating systems is emphasized. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

MCET-670 Concept Design and Critical Parameter Management
This course focuses on critical parameter management (CPM) as defined within the Design for Six Sigma framework. CPM tools and techniques include translating the voice of the customer into technical requirements, defining functions to fulfill the requirements, generating designs to physically fulfill the functions, data acquisition and analysis, and the evaluation and selection of superior product and subsystem designs that are safe to take to commercialization. Students are introduced to CPM best practices through case studies and hands-on projects. (Graduate standing or permission of instructor) **Class 3, Credit 3 (S)**

MCET-720 Product and Production System Development and Integration
This course covers topics, processes and best practices in product development. Using Design for Six Sigma (DFSS) as a motivating philosophy, students are introduced to concepts and techniques in the early stages of the product development process, including capturing the voice of the customer, critical parameter management, the phase-gate approach, and system integration for total product life cycle performance. The course provides an overview of DFSS goals, its development process, CDOV (Concept-Design-Optimize-Verify), and technology process (IDOV, Innovate-Develop-Optimize-Verify), as well as strategies in product commercialization. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

MFET-650 Manufacturing and Mechanical Systems Fundamentals
This course is intended to help students learn to think like Systems Engineers. This course will provide a thorough understanding of the systems fundamentals, its design, modeling and integration. Topics include a thorough coverage of systems architecture, conceptualization, modeling, development and management. Students in this course will be taught industry practices for systems engineering and management from concept stage to post implementation stage. System engineering and modeling tools will also be introduced to assist with the conceptualization, development and implementation of systems. **Class 3, Credit 3 (F)**

MFET-655 Electronics Packaging Fundamentals
This course provides a thorough understanding of the technology, components, equipment, design and manufacturing process for surface mount electronics manufacturing. Students will develop a strong foundation needed for advanced work in surface mount technology (SMT). The laboratory activities will provide the students an orientation and familiarization of the manufacturing equipment and process parameters for printed circuit board assembly. **Class 3, Lab 1, Credit 3 (F)**

MFET-670 Manufacturing Automation Controls
This course will provide a thorough understanding of the manufacturing automation principles, practices and system integration. Topics include a thorough coverage of the automation hardware and software, essentials of digital and analog control using Programmable Logic Controllers (PLCs), industry best practices for programming PLCs and the essentials of Human Machine Interface (HMI) for data entry, manipulation and recording system status. **Class 3, Lab 1, Credit 3 (F, S)**

MFET-685 Robots and CNC in Integrated Manufacturing
Technology and application of robots and CNC in an integrated manufacturing environment is the focus of this course. An introductory understanding of robotic hardware and software will be provided. The hardware portion of this course involves robot configurations, drive mechanisms, power systems (hydraulic, pneumatic and servo actuators), end-effectors, sensors and control systems. The software portion of this course involves the various methods of textual and lead through programming. Digital interfacing of robots with components such as programmable logic controllers, computer-controlled machines, conveyors, and numerical control will be introduced. Robotic cell design and the socio-economic impact of robotics will also be discussed. This course also has a strong laboratory component that emphasizes hands-on training. (MCET-220 Principles of Statics or equivalent) **Class 3, Lab 1, Credit 3 (F)**

MFET-756 Advanced Concepts in Electronics Packaging
This advanced course in electronics packaging will provide a thorough coverage of the materials, processes, failure and reliability of chip level and PCB level packaging. Specific topics include single-chip, multi-chip, wafer level and 3D stacked packaging, smaller passives and embedded passive component technology, advanced substrates and microvia technology, solder technologies, metallurgy and joint formation, thermal management, thermal and mechanical behavior of packaging, failure analysis and reliability testing. (MFET-655 Robots and CNC in Integrated Manufacturing or equivalent experience, graduate standing or BS/MS student fourth year standing) **Class 3, Credit 3 (S)**

MFET-788 MMSI Thesis Planning
Students will rigorously develop their thesis research ideas, conduct literature reviews, identify and plan methodologies, prepare schedules, and gain a clear understanding of the expectations of the faculty and the discipline. Each student will be required to prepare a committee approved thesis research proposal and may begin work on their thesis. (Graduate core and concentration requirements) **Class 3, Credit 3 (F, S)**

MFET-790 MMSI Thesis
The MMSI Thesis is based on thorough literature review and experimental substantiation of a problem, by the candidate, in an appropriate topic. A written proposal has to be defended and authorized by the faculty adviser/committee. The proposal defense is followed by experimental work, a formal written thesis and oral presentation of findings. The candidate should have completed the requisite courses for the program before enrolling for the thesis. (MFET-788 MMSI Thesis Planning) **Credit 3 (F, S, Su)**

MFET-795 MMSI Comprehensive Exam
A written comprehensive exam is one of the non-thesis or non-project methodology for completion of the MS-MMSI degree. Students will demonstrate a fundamental knowledge of the theories and foundation principles. This course will require the student to do an independent review of the concepts within the core courses and the chosen concentration area, and will culminate in a comprehensive written examination. The student must receive a passing grade of at least 80% to be successful. Students will have one additional opportunity to pass the exam, if their initial attempt results in a failing grade. (Department permission) **Class 3, Credit 0 (F, S, Su)**

MFET-797 MMSI Capstone Project
This course provides the MMSI graduate students an opportunity to complete their degree requirements by addressing a practical real-world challenge using the knowledge and skills acquired throughout their studies. This course is not only the culmination of a student's course work but also an indicator of the student's ability to use diverse knowledge to provide a tangible solution to a problem. The Capstone Project topic can be in the areas of product development, manufacturing automation, management system, quality management or electronics packaging. The course requires a comprehensive project report and a final presentation. (Completion of core and concentration courses) **Credit 3 (F, S, Su)**

Telecommunications Engineering Technology

TCET-661 Telecommunication Systems
The fundamental principles that govern the communication of information are introduced. At the end of this course, students will understand signal spectral analysis and the principles of digital and analog modulation formats. Topics in the course are spectral analysis techniques, modulation schemes, and noise and bit error rates. (MATH-211 Multivariable Calculus and DEQ) **Class 3, Credit 3 (F)**

TCET-670 Applied Research Methods
This course introduces first-year graduate students to the process of performing and documenting scholarly research. The course places particular emphasis on analyzing, interpreting and presenting data in order to make a convincing case for the conclusions of a line of research. It includes a review of basic probability and statistics and covers several standard statistical methods. It also includes graphical data display. Students will use MATLAB to implement the various statistical procedures. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (F)**

TCET-680 Graduate Writing Strategies
Taught in conjunction with Research Methods students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Class 3, Credit 3 (S)**

TCET-710 Principles of Telecommunications Networks
The course provides the student with a solid understanding of local access and backbone network, architecture, equipment and technology related to the Public Switched Telephone (PSTN), Cable (MSO), Access and Converged/IP networks. Passive Optical Networking and Hybrid Fiber Coax technology is also covered. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (F)**

TCET-720 Telecommunications Concepts
The course provides the student with a solid understanding of Digital and Time Division Multiplexing and Modulation schemes used in the transmission of information in a variety of networks, both packet and circuit switched. Traffic engineering and Quality of Service concepts are covered as well as a number of network protocols and signaling platforms such as MPLS and SIP. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (S)**

TCET-723 Telecommunications Network Engineering
This course covers accepted network design principles and methodologies as they apply to circuit, packet, frame, cell and synchronization networks. Course topics are transmission engineering, traffic engineering models, timing and synchronization, design of voice and data networks, and electrical grounding concepts. (TCET-710 (Principles of Telecommunications Networks) and TCET-720 (Telecommunications Concepts) **Class 3, Credit 3 (F)**

TCET-730 Telecommunications Policy and Issues
The objective of this course is to enlighten students relative to telecommunications policy and standards sufficiently, in order for them to be able to deal with the real-world issues that confront telecommunications professionals on a daily basis. Students will not be prepared to act as regulatory experts or to replace specialized experts with legal training, but should be sufficiently cognizant of pertinent issues to know when it is prudent to call in such forces. The domestic as well as the international regulatory, policy and standard arenas will be explored. This course helps students to understand that the telecommunications environment is greatly effected by technology, policy, security and market forces with a primary focus on telecommunications policy and all that it entails. (Matriculation in telecommunications engineering technology MS pr ogram or permission of instructor) **Class 3, Credit 3 (F)**

TCET-740 Fiber Optic Telecommunications Technology
This course presents the basic technologies of fiber-optic telecommunications systems including optical fiber, light sources and modulators, photodiodes and receivers, optical amplifiers, and passive components such as dispersion compensators, optical multiplexers and demultiplexers, and couplers. Fundamental concepts as well as state-of-the-art advances in these technologies will be covered. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (F)**

TCET- 745 Fiber Optic Telecommunications Networks
This course focuses on characterizing and designing the capacity and reach of fiber-optic transmission systems in terms of key performance metrics (BER, Q-factor, eye diagrams, and system margin, transmission penalty, optical-power budgets, and OSNR budgets), the impact of key physical impairments (loss, dispersion, nonlinearity), and techniques used to overcome these impairments (optical amplification, dispersion compensation, power mitigation). Widespread fiber-optic transmission modalities (such as wavelength-division multiplexing and amplitude modulation) as well as emerging modalities (such as polarization-division multiplexing and phase modulation) will be covered. (TCET-740 Fiber Optics Telecommunications Technologies) **Class 3, Credit 3 (S)**

TCET-747 Next Generation Networks
This hybrid course is a cross between an independent study and a seminar course. It provides MSTET students the opportunity to research and report on near term "Next Generation Networks" (NGN). The course consists of professor provided discussion on NGN followed by each student researching NGN types. Basically, a case study approach is utilized. Immediately after completing the research and written paper regarding one's selected topic/case, each student will read each others and then present theirs to all other students in the class. As a result, every student will not only benefit from their own research of topics/cases but also be informed of other NGN by other students. Students should already have some understanding of how to perform research and must possess at least adequate writing skills. (Telecommunications undergraduate engineering or engineering technology degree or completion of at least 3 MSTET core courses.) **Class 3, Credit 3 (F)**

TCET-750 Wireless Infrastructure and Policy
The fundamental principles of and U.S. regulatory requirements for wireless mobile and fixed radio frequency communication systems are studied in this course. At the end of this course, students will understand the radio frequency mobile wireless environment, the common wireless systems, and the regulatory aspects related to deployment of the wireless infrastructure. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (S)**

TCET-760 Network Planning and Design
This course teaches the art and science of metropolitan and wide area network design for both modern delay (data) networks and traditional blocking (voice) networks; the greatest emphasis is on modern delay networks. Both qualitative and quantitative approaches are used as the student progresses through the network analysis, architecture and network design processes. An advanced WAN fiber optic design tool, such as OPNET Transport Planner is utilized in a required graduate project. The following are typical types of projects: Write an RFP, design an extensive metropolitan and wide area network using the latest technologies, design an extensive fiber optic network using a design tool like OPNET Transport Planner. Note: Since some students may not yet have taken a fiber course, the OPNET project stresses the use of the tool rather than the specifics of fiber optics. (Matriculation in telecommunications engineering technology MS program or permission of instructor) **Class 3, Credit 3 (S)**

TCET-790 Graduate Thesis
The MSTET graduate thesis is a document that describes and presents the results of scholarly research in the field of telecommunications. The results of a MSTET graduate thesis provide new knowledge, processes, software or other assets that advance the state of the art of telecommunications, even in a modest way. (TCET-670 Applied Research Methods) **Credit 1–6 (All semesters)**

TCET-797 Graduate Project
The MSTET graduate project describes and presents the results of scholarly research in the field of telecommunications. The results of a MSTET graduate project provide new knowledge, processes, software or other assets that advance the state of the art of telecommunications or organize or implement existing knowledge in a unique and useful way. (TCET-670 Applied Research Methods) **Credit 3 (All semesters)**

Hospitality-Tourism Management

HSPT-700 Research Methods
This is an introductory graduate-level survey course on research design/ methods and analysis. The course provides a broad overview of the process and practices of social research in service-related contexts. Content includes principles and techniques of research design, sampling, data collection, and analysis including the nature of evidence, types of research, defining research questions, sampling techniques, data collection, data analysis, issues concerning human subjects and research ethics, and challenges associated with conducting research in real-world contexts. The analysis component of the course provides an understanding of statistical methodology used to collect and interpret data found in research as well as how to read and interpret data collection instruments. **Class 3, Credit 3 (F, S)**

HSPT-702 Graduate Writing Strategies
Taught in conjunction with Research Methods students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Class 3, Credit 3 (F, S)**

HSPT-730 Strategic Hospitality and Tourism Branding
This class will concentrate on how the differences between product and service branding and marketing apply to travel destinations and tourist services such as lodging and recreational activities. Specific emphasis will be placed on the branding and marketing of tourism suppliers. Special attention will also be paid to promoting destinations as they move through their life cycle. The role of experiences in the marketing system will be covered from both the destination and supplier perspective. **Class 3, Credit 3 (F)**

HSPT-740 Economic Performance Analysis for Hospitality and Tourism
Applications of economic analysis to hospitality and tourism including estimation and prediction of demand and supply, valuation, determination of regional economic impacts, and use of economic analysis in management, marketing and policy decisions. **Class 3, Credit 3 (F, S)**

HSPT-750 Strategic Processes and Assessment of Hospitality and Tourism Industries
This class will apply customer relationship management methods to hospitality and tourism industries in order to develop new service experiences and maintain the economic viability of others. A review of the quality models and strategies available for maintaining hospitality and tourism competitiveness will be covered. The use of the six sigma quality improvement process will be applied to hospitality industries. **Class 3, Credit 3 (S)**

HSPT-761 Planning and Development for Hospitality and Tourism Industries
This course analyzes tourism as a system of interrelationships between markets (demand) and destinations (supply) and between governments and private businesses. This analysis provides a framework for the in-depth study of policy initiatives at the local, regional, and international levels. Additionally this course will address tourism and hospitality planning as it defines the frames of reference used in making choices concerning the development of tourism facilities and use of space. Scenario planning will be used to create new service systems for hospitality and tourism industries. **Class 3, Credit 3 (F)**

HSPT-763 Resort Amenity and Attraction Development
This course gives the student an understanding of how resort amenities and visitor attractions are developed and managed in destinations. Focus is on the planning, development, operation, design and special needs of recreational amenities such as golf, tennis, skiing, spas and marinas. Additional emphasis is placed on managing both historical, cultural and natural resource based tourist attractions. **Class 3, Credit 3 (F)**

HSPT-765 Travel Transportation and Distribution Services
This course will provide in-depth knowledge of the role travel intermediaries play in the tourism system. Focus will be given to the use of electronic global distribution systems used in the transportation sector. Travel demand and performance characteristics and costs of transportation modes will also be addressed. **Class 3, Credit 3 (F)**

HSPT-767 Convention and Event Management
This class provides the student an opportunity to explore the function of a convention from the point of view of the convention center manager. Consideration is given to various methods used to sell a location to an event planner and the servicing of large groups. Students also examine the various ways to evaluate floor and meeting space as to profitability and quality related to the goals and objectives of the client. Various forms of business are ranked and the ability of one convention to enhance a second are considered in the decision making process. Finally codes, regulations and licensing considerations are explored. **Class 3, Credit 3 (F)**

HSPT-769 Technology Applications in the Hospitality and Tourism Industries
Survey of computer and information systems for planning and control in hospitality and tourism operations. Various software and hardware packages are examined in relation to planning and control functions. The use of technology to innovate and manage new hospitality experiences is explored. **Class 3, Credit 3 (S)**

HSPT-789 Selected Topics
Selected topics is an innovative course not reflected in the accepted curriculum. Once the outline is submitted titles will appear in the course listing for the semester. The course may be taken more than once as topics change. **Class 3, Credit 3 (F, S, Su)**

HSPT-790 Research Thesis
A thesis is based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the extension of theory into practice. A written proposal which is defended and authorized by the faculty adviser/committee followed by a formal written thesis and oral presentation of findings are required. Typically the candidate will have completed Research methods, Data analysis and graduate writing strategies prior to enrolling in this course and will start the thesis process as soon as they have completed these courses to allow them to finish the thesis when they have finished their coursework. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 1–6 (All Semesters)**

HSPT-794 Integrative Problem Solving
Students will demonstrate synthesis and integration of the theories and foundation principles of their discipline. This will be achieved through application of core knowledge in a series of progressive problem situations culminating in a comprehensive examination. To be successful students must receive a passing grade of at least 80% in the course to be allowed to take the comprehensive exam. (Department approval) **Class 3, Credit 3 (F, Su)**

HSPT-795 Comprehensive Examination
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. Students will demonstrate a fundamental knowledge of the theories and foundation principles. This course will include a review of the main concepts of each of the core subjects and at the conclusion of the course the student will take a written examination and must receive a passing grade of at least 80%to be successful. Students will have one additional opportunity to pass this examination if their initial attempt results in a failing grade. (This course will be taken with not less than 16 hours of coursework remaining to complete the program, completion of core courses and the student should be currently enrolled in the program. Possess a GPA of 3.0 or higher; No outstanding incomplete grades, nor can the student be on academic/disciplinary probation; faculty adviser approval) **Credit 0 (F, Su)**

HSPT-797 Capstone Project in Hospitality and Tourism Management
This course is practical, project-based approach to a more traditional master's thesis. Students in the course will design and develop a project which reflects a viable option for an existing or putative organization. After a review of essential project management and planning skills as well as financial skills, the student designs and develops the project with continual review and feedback from the supervising faculty. (Taken after or concurrent with all core courses) **Credit 3 (S, Su)**

Human Resource Development

HRDE-700 Research Design and Methods
This is an introductory graduate-level survey course on research design/ methods and analysis. The course provides a broad overview of the process and practices of social research in service-related contexts. Content includes principles and techniques of research design, sampling, data collection, and analysis including the nature of evidence, types of research, defining research questions, sampling techniques, data collection, data analysis, issues concerning human subjects and research ethics, and challenges associated with conducting research in real-world contexts. The analysis component of the course provides an understanding of statistical methodology used to collect and interpret data found in research as well as how to read and interpret data collection instruments. **Class 3, Credit 3 (F, S, Su)**

HRDE-702 Graduate Writing Strategies
Students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Class 3, Credit 3 (F, S)**

HRDE-710 Foundations in Human Resource Development
This course introduces students to the concepts that are the foundation of HRD and how these concepts are applied in a real-world environment. Human resource development is a distinct and unique area of practice that focuses on aligning employee learning and development with the strategic direction of an organization. This course provides an orientation to the profession; explores historical perspectives, theoretical foundations and the practice of HRD. **Class 3, Credit 3 (F, S, Su)**

HRDE-711 Program Evaluation and Design
This course teaches the systematic application of social research procedures to evaluate the conceptualization, design, implementation, and utility of human resource development programs. **Class 3, Credit 3 (S)**

HRDE-712 Performance Analysis and Development
This course provides individuals with a framework needed to successfully analyze performance and design learning interventions that drive performance improvements in an organization. Students will examine performance measurement, adult learning principles and learning styles as well as best practices in organizational learning, employee development, and alternative delivery strategies. Additionally, students will identify how to link learning initiatives with strategy and gain commitment to those initiatives from senior leaders. **Class 3, Credit 3 (F, Su)**

HRDE-715 Human Performance Design and Development
A systematic approach to improve organizational productivity and competence of the internal workforce. It is a process of selection, analysis, design, development, implementation and evaluation of programs to allow the most cost effective influence on human behavior and accomplishment to solve organizational problems. **Class 3, Credit 3 (F, Su)**

HRDE-720 Theory of Organizational Development
As organizations undergo continual change, HR leaders play a pivotal role enabling their organizations to anticipate, plan and profit from change. This course introduces the student to theories and practices of organization development and change leadership. Such leadership requires competencies of identifying and framing challenges, consulting with clients, researching solutions, creating, implementing, and evaluating action plans. Through study, practice and application, students will gain knowledge and skills to foster change, innovation, and the adaptability of an organization. (HRDE-710 Foundations in HRD or department approval) **Class 3, Credit 3 (F, S)**

HRDE-721 Organizational Learning and Knowledge Management
This is an introductory graduate-level survey course for organizational learning and knowledge management. The course will provide a broad overview of the concepts, practices, and challenges associated with learning in organizational contexts. Principles, techniques, and structures used to create, capture, store, value, distribute, and leverage knowledge to enhance organizational performance in continuously changing environments will be examined. Topics covered include types and nature of knowledge, levels of organizational learning, communities of practice, social and technological systems for capturing, storing, and distributing knowledge, valuation of knowledge assets, innovation and creativity, barriers to organizational learning, and knowledge as a source of competitive advantage. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-720 Theory of Organizational Development or department approval) **Class 3, Credit 3 (F, S)**

HRDE-722 Talent Development
This course provides skills to develop, retain, and engage the best available talent required for current and future success. Students examine benchmark practices from all industry types to derive effective strategies for their own organizations, develop a human capital strategy development and complete an integrated set of projects to implement selected components of the strategy. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development or department approval) **Class 3, Credit 3 (F, S, Su)**

HRDE-723 Group Dynamics and Leadership
The group dynamics course explores the current theories and models of how individuals work within groups. Students will learn how to effectively manage, lead and generate results from group processes. More specifically, this course will explore how groups function and the importance of effectively leading a group towards a specific outcome. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-720 Theory of Organizational Development or department approval)

HRDE-730 Theories of Adult Learning
This course examines the physiological, psychological, and socio/cultural factors related to adult learning and development. Selected theories of learning and development are critically analyzed and applied to adult contexts. Students are expected to critically examine their own assumptions and beliefs about learning and development. Attention is given to stages of adult growth, the development of learning goals, learning environments, and to a variety of theories of learning. (HRDE-710 Foundations in HRD or department approval) **Class 3, Credit 3 (F, S, Su)**

HRDE-731 Team Process and Facilitation Skills
The ability to build a functioning team and then facilitate the group process ranks among the most critical competencies for HRD practitioners today. HRD practitioners are required to develop work teams and facilitate a variety of events from meetings and new employee orientations to training sessions. This course provides the HRD practitioner with the skills required to effectively develop teams, and plan for and facilitate a variety of events. Individuals in other disciplines will benefit from this course as well. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-732 Learning Transfer
Learning transfer is the ability of an organization to promote the individuals transfer of learning back to their job. This course examines the research conducted in this area and how it is applied in practice. As an HRD practitioner it is imperative that the impact of training, the transfer of knowledge, is built in to the design of every program. By focusing on learning transfer, the goal of any program is to ensure that employees in the workplace are applying the newly acquired knowledge in the fulfillment of their job. This course examines the theoretical foundations of knowledge transfer, how to measure and evaluate this transfer and strategies for increasing the probability this transfer will occur. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-733 Instructional Design and Technology in Human Resource Development
The process of instructional design is both an art and science. The framework of this course is to teach the students how to design instruction regardless of content area to allow learners to successfully achieve stated outcomes. The components of the course include the needs assessment, analysis of learner's abilities, the design of measurable performance objectives, development of assessment strategies followed by the design of instructional materials and the formative and summative evaluation process. A brief overview of technology used to support the instructional strategy will be provided as will opportunities to assess technology designed to support the learner through self-instruction of content areas. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-740 Strategic Human Resource Development for Global Organizations
Global Human Resource Development is a method for developing employees in global organizations. In this course, students will be exposed to the fundamentals of developing HRD programs within a multicultural framework. The need to be aware of cultural differences and how to best address them is critical for the global company. This course will explore globalization and HRD, design and development of global HRD programs, delivery and assessment of global HRD programs, and consulting across cultures. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development or department approval) **Class 3, Credit 3 (F, S)**

HRDE-741 Global Human Resource Development Leadership
This course provides students with a theoretical foundation of global leadership. The frameworks presented in this course will help to guide students through a critical perspective of how they view leadership and how HRD can take part in developing leaders. Additionally, the global context of leadership will provide knowledge of the foundational concepts of leadership and how it impacts multinational organizations. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (S)**

HRDE-742 Change Leadership Development
The goal of this course is to encourage students to carefully analyze their responsibilities and commitments in the context of leadership for change affecting the good of the organization. The course goes beyond the study of leadership; it will focus the student on developing the specific leadership skills for HRD they will need to effectively lead organizations through change to achieve their visions and goals. Most importantly, it will guide students through a self-awareness process that will highlight their change leadership characteristics and help to establish a plan of action to increase these competencies. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (F, Su)**

HRDE-743 Training for Global Organizations
This course is designed to develop a student's understanding of cross-cultural communication and adaptation and how to design and deliver formal training. The course provides an introduction to different theoretical perspectives on cross-cultural communication and adaptation and the application of these perspectives to the design of training. Issues examined include culture theory, cross-cultural competence, and techniques and design of cross-cultural training. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-750 Theories of Career Development
Theories of Career Development (TCD) introduces students to traditional and emerging career development theory and its application to workplace issues. Theories such as trait and factor, type, developmental, psychodynamic, work adjustment, life-span, social learning, and career decision-making are covered using a system theory approach. Additional topics include organizational career development, application of theory to modern problems and issues, and contemporary issues in career development. The course is participative and draws heavily on case studies, role-playing, self-assessment, and group work to understand the theory and workplace application issues. **Class 3, Credit 3 (S)**

HRDE-751 Career Counseling Techniques
This course introduces students to selected theories and techniques for use in counseling clients and/or employees about career issues. Students analyze and practice various counseling scenarios and apply theory. They learn to give and accept feedback related to career counseling skills through the use of role plays. Issues related to careers and the HR professional's roles are explored. The future of career counseling in the workplace is examined as it relates to HR planning. **Class 3, Credit 3 (Su)**

HRDE-752 Assessments and Measurements in Human Resource Development
This course provides and introduction to the fundamentals of assessment and measurement tools used in human resource and organizational development activities. An overview of a variety of instruments will be studied and some will be administered. Reading, lecture and class activities will include theory of test development, criteria for administration, validity, reliability, and assessing best instruments for use. **Class 3, Credit 3 (F)**

HRDE-755 Program Assessment and Evaluation
A learning environment assessment of accomplishment of learning outcomes and the summative effect these have on forming professional and workforce competencies requires attention to assessment strategies and overall summative evaluation of the learning program outcomes and abilities to meet the needs of the learners and the organization. This course will consider how to measure performance for the variety of intellectual learner domains as well as the overall program effectiveness and interpretation of data collection efforts to test the efficacy of the learning outcomes. (HRDE-715 Human Performance Design and Development) **Class 3, Credit 3 (F)**

HRDE-756 Training Design
Given the organizational needs assessment results and the learners abilities training is often the solution used to enhance personal performance within an organization. A variety of strategies including non-traditional learning programs and tools, development of engaging learning programs linked to corporate strategies for promotion and succession and/or use of traditional instruction strategies to engage the learner in the task and enhance personal productivity will be explored, developed for situational. (HRDE-715 Human Performance Design and Development) **Class 3, Credit 3 (S)**

HRDE-758 Design for On-Line Learning
On-Line learning has grown to be a significant learning/teaching strategy for higher education. This course will include strategies for interactive learning activities to engage adult learner and achieve learning outcomes using a variety of instructional techniques appropriate for the on-line learning environment. This course will provide an opportunity to complete an actual work-related learning activity as an alternative to a case-based learning activity. **Class 3, Credit 3 (S)**

HRDE-780 Internship
This course provides the student with the opportunity to apply their graduate coursework to the world of work. Students will be placed or seek out internship opportunities in a work scenario similar to their ultimate career choice in the field. A mentor for the student must be identified in the place of the internship. The role of the mentor will be to work with students to develop a plan for the internship, facilitate the internship experience, and verify the student's accomplishment of specified outcomes as a result of the internship. Once the mentor approves of the plan of work and student accomplishments at the conclusion of the internship they will send this final report to the student's program adviser. **Class 3, Credit 3 (F, S, Su)**

HRDE-789 Special Topics
Special topics is an innovative course not reflected in the accepted curriculum. Once the outline is submitted titles will appear in the course listing for the semester. The course may be taken more than once as topics change. **Class 3, Credit 3 (F, S, Su)**

HRDE-795 Comprehensive Exam
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. Students will demonstrate a fundamental knowledge of the theories and foundation principles. This course will include a review of the main concepts of each of the core subjects and at the conclusion of the course the student will take a written examination and must receive a passing grade of at least 80%to be successful. Students will have one additional opportunity to pass this examination if their initial attempt results in a failing grade. **Credit 0 (F, Su)**

HRDE-797 Graduate Capstone Project
The purpose of this course is to provide students the opportunity to conduct research, develop a plan and evaluation components and submit the project as a demonstration of final proficiency in the program. The topic selected by the student will be guided by the faculty teaching the class and it will require the student to coalesce and incorporate into the final project a culmination of all their course work in the program to date. **Class 3, Credit 3 (F, S, Su)**

HRDE-798 Research Thesis
A thesis is based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the extension of theory into practice. A written proposal which is defended and authorized by the faculty adviser/committee followed by a formal written thesis and oral presentation of findings are required. Typically the candidate will have completed Research methods, Data analysis and Graduate writing strategies prior to enrolling in this course and will start the thesis process as soon as they have completed these courses to allow them to finish the thesis when they have finished their coursework. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 1–6 (All semesters)**

HRDE-799 Independent Study
This course provides for independent study or research activity in subject matter areas not included in any existing course in the degree program, but having specialized value to students. Proposals approved by a supervising faculty member and the program chairperson are required prior to registration. This course may be taken more than once but for not more than 3 credits. **Class 3, Credit 1–3 (F, S, Su)**

Human Resource Development

HRDE-700 Research Design and Methods
This is an introductory graduate-level survey course on research design/ methods and analysis. The course provides a broad overview of the process and practices of social research in service-related contexts. Content includes principles and techniques of research design, sampling, data collection, and analysis including the nature of evidence, types of research, defining research questions, sampling techniques, data collection, data analysis, issues concerning human subjects and research ethics, and challenges associated with conducting research in real-world contexts. The analysis component of the course provides an understanding of statistical methodology used to collect and interpret data found in research as well as how to read and interpret data collection instruments. **Class 3, Credit 3 (F, S, Su)**

HRDE-702 Graduate Writing Strategies
Students will become articulate in a variety of business and research communication methodologies. These methods will include writing a research proposal, a white paper, and a grant proposal. A search of the literature for a defined research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and write a research article which could be submitted for publication to the identified journal. **Class 3, Credit 3 (F, S)**

HRDE-710 Foundations in Human Resource Development
This course introduces students to the concepts that are the foundation of HRD and how these concepts are applied in a real-world environment. Human resource development is a distinct and unique area of practice that focuses on aligning employee learning and development with the strategic direction of an organization. This course provides an orientation to the profession; explores historical perspectives, theoretical foundations and the practice of HRD. **Class 3, Credit 3 (F, S, Su)**

HRDE-711 Program Evaluation and Design
This course teaches the systematic application of social research procedures to evaluate the conceptualization, design, implementation, and utility of human resource development programs. **Class 3, Credit 3 (S)**

HRDE-712 Performance Analysis and Development
This course provides individuals with a framework needed to successfully analyze performance and design learning interventions that drive performance improvements in an organization. Students will examine performance measurement, adult learning principles and learning styles as well as best practices in organizational learning, employee development, and alternative delivery strategies. Additionally, students will identify how to link learning initiatives with strategy and gain commitment to those initiatives from senior leaders. **Class 3, Credit 3 (F, Su)**

HRDE-715 Human Performance Design and Development
A systematic approach to improve organizational productivity and competence of the internal workforce. It is a process of selection, analysis, design, development, implementation and evaluation of programs to allow the most cost effective influence on human behavior and accomplishment to solve organizational problems. **Class 3, Credit 3 (F, Su)**

HRDE-720 Theory of Organizational Development
As organizations undergo continual change, HR leaders play a pivotal role enabling their organizations to anticipate, plan and profit from change. This course introduces the student to theories and practices of organization development and change leadership. Such leadership requires competencies of identifying and framing challenges, consulting with clients, researching solutions, creating, implementing, and evaluating action plans. Through study, practice and application, students will gain knowledge and skills to foster change, innovation, and the adaptability of an organization. (HRDE-710 Foundations in HRD or department approval) **Class 3, Credit 3 (F, S)**

HRDE-721 Organizational Learning and Knowledge Management
This is an introductory graduate-level survey course for organizational learning and knowledge management. The course will provide a broad overview of the concepts, practices, and challenges associated with learning in organizational contexts. Principles, techniques, and structures used to create, capture, store, value, distribute, and leverage knowledge to enhance organizational performance in continuously changing environments will be examined. Topics covered include types and nature of knowledge, levels of organizational learning, communities of practice, social and technological systems for capturing, storing, and distributing knowledge, valuation of knowledge assets, innovation and creativity, barriers to organizational learning, and knowledge as a source of competitive advantage. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-720 Theory of Organizational Development or department approval) **Class 3, Credit 3 (F, S)**

HRDE-722 Talent Development
This course provides skills to develop, retain, and engage the best available talent required for current and future success. Students examine benchmark practices from all industry types to derive effective strategies for their own organizations, develop a human capital strategy development and complete an integrated set of projects to implement selected components of the strategy. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development or department approval) **Class 3, Credit 3 (F, S, Su)**

HRDE-723 Group Dynamics and Leadership
The group dynamics course explores the current theories and models of how individuals work within groups. Students will learn how to effectively manage, lead and generate results from group processes. More specifically, this course will explore how groups function and the importance of effectively leading a group towards a specific outcome. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-720 Theory of Organizational Development or department approval)

HRDE-730 Theories of Adult Learning
This course examines the physiological, psychological, and socio/cultural factors related to adult learning and development. Selected theories of learning and development are critically analyzed and applied to adult contexts. Students are expected to critically examine their own assumptions and beliefs about learning and development. Attention is given to stages of adult growth, the development of learning goals, learning environments, and to a variety of theories of learning. (HRDE-710 Foundations in HRD or department approval) **Class 3, Credit 3 (F, S, Su)**

HRDE-731 Team Process and Facilitation Skills
The ability to build a functioning team and then facilitate the group process ranks among the most critical competencies for HRD practitioners today. HRD practitioners are required to develop work teams and facilitate a variety of events from meetings and new employee orientations to training sessions. This course provides the HRD practitioner with the skills required to effectively develop teams, and plan for and facilitate a variety of events. Individuals in other disciplines will benefit from this course as well. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-732 Learning Transfer
Learning transfer is the ability of an organization to promote the individuals transfer of learning back to their job. This course examines the research conducted in this area and how it is applied in practice. As an HRD practitioner it is imperative that the impact of training, the transfer of knowledge, is built in to the design of every program. By focusing on learning transfer, the goal of any program is to ensure that employees in the workplace are applying the newly acquired knowledge in the fulfillment of their job. This course examines the theoretical foundations of knowledge transfer, how to measure and evaluate this transfer and strategies for increasing the probability this transfer will occur. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-733 Instructional Design and Technology in Human Resource Development
The process of instructional design is both an art and science. The framework of this course is to teach the students how to design instruction regardless of content area to allow learners to successfully achieve stated outcomes. The components of the course include the needs assessment, analysis of learner's abilities, the design of measurable performance objectives, development of assessment strategies followed by the design of instructional materials and the formative and summative evaluation process. A brief overview of technology used to support the instructional strategy will be provided as will opportunities to assess technology designed to support the learner through self-instruction of content areas. (HRDE-710 Foundations in HRD, HRDE-711 Program Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-730 Theories of Adult Learning, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-740 Strategic Human Resource Development for Global Organizations
Global Human Resource Development is a method for developing employees in global organizations. In this course, students will be exposed to the fundamentals of developing HRD programs within a multicultural framework. The need to be aware of cultural differences and how to best address them is critical for the global company. This course will explore globalization and HRD, design and development of global HRD programs, delivery and assessment of global HRD programs, and consulting across cultures. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development or department approval) **Class 3, Credit 3 (F, S)**

HRDE-741 Global Human Resource Development Leadership
This course provides students with a theoretical foundation of global leadership. The frameworks presented in this course will help to guide students through a critical perspective of how they view leadership and how HRD can take part in developing leaders. Additionally, the global context of leadership will provide knowledge of the foundational concepts of leadership and how it impacts multinational organizations. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (S)**

HRDE-742 Change Leadership Development
The goal of this course is to encourage students to carefully analyze their responsibilities and commitments in the context of leadership for change affecting the good of the organization. The course goes beyond the study of leadership; it will focus the student on developing the specific leadership skills for HRD they will need to effectively lead organizations through change to achieve their visions and goals. Most importantly, it will guide students through a self-awareness process that will highlight their change leadership characteristics and help to establish a plan of action to increase these competencies. Course focuses on Human Resource Development applications and problem solving and not on Human Resource Management. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (F, Su)**

HRDE-743 Training for Global Organizations
This course is designed to develop a student's understanding of cross-cultural communication and adaptation and how to design and deliver formal training. The course provides an introduction to different theoretical perspectives on cross-cultural communication and adaptation and the application of these perspectives to the design of training. Issues examined include culture theory, cross-cultural competence, and techniques and design of cross-cultural training. (HRDE-710 Foundations in HRD, HRDE-711 Performance Evaluation and Design, HRDE-712 Performance Analysis and Development, HRDE-740 Strategic Human Resource Development for Global Organizations, or department approval) **Class 3, Credit 3 (F, S)**

HRDE-750 Theories of Career Development
Theories of Career Development (TCD) introduces students to traditional and emerging career development theory and its application to workplace issues. Theories such as trait and factor, type, developmental, psychodynamic, work adjustment, life-span, social learning, and career decision-making are covered using a system theory approach. Additional topics include organizational career development, application of theory to modern problems and issues, and contemporary issues in career development. The course is participative and draws heavily on case studies, role-playing, self-assessment, and group work to understand the theory and workplace application issues. **Class 3, Credit 3 (S)**

HRDE-751 Career Counseling Techniques
This course introduces students to selected theories and techniques for use in counseling clients and/or employees about career issues. Students analyze and practice various counseling scenarios and apply theory. They learn to give and accept feedback related to career counseling skills through the use of role plays. Issues related to careers and the HR professional's roles are explored. The future of career counseling in the workplace is examined as it relates to HR planning. **Class 3, Credit 3 (Su)**

HRDE-752 Assessments and Measurements in Human Resource Development
This course provides and introduction to the fundamentals of assessment and measurement tools used in human resource and organizational development activities. An overview of a variety of instruments will be studied and some will be administered. Reading, lecture and class activities will include theory of test development, criteria for administration, validity, reliability, and assessing best instruments for use. **Class 3, Credit 3 (F)**

HRDE-755 Program Assessment and Evaluation
A learning environment assessment of accomplishment of learning outcomes and the summative effect these have on forming professional and workforce competencies requires attention to assessment strategies and overall summative evaluation of the learning program outcomes and abilities to meet the needs of the learners and the organization. This course will consider how to measure performance for the variety of intellectual learner domains as well as the overall program effectiveness and interpretation of data collection efforts to test the efficacy of the learning outcomes. (HRDE-715 Human Performance Design and Development) **Class 3, Credit 3 (F)**

HRDE-756 Training Design
Given the organizational needs assessment results and the learners abilities training is often the solution used to enhance personal performance within an organization. A variety of strategies including non-traditional learning programs and tools, development of engaging learning programs linked to corporate strategies for promotion and succession and/or use of traditional instruction strategies to engage the learner in the task and enhance personal productivity will be explored, developed for situational. (HRDE-715 Human Performance Design and Development) **Class 3, Credit 3 (S)**

HRDE-758 Design for On-Line Learning
On-Line learning has grown to be a significant learning/teaching strategy for higher education. This course will include strategies for interactive learning activities to engage adult learner and achieve learning outcomes using a variety of instructional techniques appropriate for the on-line learning environment. This course will provide an opportunity to complete an actual work-related learning activity as an alternative to a case-based learning activity. **Class 3, Credit 3 (S)**

HRDE-780 Internship
This course provides the student with the opportunity to apply their graduate coursework to the world of work. Students will be placed or seek out internship opportunities in a work scenario similar to their ultimate career choice in the field. A mentor for the student must be identified in the place of the internship. The role of the mentor will be to work with students to develop a plan for the internship, facilitate the internship experience, and verify the student's accomplishment of specified outcomes as a result of the internship. Once the mentor approves of the plan of work and student accomplishments at the conclusion of the internship they will send this final report to the student's program adviser. **Class 3, Credit 3 (F, S, Su)**

HRDE-789 Special Topics
Special topics is an innovative course not reflected in the accepted curriculum. Once the outline is submitted titles will appear in the course listing for the semester. The course may be taken more than once as topics change. **Class 3, Credit 3 (F, S, Su)**

HRDE-795 Comprehensive Exam
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. Students will demonstrate a fundamental knowledge of the theories and foundation principles. This course will include a review of the main concepts of each of the core subjects and at the conclusion of the course the student will take a written examination and must receive a passing grade of at least 80%to be successful. Students will have one additional opportunity to pass this examination if their initial attempt results in a failing grade. **Credit 0 (F, Su)**

HRDE-797 Graduate Capstone Project
The purpose of this course is to provide students the opportunity to conduct research, develop a plan and evaluation components and submit the project as a demonstration of final proficiency in the program. The topic selected by the student will be guided by the faculty teaching the class and it will require the student to coalesce and incorporate into the final project a culmination of all their course work in the program to date. **Class 3, Credit 3 (F, S, Su)**

HRDE-798 Research Thesis
A thesis is based on experimental evidence obtained by the candidate in an appropriate topic demonstrating the extension of theory into practice. A written proposal which is defended and authorized by the faculty adviser/committee followed by a formal written thesis and oral presentation of findings are required. Typically the candidate will have completed Research methods, Data analysis and Graduate writing strategies prior to enrolling in this course and will start the thesis process as soon as they have completed these courses to allow them to finish the thesis when they have finished their coursework. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 1–6 (All semesters)**

HRDE-799 Independent Study
This course provides for independent study or research activity in subject matter areas not included in any existing course in the degree program, but having specialized value to students. Proposals approved by a supervising faculty member and the program chairperson are required prior to registration. This course may be taken more than once but for not more than 3 credits. **Class 3, Credit 1–3 (F, S, Su)**

Environmental, Health and Safety Management

ESHS-601 Fire Protection
Introduces fundamental concepts in protection of industrial workers and property from fire and explosion. Fire chemistry, control of ignition sources in industry, and properties of combustible materials are discussed. Fire detection and extinguishment are covered along with building construction for fire prevention, life safety, fire codes and related topics. **Class 3, Credit 3 (F)**

ESHS-611 Occupational Health
This course will provide students with an overview of the fundamentals of industrial hygiene. Emphasis will be on the toxicological effects of various industrial substances on the body; monitoring and personal sampling for these substances and personal protection against such substances. (College level biology and college level chemistry, or department permission. Students who have completed ESHS-340 may not take this course.) **Class 3, Credit 3 (F, S)**

ESHS-613 Solid and Hazardous Waste Management
An examination of strategies and technologies to move an organization toward environmental sustainability, including: resource use reduction, material substitution, process and product modification, and waste minimization; and for handling and managing wastes including: treatment, storage, transport and disposal storing solid and hazardous waste. Associated environmental impacts, regulatory concerns, technical feasibility and costs are considered. (College level chemistry chemistry or department permission.. Students who have completed ESHS-310 may not take this course.) **Class 3, Credit 3 (F)**

ESHS-614 Industrial Wastewater Management
This course investigates characteristics and sources of industrial wastewaters, related environmental impacts, regulatory implications, and technical considerations of current treatment and disposal methodologies. Students learn to identify appropriate methods, technologies and sequences for source reduction, treatment and pretreatment, direct discharge and management of treatment residuals. (College level chemistry or department permission. Students who have completed ESHS-330 may not take this course.) **Class 3, Credit 3 (S)**

ESHS-615 Air Emissions Management
This course will present an overview of industrial air pollution management: its sources, methods of reduction, control and management. Students will become familiar with the history of air pollution, the chemistry and effects of pollutants, regulations and standards, and control technologies; as well as developing analytical and quantitative skills necessary in air emissions management decision-making. By the end of the course, students will be able develop a comprehensive facility air emissions management plan. (College level chemistry or department permission. Students who have completed ESHS-350 may not take this course.) **Class 3, Credit 3 (F)**

ESHS-620 Occupational Safety
This course is an overview of the occupational safety management tools and techniques utilized in today's industry. Topics examined include OSHA requirements, recordability and safety indices; guarding; electrical and material handling; welding, fire prevention; excavation; medical surveillance and worker's compensation; inspection techniques and auditing; committees; incentives and voluntary programs. (College level chemistry and physics or department permission. Students who have completed ESHS-320 may not take this course.)) **Class 3, Credit 3 (F)**

ESHS-626 Exposure Assessment and Analysis
The course focuses on industrial hygiene applications and hands on participation. Particular attention will be given to sampling strategies- from similar exposure grouping, actual sampling experiences with a wide range of industrial hygiene instruments, and sampling analysis using statistical protocols. Field experience with instrumentation, as well as professional written and oral communication of results is emphasized. There are several learning experiences required that are out of the classroom (team based). (ESHS-611 Occupational Health or department permission. Students who have completed ESHS 526 may not take this course.) **Lecture/Lab 4, Credit 3 (F)**

ESHS-630 Mechanical and Electrical Controls and Standards
Discussion of machine safety with emphasis on hazard analysis, risk estimation, safeguarding techniques, and electrical safety. Particular attention will be paid to applicable OSHA, ANSI, NFPA, and EN standards as they relate to wood, metal, films and automation. Elements of the course will change regularly to reflect emerging issues in industry. (Students who have completed ESHS-530 may not take this course.) **Class 3, Credit 3 (S)**

ESHS-710 Research Methods
This course prepares students to plan and conduct research using methodologies commonly employed in the environmental, health and safety management and the facility management disciplines. Included are: literature reviews; case studies; in-depth interviews; quasi-experimental design, and representative, cross-sectional surveys. Students will be instructed in the requirements that must be met in order to comply with the Department of Health and Human Services (DHHS) regulations for the protection of human research subjects. This course will also prepare students to identify common approaches to the use of the works of others, and introduce them to associated resources. Students will learn to use the Chicago Manual of Style formats for citing references. (Matriculation into the EHS management or facility management program) **Class 3, Credit 3 (F, S)**

ESHS-715 Graduate Writing Strategies
This course provides the opportunity for students to communicate in writing using the formats most often required as a professional in their field. The goal of this course is to ensure students have the opportunity to practice written communication strategies including a white paper, research proposal, grant application and a professional paper submission. (Matriculation into the EHS management or facility management MS program) **Class 3, Credit 3 (F, S)**

ESHS-720 Environmental, Health and Safety Management
This is the initial course in the curriculum core of RIT's MS degree program in Environmental, Health and Safety (EHS) Management. It defines and profiles EHS management within the organization; explores EHS management history, motivations and strategies; introduces current and developing systems for managing an organization's EHS aspects; and investigates the elements and implications of developing an organizational EHS vision and policy statement. The course's unique delivery style combines elements of distance-learning and an onsite executive-leader format. (Matriculation into EHS management MS program or department permission) **Class 3, Credit 3 (F)**

ESHS-722 Environmental, Health and Safety Law
An overview of environmental, health and safety (EHS) related law with an emphasis on legislative law. Topics include a review of the historical and modern sources for EHS law, the emergence of administrative law and the responsibilities of the separate branches of government. Major EHS related legislation and their impact on EHS management systems will be covered. (Matriculation into the EHS management MS program or department permission. Students who have completed ESHS-480 may not take this course) **Class 3, Credit 3 (F)**

ESHS-725 Environmental, Health and Safety Accounting and Finance
This course focuses on the environmental, health, and safety (EHS) costs of business decisions. Methods will be taught to identify and quantify EHS related costs and benefits that can lead an organization towards a more sustainable future. (Matriculation into the EHS management or facility management MS program or department permission.) **Class 3, Credit 3 (F)**

ESHS-740 Environmental, Health and Safety Management System Design
This course examines the design and development of environmental, health and safety management systems in order to implement an organization's policies and offers strategies for measurement of results in order to assess performance and ensure continual improvement; significant team project work as well as individual work is required. (ESHS-720 EHS Management or department permission) **Class 3, Credit 3 (S)**

ESHS-750 Environmental, Health and Safety and FM Project Management
This course has been designed to give the student an overview of the fundamental concepts of modern project management. Areas of focus include the project life cycle (PLC), the project management body of knowledge (PMBOK), program evaluation review technique (PERT), critical path method (CPM) and various budgeting and resource allocation techniques. Discussion of project management organizations, negotiation and conflict resolution and project termination will be included, along with an introduction to Project Management Institute (PMI) and Microsoft Project for Windows. (Matriculation into the EHS management or facility management MS program or department permission) **Class 3, Credit 3 (S)**

ESHS-755 Corporate Social Responsibility
This course will introduce social responsibility concepts and approaches presented in key documents like the ISO 26000 Social Responsibility Standard, and will explore strategies for assisting an organization to identify and implement socially responsible initiatives appropriate to the nature and scope of its activities, products and services. (Matriculation into the EHS management MS program or department permission) **Class 3, Credit 3 (F)**

ESHS-760 Integrating EHS Management
This course examines strategies for integrating EHS systems and processes. Using case studies, the course explores interrelationships between EHS and: total quality management, business value, reporting, and approaches for sustainable business development. Students will be prepared to select appropriate quality tools to improve EHS processes; identify opportunities, strategies and tools for integrating EHS into business management; and identify best practices in EHS/business integration. (ESHS-720 EHS Management or department permission) **Class 3, Credit 3 (S)**

ESHS-765 Product Stewardship
This course examines the principles of product stewardship, including the ethical, legal, and economic issues that product manufacturers face. Students will be exposed to the principles and practices used to identify and manage product environmental, health and safety (EHS) aspects and impacts. Sustainability will be covered and case studies will be reviewed. (Graduate engineering technology, packaging, EHS management students or department permission.) **Class 3, Credit 3 (F)**

ESHS-770 Risk Assessment, Management and Communication
This course focuses on risk management systems, including implementation of risk management and risk reduction strategies the course includes case studies and application of risk analysis, technological risk, cost benefit analysis and decision-making under uncertainty in a corporate environment; Risk communication strategies are examined as an integral step in the risk management process. (ESHS- 611 Occupational Health; Matriculated into EHS management MS program or department permission.) **Class 3, Credit 3 (S)**

ESHS-780 Environmental, Health and Safety Management System Evaluation
This course covers the development and use of EHS management system checking and corrective action techniques, including auditing. The course also addresses the issues and elements for designing and managing an internal EHS audit program. Exercises provide opportunities to apply checking and corrective action skills and techniques. (ESHS-720 EHS Management or department permission) **Class 3, Credit 3 (F)**

ESHS-788 Thesis Planning
Students will rigorously develop their thesis research ideas, conduct literature reviews, identify and plan methodologies, prepare schedules, and gain a clear understanding of the expectations of the faculty and the discipline. Each student will be required to prepare a committee approved thesis research proposal and may begin work on their thesis. (ESHS-710 Research Methods, ESHS-715 Graduate Writing Strategies and department permission) **Class 3, Credit 3 (F, S)**

ESHS-790 Thesis
The graduate thesis is a formal research document that empirically relates theory with practice. A formal written thesis and oral defense are required. ("B" or better in ESHS-788 Thesis Planning.) **Class 3, Credit 3 (F, S)**

ESHS-795, Comprehensive Exam
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. This course will provide a forum for independent review of the main concepts of the program core subject areas. The student will take a written examination at the conclusion of the course and must receive a passing grade of at least 80% to be successful. Students will have one additional opportunity to pass this examination if their initial attempt is unsuccessful. (Department permission) **Credit 0 (F, S)**

ESHS-797 Graduate Project
This course provides an opportunity for students to demonstrate their capabilities developed through their course of study to design, develop and/or evaluate an EHS management related project culminating in a written report or manuscript and presentation. (ESHS-710 Research Methods, ESHS-715 Graduate Writing Strategies and department permission) **Class 3, Credit 3 (F, S)**

Facility Management

FCMG-660 Principles and Practice in Facility Management
Presents the overall methodology of facility management including organizational, managerial, ethical, and legal principles for the delivery of facility services. Topics discussed include: FM: budgets, finance, history, regulatory and legal issues, corporate culture, contracts, purchasing and procurement, planning; management of projects, personnel. It covers the relationship between the facility management function and the overall corporate structure. (Enrollment in Facility Management or department permission) **Class 3, Credit 3 (F)**

FCMG-720 Environmental, Health and Safety in Facility Management
According to the International Facility Management Association the primary goal of facility managers is the management of safe, humane and functional work environments in the context of sound ecological practices. This course will provide students with a solid foundation in environmental, health and safety management which will enhance their ability to develop and implement practices that promote and protect health, safety, security, the quality of work life, the environment and organizational effectiveness pertaining to facilities. Topics examined include: EHS moral, legal and economic issues, EHS related laws and regulations (OSHA, EPA, ADA), principles of accident causation and prevention, EHS management systems, fire protection and life safety codes, emergency preparedness, ergonomics, indoor air quality, mold, solid and hazardous waste, recycling, sustainable design, other environmental related issues, environmental psychology and impacts of facilities on individual, group and organizational performance, comfort and satisfaction. (FCMG-660 Principles and Practice in Facility Management or department permission) **Class 3, Credit 3 (S)**

FCMG-740 Real Estate in Facility Management
This course has been designed to give the student the knowledge and tools to manage property assets as an investment and/or profit center. The concepts covered in this course include: asset management, master planning, property acquisition and disposal, interior programming, space planning, property and facility design parameters, regulatory and legal issues, market and financial analysis, ownership and leasing management, constituent service, inventory control, and future trends. All relevant issues from planning for facility needs to life-cycle property management through ultimate property disposition are covered in this course. (FCMG-660 Principles and Practice in Facility Management or department permission) **Class 3, Credit 3 (F)**

FCMG-760 Operation and Maintenance in Facility Management
This is a first course in operations and maintenance of facilities and provides a basic understanding of the physical plant. Students will learn about common systems within facilities including HVAC, communications, building's structural components, and exterior elements. (FCMG-660 Principles and Practice in Facility Management or department permission) **Class 3, Credit 3 (S)**

FCMG-788 Thesis Planning
Students will rigorously develop their thesis research ideas, conduct literature reviews, identify and plan methodologies, prepare schedules, and gain a clear understanding of the expectations of the faculty and the discipline. Each student will be required to prepare a committee approved thesis research proposal (ESHS-710 Research Methods, ESHS-715 Graduate Writing Strategies anddepartment permission) **Class 3, Credit 3 (F, S)**

FCMG-790 Thesis
The graduate thesis is a formal research document that empirically relates theory with practice. A formal written thesis and oral defense are required. ("B" or better in FCMG-788 Thesis Planning) **Class 3, Credit 3 (F, S)**

FCMG-795 Comprehensive Facility Management Examination
A written comprehensive exam is one of the non-thesis methodologies for completion of the MS degree. This course will provide a forum for independent review of the main concepts of each of the program core subject areas. The student will take a written examination at the conclusion of the course and must receive a passing grade of at least 80% to be successful. Students will have one additional opportunity to pass this examination if their initial attempt is unsuccessful. This examination is part of the comprehensive examination exit strategy. (Department permission) **Class 3, Credit 0 (F, S)**

E. Philip Saunders College of Business

dt ogilvie, Dean
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Programs of study

Online learning option available

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Success in the 21st century business environment requires leadership and management attuned to rapid changes in technology and increasingly vigorous global competition. Astute problem solvers who have gained a systems perspective must be able to convert product development and management challenges into competitive advantages. The E. Philip Saunders College of Business offers a portfolio of comprehensive, vigorous programs of study. Our innovative, multidisciplinary curriculum—embedding an international perspective and current technology throughout—produces graduates able to convert managerial learning into pragmatic business applications.

Entrepreneurship at RIT

Entrepreneurs are major drivers of economic growth. They combine original, imaginative ideas with creativity and a healthy dose of tenacity. They're resourceful, inventive, and ambitious. At RIT, entrepreneur's ideas are transformed into reality.

At the heart of the university's entrepreneurship initiatives is the Albert J. Simone Center for Innovation and Entrepreneurship. The center promotes, nurtures, and expands innovation and entrepreneurship by supporting academic programs, hosting competitions, and providing commercial activities that integrate academic initiatives with applied business creation and commercialization experiences. The Center for Student Innovation promotes a multidisciplinary, team-oriented approach and fosters the creation of innovative concepts and products that have the potential to become thriving businesses. Venture Creations/RIT Business Incubator provides assistance in evaluating business opportunities, developing business plans, and offering mentoring and guidance to new ventures. In addition, students have access to the Entrepreneurs Conference, the Student Incubator, and a speaker's series.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarship

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

Our faculty members combine teaching excellence, innovative research, and personalized attention to meet student needs. Our setting, in a technological university embarked on creative business partnering and entailing joint programs across colleges, opens unique opportunities for all partners—industry leaders, faculty, and students.

Facilities

RIT is a national leader in incorporating computer technology into the classroom. Saunders College students have access to extensive resources and utilize the same business software used by Fortune 100 companies worldwide. The college's classrooms and study areas all feature wireless access.

Accreditation

The Saunders College is accredited by the Association to Advance Collegiate Schools of Business (AACSB International).

Business Administration–Traditional, MBA

http://saunders.rit.edu/graduate/mba_program.php

Program overview

The master of business administration degree provides students with the capabilities for strategic and critical thinking needed for effective leadership in a global economy where creative management of both people and technology is vital. The curriculum begins with a solid grounding in the functional areas of business and combines that foundation with the flexibility that allows students to specialize in one or two areas of expertise. In the classroom, students learn the latest theories and concepts, and how they can be immediately applied to solve problems in the workplace.

The MBA program requires 72 quarter credit hours and consists of 18 courses, nine of which are devoted to core functional areas and nine available in concentration areas and as electives. All courses in the Saunders College carry four quarter credit hours.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

MBA degree (traditional), typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
1012-703	Accounting for Decision Makers*	4
0102-735	Strategic Management of Technological Innovation	4
0102-740	Organizational Behavior and Leadership*	4
0103-705	Economics for Managers*	4
0104-721	Financial Analysis for Managers*	4
0105-761	Marketing Concepts*	4
0106-743	Operations and Supply Chain Management*	4
0106-782	Statistical Analysis for Decision Making*	4
0102-759	Competitive Strategy	4
	MBA Elective 1, 2, 3, 4, 5, 6, 7, 8, 9	36
Total Quarter Credit Hours		**72**

*Up to six of these courses can be waived, thus reducing the number of courses required to graduate.

MBA degree (traditional), typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MGMT-601	Foundations of Business Ethics	1
MGMT-740	Organizational Behavior and Leadership	3
ACCT-703	Accounting for Decision Makers	3
MKTG-761	Marketing Concepts and Commercialization	3
ESCB-705	Economics and Decision Modeling	3
FINC-721	Financial Analysis for Managers	3
DECS-743	Operations and Supply Chain Management	3
MGMT-735	Management of Innovation in Products and Services	3
MGMT-759	Competitive Strategy*	3
	MBA Elective 1, 2, 3, 4, 5, 6, 7, 8	24
Total Semester Credit Hours		**49**

* A computer simulation will be one component of MGMT-759

All full-time students are required to complete Professional Skills Seminar I, II (0102-070, 071). These noncredit courses give students the skills to successfully complete their graduate degree and prepare them to obtain a job or co-op position. A background in statistics is required. All entering students will complete a statistics diagnostic test. If deficient they must use one of their electives to take Statistical Analysis for Decision Making (DEC-782).

Concentrations

Students have the option of choosing one or two concentration areas. A concentration is a sequence of four courses in a specialized area of business, thus giving students in-depth knowledge in a particular field.

Students with one concentration area will complete:

- Nine foundation courses
- Four courses in a concentration area
- Five electives, outside the selected concentration area (no more than four of these can be taken in any one discipline). Electives must be selected from approved Saunders College graduate courses or from graduate courses outside the Saunders College that are part of an approved MBA concentration.

Students with two concentration areas will complete:

- Nine foundation courses
- Four courses in a concentration area
- Four courses in a second concentration area (different discipline)
- One elective, outside the selected concentration areas

Notes:

- Students cannot complete more than two concentration areas.
- No course can be counted in more than one concentration.
- No more than four electives can be completed in any one discipline.
- Students taking two concentration areas must meet with an adviser.
- Finance is a five-course concentration.

Students select a concentration area and choose a four-course sequence in a particular area of specialization. Concentrations are available both through the Saunders College and from departments within RIT's other colleges.

Accounting

Designed for students planning to enter corporate accounting. This concentration is also an excellent complement to a concentration in finance or management information systems.

Accounting (quarters)

COURSE		QUARTER CREDIT HOURS
0101-704	Corporate Financial Reporting I	4
0101-705	Corporate Financial Reporting II	4
0101-706	Cost Management	4
Choose one from the following:		4
0101-707	Advanced Accounting	
0101-708	Auditing	
0101-709	Basic Taxation	

Accounting (semesters)

COURSE		SEMESTER CREDIT HOURS
Required courses:		
ACCT-704	Corporate Financial Reporting I	3
ACCT-705	Corporate Financial Reporting II	3
Choose one or two MBA accounting electives		3-6

Digital marketing

One of the most significant forces to affect marketing since the emergence of mass media, the Internet has introduced a global electronic marketplace that has caused a dramatic shift in standard business practices. This has given rise to an enormous need to understand the implications of these shifts for strategic initiatives in marketing and advertising.

Digital marketing (quarters)

COURSE		QUARTER CREDIT HOURS
0105-772	Internet Marketing: Strategy and Tactics	4
0105-775	Business to Business E-marketing	4
Choose two from the following:		8
0105-762	Advanced Marketing Management	
0105-763	Buyer Behavior	
0105-767	Advertising and Integrated Marketing Communications	

Digital marketing (semesters)

COURSE		SEMESTER CREDIT HOURS
MKTG-772	Internet Marketing: Strategy and Tactics	3
Choose two or three MBA courses in marketing with permission of a Saunders College graduate adviser.		6-9

Entrepreneurship

The entrepreneurship concentration is designed to enable students to recognize and commercialize attractive business opportunities—either by new independent ventures or by established firms seeking growth or rejuvenation. It involves integrating all functions of business (strategy, marketing, innovation, finance, accounting, etc.) within one concerted value-creating initiative.

The concentration requires an applied entrepreneurial learning experience that may be satisfied through either the Field Experience in Business Consulting (0102-753) course or an approved commercialization project. These projects may involve students developing their own businesses or working with RIT incubator companies, local startup firms, or RIT multidisciplinary commercialization projects. Students interested in high-technology initiatives are encouraged to enroll in Technology Management (0102-742) as the fourth course in the concentration.

Entrepreneurship (quarters)

COURSE		QUARTER CREDIT HOURS
0102-720	Entrepreneurship and New Venture Creation	4
0102-753	Field Experience in Business Consulting*	4
0105-776	Product and Brand Management	4
Choose one from the following:†		4
0101-709	Basic Taxation	
0102-742	Technology Management	
0104-722	Financial Management II	
0105-763	Buyer Behavior	
0105-772	Internet Marketing: Strategy and Tactics	
0110-730	Business Legal Concepts	

* Or an approved entrepreneurial field experience.

† Or a management course, with approval of graduate adviser.

Entrepreneurship (semesters)

COURSE		SEMESTER CREDIT HOURS
MGMT-720	Entrepreneurship and New Venture Creation	3
MGMT-753	Field Experience in Business Consulting	3
MKTG-776	Product and Brand Management	3
Choose one from the following, if this is your primary conentration:		3
ACCT-709	Basic Taxation	
MGMT-742	Technology Management	
FINC-722	Financial Management II	
MKTG-763	Buyer Behavior	
MKTG-772	Internet Marketing: Strategy and Tactics	
BLEG-730	Business Legal Concepts	

Environmentally sustainable management

With a goal of familiarizing students with environmentally sustainable business practices, this concentration is attractive to students with an overall interest in understanding how firms can manage social and political demands for more environmentally sustainable products and operations. It may be of particular interest to those students in industries with a significant environmental impact such as the automotive, chemical, energy, transportation, or agricultural industries, where environmental issues are central to operational and strategic decision making.

Environmentally sustainable management (quarters)

COURSE		QUARTER CREDIT HOURS
0102-710	Managing for Environmental Sustainability	4
0102-745	Social and Political Environment of Business	4
Choose two from the following:		8
0102-775	Business Ethics	
0303-790	Fundamentals of Sustainable Engineering	
0303-791	Lifecycle Assessment/ Costing	
0521-751	Energy Policy	
0630-720	Environmental Health and Safety Management*	
0630-765	Product Stewardship	
0630-750	EHS Project Management	
5001-803	Economics of Sustainability	
5001-804	Industrial Ecology	
5001-805	Technology, Policy, and Sustainability	

* Online course. As a part of this class, students are required to attend a four-day executive leader session held on campus.

Environmentally sustainable management (semesters)

COURSE		SEMESTER CREDIT HOURS
MGMT-745	Social and Political Environment of Business	3
MGMT-710	Managing for Environmental Sustainability	3
Choose one or two from the following:		3-6
ISEE-785	Fundamentals of Sustainable Engineering	
ISEE-786	Lifecycle Assessment	
ESHS-720	Environmental Health and Safety Management	
ESHS-765	Product Stewardship	
ESHS-750	ESH and FM Project Management	
PUBL-630	Energy Policy	

Finance

This concentration is designed to provide a foundation of knowledge in finance and allow students to choose courses appropriate for a career in investments or corporate finance. Students interested in investments will acquire advanced skills in securities evaluation and portfolio management. Those interested in corporate finance will acquire advanced skills in budgeting, planning, global financing and operations, and corporate risk management. Note: Finance is a five-course concentration.

Finance (quarters)

COURSE		QUARTER CREDIT HOURS
0104-722	Financial Management II	4
0104-725	Securities and Investments Analysis	4
Plus one of the following courses:		4
0103-711	Microeconomics	
0103-712	Macroeconomics	
Choose two from the following:		8
0104-732	Portfolio Management	
0104-740	Options and Futures	
0104-742	Financial Modeling and Analysis	
0104-744	Innovation in Financial Markets and Securities	
0104-760	Finance in a Global Environment	

Finance (semesters)

COURSE		SEMESTER CREDIT HOURS
FINC-725	Securities and Investment Analysis	3
Choose any two or three MBA finance electives		6-9

International business

This concentration prepares graduates for today's global business environment. Large, medium, and small enterprises all operate globally: sourcing, producing, researching, and marketing worldwide. Suppliers and competitors are not only across the street, they are around the globe. To balance the needs of local, regional, and national communities and the benefits attained from global competition and cooperation requires an understanding of the international dimensions of business. Managers and professionals must be able to think, market, negotiate, and make decisions designed for the diversity, complexity, and dynamism that are the hallmarks of global business.

International business (quarters)

COURSE		QUARTER CREDIT HOURS
0113-710	Global Business Environments	4
Choose three from the following:		12
0104-760	Finance in a Global Environment	
0113-730	Managing in a Global Business	
0113-750	Marketing in a Global Environment	
0113-780	Global Issues and Strategies	

International business (semesters)

COURSE		SEMESTER CREDIT HOURS
INTB-710	Global Business Opportunities and Threats	3
Choose two or three from the following:		6-9
INTB-780	Global Issues and Strategies	
INTB-758	Seminar in Global Business	
INTB-730	Cross Cultural Management	
FINC-760	Finance in a Global Environment	
INTB-750	Global Marketing Management	

Management and leadership

Managers need to combine effective leadership with analytical reasoning. The management and leadership concentration provides students with the leadership skills needed to be successful managers in business, nonprofit, and public organizations. Students will develop the essential analytical and decision-making skills for today's rapidly changing world. They will learn why change is difficult, when to initiate change, and how to introduce and manage change in the workplace. These courses also will prepare students for the demands of managing people and projects.

Management and leadership (quarters)

COURSE		QUARTER CREDIT HOURS
0102-741	Managing Organizational Change	4
Choose three from the following:		12
0102-720	Entrepreneurship and New Venture Creation	
0102-742	Technology Management	
0102-745	Social and Political Environment of Business	
0102-750	Human Resource Management	
0102-756	Power and Influence	
0102-758	Seminar in Management	
0102-763	Behavioral Skills for Managers and Professionals	
0102-775	Business Ethics	
0110-745	Legal and Ethical Issues in Technology Intensive Environments	

Management and leadership (semesters)

COURSE		SEMESTER CREDIT HOURS
MGMT-741	Managing Organizational Change	3
Choose two or three from the following:		6-9
MGMT-720	Entrepreneurship and New Venture Creation	
MGMT-742	Technology Management	
MGMT-745	Social and Political Environment of Business	
MGMT-750	Human Resource Management	
MGMT-756	Power and Influence	
MGMT-758	Seminar in Management	
MGMT-763	Behavioral Skills for Managers and Professionals	
MGMT-775	Business Ethics	
BLEG-745	Legal and Ethical Issues in Technology Intensive Environments	

Managment information systems

Services are playing an increasing role in many economies and information technology is a critical element in supporting, managing and innovating services. The managing service systems concentration provides students with interdisciplinary perspectives on the concepts of service delivery and management, and the role of information technology in the design, management, delivery and evaluation of services required to improve and innovate in service-focused organizations. The concentration prepares students for diverse careers in IT-intensive service organizations and industries, such as health care, information technology, and financial services. Students taking this concentration are encouraged to focus on a specific industry, such as health care, information technology, or financial services.

Managment information systems (quarters)

COURSE		QUARTER CREDIT HOURS
0112-720	Information Systems Design	4
Choose three from the following:		12
0112-725	Data Management	
0112-730	Information Systems Consulting	
0112-755	Information Technology Strategy and Management	
0112-760	Integrated Business Systems	
0112-761	Business Process Analysis and Workflow Design	

Management information systems (semesters)

COURSE		SEMESTER CREDIT HOURS
MGIS-720	Information Systems Design	3
Choose two or three from the following:		6-9
MGIS-725	Data Management	
MGIS-730	Information Systems Consulting	
MGIS-755	Information Technology Strategy and Management	
MGIS-760	Integrated Business Systems	
MGIS-761	Business Process Analysis and Workflow Design	

Marketing

The overall process of entering markets, creating value for customers, and developing profit for the firm are the fundamental challenges for today's marketing manager. Effective marketing must consider the target audience, along with the changing business environment and competitive pressures of technological and global challenges. These marketing basics apply to governmental agencies, not-for-profit organizations, and profit-making firms.

Marketing (quarters)

COURSE		QUARTER CREDIT HOURS
0105-762	Advanced Marketing Management	4
Choose three from the following:		12
0105-758	Seminar in Marketing*	
0105-763	Buyer Behavior	
0105-765	Professional Sales Management	
0105-767	Advertising and Integrated Marketing Communications	
0105-771	Marketing Research Methods	
0105-772	Internet Marketing: Strategy and Tactics	
0105-773	Database Marketing	
0105-776	Product and Brand Management	
0105-778	Commercialization and Marketing of New Products	
0113-750	Marketing in a Global Environment	

* Topics may vary.

Marketing (semesters)

COURSE		SEMESTER CREDIT HOURS
MKTG-762	Advanced Marketing Management	3
MKTG -763	Buyer Behavior	3
Choose one or two from the following:		3-6
MKTG-758	Seminar in Marketing*	
MKTG-778	Commercialization and Marketing of New Products	
INTB-750	Global Marketing Management	
MKTG-767	Advertising and Integrated Marketing Communications	
MKTG-771	Marketing Research Methods	
MKTG-772	Internet Marketing: Strategy and Tactics	
MKTG-775	Business to Business E-Marketing	
MKTG-776	Product and Brand Management	

* Topics may vary.

Marketing research

How do you identify your customers' needs and wants, and respond with the most profitable product or service? Marketing research analysts take a leading role in identifying and defining marketing problems. Relying on communication as well as analytical and conceptual skills, a market researcher can evaluate the market, generate product ideas, refine the delivery process, monitor marketing performance, and improve the company's profitability. Increasing numbers of specialized research firms add more opportunities to the traditional marketing profession.

Marketing research (quarters)

COURSE		QUARTER CREDIT HOURS
0307-717	Design/Analysis of Experiments I	4*
Choose one from the following:		4
0105-770	Business Research Methods	
0105-771	Marketing Research Methods	
Choose two from the following:		8
0105-762	Advanced Marketing Management	
0105-772	Internet Market Strategy and Tactics	
0307-818	Design/Analysis of Experiments II*	
0307-831	Multivariate Analysis Applications*	
0307-841	Regression Analysis*	

* Student must register for the four credit hour option of these courses.

Marketing research (semesters)

COURSE		SEMESTER CREDIT HOURS
MKTG-771	Marketing Research Methods	3
MKTG-763	Buyer Behavior	3
Choose one or two MBA courses in marketing or courses from the Center for Quality and Applied Statistics with the permission of a Saunders College graduate adviser.		3-6

Product commercialization

This concentration is targeted to students who are interested in developing expertise in managing the marketing-related activities required to move new products and services through the preliminary business stages to a successful launch. The commercialization of new corporate offerings is increasingly important as product life cycles get shorter.

Product commercialization (quarters)

COURSE		QUARTER CREDIT HOURS
0105-776	Product and Brand Management	4
0105-778	Commercializing and Marketing of New Products	4
Choose one from the following:		4
0102-770	Business Research Method	
0105-771	Marketing Research Methods	
Choose two from the following:		8
0102-762	Managing New Process and Product Development	
0105-762	Advanced Marketing Management	
0105-763	Buyer Behavior	
0105-767	Advertising and Integrated Marketing Communications	
0106-744	Project Management	
0113-750	Marketing in a Global Environment	

Product commercialization (semesters)

COURSE		SEMESTER CREDIT HOURS
MKTG-778	Commercialization and Marketing of New Products	3
Choose two or three from the following:		3-6
MKTG-776	Product and Brand Management	
MKTG-771	Marketing Research Methods	
MGMT-762	Managing New Process and Product Development	
MGMT-762	Buyer Behavior	
DECS-744	Project Management	

Operations management

This concentration is designed to enhance the student's understanding of manufacturing and service functions as they exist in modern business. In addition to courses covering project management, quality control, and improvement and manufacturing strategy, electives allow students the ability to broaden their knowledge base.

Operations management (quarters)

COURSE		QUARTER CREDIT HOURS
0106-744	Project Management	4
0106-745	Quality Control and Improvement	4
Choose two from the following:		8
0102-741	Managing Organizational Change	
0102-742	Technology Management	
0307-721	Statistical Process Control*	
0307-731	Statistical Acceptance Control*	
0307-781	Quality Management*	
0307-782	Quality Engineering*	

* Student must register for the four credit hour option of these courses.

Operations management (semesters)

COURSE		SEMESTER CREDIT HOURS
DECS-744	Project Management	3
DECS- 745	Quality Control and Improvement	3
Choose one or two from the following:		3-6
MGMT-741	Managing Organizational Change	
MGMT-742	Technology Management	
MGMT-762	Managing New Process and Product Development	
CQAS-621	Statistical Quality Control	
CQAS-682	Lean Six Sigma Fundamentals	

Quality and applied statistics

This concentration is for those students who would like to study the technical aspect of managing quality, i.e., statistical quality control. Students will gain an understanding of the basics of statistical process control, quality improvement, acceptance sampling, and off-line quality control techniques such as the design of experiments.

Quality and applied statistics (quarters)

COURSE		QUARTER CREDIT HOURS
Choose four of the following:		*16*
0106-745	Quality Control and Improvement	
0307-721	Statistical Process Control*	
0307-731	Statistical Acceptance Control*	
0307-782	Quality Engineering*	
0307-801	Design of Experiments I*	
0307-802	Design of Experiments II*	

* Student must register for the four credit hour option of these courses.

Quality and applied statistics (semesters)

COURSE		SEMESTER CREDIT HOURS
Choose three or four from the following:		*9-12*
DECS-745	Quality Control and Improvement	
CQAS-621	Statistical Quality Control	
CQAS-682	Lean Six Sigma Fundamentals	
CQAS-670	Designing Experiment for Process Improvement	
CQAS-611	Statistical Software	
CQAS-701	Foundations of Experimental Design	

Quality and organizational improvement

This concentration is designed for students who would like to learn more about the organizational and managerial (i.e., "soft") aspects of quality. The courses offered help students lead organizational change and manage quality improvement projects.

Quality and organizational improvement (quarters)

COURSE		QUARTER CREDIT HOURS
0102-741	Managing Organizational Change	4
0106-745	Quality Control and Improvement	4
Choose one from the following:		4
0102-770	Business Research Methods†	
0105-771	Marketing Research Methods†	
Choose one from the following:		4
0106-744	Project Management	
0307-721	Statistical Process Control*	
0307-731	Statistical Acceptance Control*	
0307-782	Quality Engineering*	
0625-841	Benchmarking and the Process of Continuous Improvement	

* Student must register for the four credit hour option of these courses.

† Students may choose either Marketing Research Methods (0105-771) or Business Research Methods (0102-770), but not both.

Technology management

In a constantly changing environment, the ability of an organization to innovate and renew itself is critical if it is to survive and prosper. Technology managers, who typically are responsible for the innovation and application of new technology, are central to the long-term strategy and success of their companies. To manage these processes well, managers need to understand both business and technological perspectives. Co-op or internship experience in high-technology settings may be helpful to students pursuing a specialty in technology management.

Technology management (quarters)

COURSE		QUARTER CREDIT HOURS
0102-742	Technology Management	4
Choose one or both of the following†:		4
0102-761	Managing Research and Innovation	
0102-762	Managing New Process and Product Development	
Choose one or two courses from the following:		4-8
0102-741	Managing Organizational Change	
0105-776	Product and Brand Management	
0106-744	Project Management	
0110-745	Legal and Ethical Issues in Technology Intensive Environments	

† If students choose both Managing Research Innovation (0102-761) and Managing New Process and Product Development (0102-762), students are required to take only one additional course.

Technology management (semesters)

COURSE		SEMESTER CREDIT HOURS
MGMT-742	Technology Management	3
Choose two or three of the following:		6-9
MGMT-761	Managing Research and Innovation	
MGMT-762	Managing New Process and Product Development	
MGMT-741	Managing Organizational Change	
MGMT-776	Product and Brand Management	
DECS-744	Project Management	
BLEG-745	Legal and Ethical Issues in Technology Intensive Environments	

Additional concentrations

In addition to the business-related concentrations, several additional concentrations are available from outside the Saunders College. Customized concentrations are also available and require the approval of a graduate adviser. To register for courses in the following concentrations, students must see a graduate adviser.

Communication and media technologies

Communication, and the technologies for message creation and dissemination, is at the center of dramatic economic, social, and cultural changes occurring as a result of technological development and global connectedness. This concentration, offered by the College of Liberal Arts, prepares students for careers as communication experts in commerce, industry, education, entertainment, government, and the not-for-profit sector.

Health systems administration

This concentration is specifically designed for those students who are employed in the health care environment. Offered by the College of Applied Science and Technology, courses introduce up-to-date, industry-relevant content that is continually developed in response to the changing health care environment. All courses in this concentration are offered online.

Human resource development

The field of human resource development has grown in both size and importance over the past decade, leading to a high demand for educated and skilled human resource professionals. This concentration, offered by the College of Applied Science and Technology, provides education in training, and career and organizational development.

Industrial and systems engineering management

Organizations need individuals who possess a blend of technical and business skills, as well as the integrated systems perspective needed to commercialize complex products and services. This concentration, offered by the Kate Gleason College of Engineering, may be significantly interdisciplinary.

Information technology

Corporations are aware of the cost savings and performance improvement possible when information technology is applied in a systematic manner, improving organizational information flow, employee learning, and business performance. Information technology includes a mixture of computers and multipurpose devices, information media, and communication technology. Students may choose from the following areas of specialization: Web programming/multimedia, software project management, programming, and telecommunications. This concentration is offered by the B. Thomas Golisano College of Computing and Information Sciences.

Print media

Leadership and management in the print media industry require an understanding of the cutting-edge technology and emerging markets to articulate a corporate vision that encompasses new opportunities and directions. This concentration, offered by the College of Imaging Arts and Sciences, is designed to provide a solid technical background in cross-media digital workflow processes and a keen understanding of the issues and trends in the print media industry.

Public policy

Formulating public policy and understanding its impact are critical, whether you work in government, not-for-profit, or the private sector. This concentration, offered by the College of Liberal Arts, gives students the skills to effectively formulate public policy and evaluate its impact, particularly as related to science and technology issues. The courses focus on policy formation, implementation, and analysis.

Admission requirements

To be considered for admission to the MBA program, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a working knowledge of algebra and statistics,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE) (GMAT preferred for international applicants and those applying for scholarships),
- Submit a personal statement,
- Submit a current resume, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 580 (paper-based) or 92 (Internet-based) are required. Scores from the International English Testing Language System (IELTS) are accepted in place of the TOEFL exam. The minimum acceptable score is 7.0. The TOEFL or IELTS requirement is waived for native speakers of English and for those submitting transcripts and diplomas from accredited American institutions. For additional information on the IELTS, visit www.ielts.org.

Applications are accepted for all four academic quarters. Most full-time students begin their program of study in the fall. Students may complete their studies on a full or part-time basis.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services at least four weeks prior to registration for the next academic quarter for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Additional information

Nonmatriculated status

Students with strong undergraduate records are permitted to take two graduate courses on a nonmatriculated basis. To become a matriculated student and admitted formally to the MBA program, the regular admissions process should be followed. Graduate credits earned as a nonmatriculated student may be applied to the student's degree program.

Academic standards

Graduate students must maintain a grade of B (3.0) or better for all courses. Grades of all repeated MBA courses will be counted in the GPA computation. The policy on probation and suspension is explained in the Registration and Degree Requirements section of this bulletin.

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program.

Orientation

All new students are required to attend an orientation session prior to beginning their studies. Course selection, career planning, program planning, and academic advising are discussed during orientation.

Waiver policy/transfer credit

The MBA normally requires 72 quarter credit hours, however, students may be able to waive up to six MBA foundation courses. Prior academic preparation must be from an institution accredited by AACSB International and the course work must be equivalent to MBA foundation courses. Prior course work must be completed within the last five years, with a grade of B (3.0) or better. Foundation courses may be waived either outright or through an examination.

A maximum of 12 quarter credit hours may be awarded as transfer credit from other graduate programs. The courses must be relevant to the MBA program, taken within the last five years at an institution accredited by AACSB International, and the student must have earned a grade of B or better.

Credits for waiver, transfer, or undergraduate courses are not counted in the GPA computation. Students must apply for transfer/waiver credit.

Placement

Preparation for professional placement begins early in the student's program with the completion of Professional Skills Seminar II (0102-071). The Office of Cooperative Education and Career Services offers individualized career counseling, provides critical job leads, coordinates employers' annual campus recruiting visits, maintains an extensive online job listing, and sponsors two annual career fairs.

Cooperative education

Cooperative education in the MBA program is optional. Co-op experience affords students the opportunity to obtain a paid position for three to six months and gain valuable work experience.

Academic credit is not granted, but formal recording of the co-op experience is made on the student's transcript. Students in good academic standing are eligible for co-op after completing the foundation courses, Professional Skills Seminar I and II (0102-070, 071), and a substantial portion of their concentration courses. They also must attend a series of co-op and career services workshops.
RIT does not guarantee co-op placements.

Deferment

Accepted students can defer enrollment for up to one year. After one year, a new application must be submitted and will be re-evaluated based on the most current admission standards.

Business Administration–Executive, MBA

http://saunders.rit.edu/executive/index.php
Donald O. Wilson, Director of EMBA Program
(585) 475-6798, dwilson@saunders.rit.edu

Program overview

The executive MBA is an integrated, 15-month, five-quarter, cohort-based program designed to develop future leaders and general managers in organizations serious about improving customer satisfaction, product quality, and organizational success.

A team of faculty and executives from all sectors of business and industry designed the program for professionals with substantial career experience. Through the use of practical approaches to improving business results and increasing personal productivity, participants will:

- strengthen their leadership and interactive skills by collaborating with teams of professional peers and faculty;
- develop strategic perspectives consistent with the needs of customers, stockholders, employees, the community, and other organizational stakeholders;
- apply cross-functional approaches to enhance their analytical and decision-making capabilities; and
- obtain a solid foundation in the functional areas of business.

Students must have a minimum of six years of professional work experience. Courses are conducted all day Friday and Saturday on alternating weekends. Participants work in teams, studying a curriculum that focuses on developing general management skills with a strategic focus. The program is structured in an interactive fashion, with an emphasis on cross-functional integration.

Curriculum

The program consists of six weekends per quarter (for a total of 30 weekends over a 15 month period), two one-week on-campus sessions, and a one-week international study trip.

The first two quarters of the curriculum focus on core business concepts, providing fundamental skills, knowledge, and perspectives in accounting, statistics, leadership, finance, and economics. The remaining three quarters of the program develop cross-functional analysis skills with an emphasis on strategy, marketing, technology, and international business. Interdisciplinary examples, case analyses, and an applied orientation are key components of the program.

The program features practical experience obtained through capstone consulting projects; ongoing support for career-oriented skills such as career development planning, communications, and team building; the application of a cross-functional business simulation model; and a week-long international business trip.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Executive MBA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0102-806	Team Building and Business Ethics (August)	1
0101-801	Accounting and Organizational Goals	3
0101-802	Managerial Accounting	3
0102-800	Leadership Development Skills I	1
0102-810	Leadership	3
0106-810	Statistical Analysis for Managers	3
0102-862	Power and Influence	3
0103-840	Microeconomics	3
0104-845	Valuation and Capital Budgeting	3
0104-846	Financial Planning and Analysis	3
0102-818	Strategic Thinking I	3
0102-819	Strategic Thinking II	3
0103-841	Macroeconomics	3
0105-851	Marketing Strategy	3
0102-801	Leadership Development Skills II (May)	1
0106-875	Business Simulation: Consulting Skills (May)	4
0102-861	Managing Technology, Innovation and Research (summer)	3
0102-889	Capstone Consulting Project I (summer)	4
0106-864	System Support for Operations (summer)	3
0105-865	Managing New Product Commercialization (summer)	3
Second Year		
0113-820	International Business	3
0113-825	International Business Seminar	2
0102-860	Executive Leadership	3
0102-890	Capstone Consulting Project II	4
0104-850	International Finance	3
0102-802	Leadership Development Skills III	1
Total Quarter Credit Hours		**72**

Executive MBA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-806	Team Building and Ethics (summer)	1
ACCT-801	Accounting and Organizational Goals	2
ACCT-802	Managerial Accounting	2
DECS-810	Statistical Analysis for Managers	2
MGMT-810	Leadership	2
ESCB-840	Microeconomics and Pricing	2
MGMT-804	Professional Skills for General Management	2
FINC-845	Valuation and Capital Budgeting	2
FINC-846	Financial Planning and Analysis	2
MGMT-862	Power and Influence	2
MKTG-851	Marketing Strategy	2
MGMT-818	Strategic Thinking I	2
MGMT-819	Strategic Thinking II	2
DECS-875	Business Simulation (summer)	2
MGMT-861	Managing Technology, Innovation and Research (summer)	2
MKTG-865	Managing New Product Commercialization (summer)	2
DECS-864	Systems Support for Operations (summer)	2
MGMT-800	Leadership Development I (summer)	1
MGMT-889	Capstone Consulting Project I (summer)	3
Second Year		
INTB-820	International Business	2
INTB-825	International Study Seminar	2
FINC-850	International Finance	2
MGMT-860	Executive Leadership	2
MGMT-890	Capstone Consulting Project II	3
MGMT-801	Leadership Development II	1
Total Semester Credit Hours		**49**

Admission requirements

To be considered for admission to the executive MBA program, candidates must fulfill the following requirements:

- Have a minimum of six years of professional work experience,
- Hold a baccalaureate degree from an accredited program,
- Submit official transcipts (in English) of all previously completed undergraduate and graduate course work,
- Participate in an interview with a representative of the executive MBA team, and

- Complete a graduate application.
- International applicants, whose native language is not English, must submit the scores from the Test of English as a Foreign Language (TOEFL).

Additional information

Sponsorship

Employers sponsoring students must permit candidates to attend scheduled classes, the on-campus sessions, and the international trip. The weeklong sessions occur in the summer and spring, and the international trip takes place in the student's final quarter. Business owners or individuals may sponsor themselves.

Business Administration–Online Executive, MBA

http://embaonline.rit.edu
Marty Lawlor, Director, Online EMBA Program
(585) 475-4472, mlawlor@saunders.rit.edu

Program overview

The online executive MBA program is a challenging and demanding degree designed to accelerate the careers of mature, high-performance professionals with significant business experience, unlike traditional MBA programs which are geared primarily toward a less experienced audience. The online program, delivered via distance learning, covers the same rigorous curriculum as the on campus EMBA.

This program is ideal for creative, innovative individuals who have gained experience in the workforce. Participants have established careers and are looking for proven and effective methods and strategies to propel them further up the career ladder. Students will master executive skills such as strategic and cross–functional thinking and leadership. They learn from knowledgeable and professional instructors and from the successful, motivated, diverse peer group enrolled in the program.

The program encourages students to think outside the box and places a strong emphasis on group networking. Students leave the program with a strong network of influential peers.

Curriculum

The program delivers courses in two six-week sessions every quarter. The program length is five quarters (15 months), with a new group of students beginning every quarter. The following represents the typical curriculum based on a student beginning in the fall quarter.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Online executive MBA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0102-806	Team Building and Business Ethics	1
0101-801	Accounting and Organizational Goals	3
0101-802	Managerial Accounting	3
0102-800	Leadership Development Skills I	1
0102-810	Leadership	3
0106-810	Data Analysis	3
0102-862	Power and Influence	3
0104-845	Valuation and Capital Budgeting	3
0103-840	Microeconomics	3
0105-851	Marketing Strategy	3
0102-818	Strategic Thinking I	3
0104-846	Financial Planning and Analysis	3
0102-801	Leadership Development Skills II	1
0102-819	Strategic Thinking II	3
0103-841	Macroeconomics	3
0106-875	Business Simulation	4
0102-861	Managing Technology, Innovation and Research	3
0106-864	System Support for Operations	3
0102-889	Capstone Consulting Project I	4
0105-865	Managing New Product Commercialization	3
Second Year		
0113-820	International Business	3
0113-825	International Business Seminar	2
0104-850	International Finance	3
0102-890	Capstone Consulting Project II	4
0102-802	Leadership Development Skills III	1
0102-860	Executive Leadership	3
Total Quarter Credit Hours		**72**

Online executive MBA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-806	Team Building and Ethics	1
ACCT-801	Accounting and Organizational Goals	2
ACCT-802	Managerial Accounting	2
DECS-810	Statistical Analysis for Managers	2
MGMT-810	Leadership	2
ESCB-840	Microeconomics and Pricing	2
MGMT-804	Professional Skills for General Management	2
FINC-845	Valuation and Capital Budgeting	2
FINC-846	Financial Planning and Analysis	2
MGMT-862	Power and Influence	2
MKTG-851	Marketing Strategy	2
MGMT-818	Strategic Thinking I	2
MGMT-819	Strategic Thinking II	2
DECS-875	Business Simulation	2
MGMT-861	Managing Technology, Innovation and Research	2
MKTG-865	Managing New Product Commercialization	2
DECS-864	Systems Support for Operations	2
MGMT-800	Leadership Development I	1
MGMT-889	Capstone Consulting Project I	3
Second Year		
INTB-820	International Business	2
INTB-825	International Study Seminar	2
FINC-850	International Finance	2
ESCB-841	Macroeconomics	2
MGMT-890	Capstone Consulting Project II	3
MGMT-801	Leadership Development II	1
Total Semester Credit Hours		**49**

Admission requirements

To be considered for admission to the online executive MBA program, candidates must fulfill the following requirements:

- Have a minimum of six years of professional experience and hold advanced technical, managerial, or executive responsibilities,
- Hold a regionally accredited bachelor's degree,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL).

Accounting, MBA

http://saunders.rit.edu/graduate/mba_accounting.php

Program overview

In addition to the educational preparation for a career leading to top management, the master of business administration—accounting program fulfills the education requirements that allow students to sit for the New York State Certified Public Accountancy exam. The program stresses the skills necessary for the design, operation, and control of accounting information systems.

Curriculum

Students will complete foundation, accounting, and business courses. The program offers two tracks, one for students with an undergraduate degree in accounting and one for students who have an undergraduate degree in a field other than business or accounting.

Students with an undergraduate degree in accounting may be able to complete the program with as few as 12 graduate courses totaling 48 quarter credit hours. Full-time students starting in the fall quarter may be able to complete the degree in three quarters. With some required courses only offered once a year, additional completion time may be required for full-time students entering in other quarters. The program also is available on a part-time basis for practicing professionals.

For students without undergraduate business course work, but with an undergraduate degree meeting CPA liberal arts and science requirements, the program consists of 27 courses that may be completed in seven quarters (two academic years) of full-time study. Because of the length of required prerequisite courses, seven-quarter completion for full-time students is based on fall quarter entry. Variations will likely extend the time needed to complete the program.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Accounting, MBA degree, (for applicants with an undergraduate degree in accounting), typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0101-758	Forensic and Fraud Accounting	4
0102-740	Organizational Behavior and Leadership	4
0102-759	Competitive Strategy	4
0103-705	Economics for Managers	4
0102-735	Strategic Management of Technological Innovation	4
0105-761	Marketing Concepts	4
0101-707	Advanced Accounting*	4
0101-722	Advanced Cost Management	4
0101-738	Information Systems Auditing and Assurances Services	4
0101-795	Financial Accounting Theory and Research	4
0112-725	Data Management	4
0112-760	Integrated Business Systems	4
Total Quarter Credit Hours		**48**

* Students taking these courses as part of their undergraduate program may substitute electives or other courses to fulfill the education requirements for the CPA exam.

Accounting, MBA degree, (for applicants with an undergraduate degree in accounting), typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
	Finance or Economics Elective	3
MGMT-740	Organizational Behavior and Leadership	3
BLEG-731	Commercial Law and Professional Skills	3
MKTG-761	Marketing Concepts and Commercialization	3
MGMT-735	Management of Innovation in Products and Services	3
MGMT-759	Competitive Strategy	3
ACCT-795	Financial Accounting Theory and Research	3
ACCT-738	Information Systems Auditing and Assurance	3
ACCT-708	Auditing and Professional Responsibility	3
ACCT-707	Advanced Accounting	3
Total Semester Credit Hours		**30**

Accounting, MBA degree, (for students without undergraduate business course work), typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0101-703	Accounting for Decision Makers	4
0102-735	Strategic Management of Technological Innovation	4
0102-740	Organizational Behavior and Leadership	4
0103-705	Economics for Managers	4
0104-721	Financial Analysis for Managers	4
0105-761	Marketing Concepts	4
0106-743	Operations and Supply Chain Management	4
0106-782	Statistical Analysis for Decision Making	4
0101-704	Corporate Financial Reporting I	4
0101-705	Corporate Financial Reporting II	4
0101-706	Cost Management	4
0101-709	Basic Taxation	4
0101-710	Advanced Taxation	4
0101-745	Accounting Information Systems	4
	Non-accounting Professional Elective	4
Second Year		
0101-707	Advanced Accounting	4
0101-708	Auditing	4
0101-722	Advanced Cost Management	4
0101-738	Information Systems Auditing and Assurances Services	4
0101-758	Forensic and Fraud	4
0101-795	Financial Accounting Theory and Research	4
0102-795	Competitive Strategy	4
0110-730	Business Legal Concepts	4
0110-731	Commercial Law	4
0112-725	Data Mangement	4
0112-760	Integrated Business Systems	4
	Finance Elective	4
Total Quarter Credit Hours		**108**

Accounting, MBA degree, (for applicants with no previous business, economics or statistics coursework), typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-601	Business Ethics	1
MGMT-740	Organizational Behavior and Leadership	3
ACCT-703	Accounting for Decision Makers	3
MKTG-761	Marketing Concepts and Commercialization	3
DECS-782	Statistical Analysis for Decision Makers	3
BLEG-730	Business Legal Concepts	3
FINC-721	Financial Analysis for Managers	3
ACCT-704	Corporate Financial Reporting I	3
ACCT-709	Basic Taxation	3
ACCT-745	Accounting Information Systems	3
ACCT-706	Cost Management	3
MGMT-735	Management of Innovation in Products and Services	3
ESCB-705	Economics and Decision Modeling	3
DECS-743	Operations and Supply Chain Management	3
	Business Elective	3
Second Year		
ACCT-710	Advanced Taxation	3
BLEG-731	Commercial Law and Professional Skills	3
ACCT-705	Corporate Financial Reporting II	3
	Accounting Elective	3
	Economics or Finance Elective	3
ACCT-708	Auditing and Professional Responsibility	3
ACCT-795	Financial Accounting Theory and Research	3
ACCT-738	Information Systems Auditing and Assurance	3
ACCT-707	Advanced Accounting	3
MGMT-759	Competitive Strategy	3
Total Semester Credit Hours		**73**

Admission requirements

To be considered for admission to the MBA—accounting program, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have working knowledge of algebra and statistics,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE) (GMAT preferred for international applicants and those applying for scholarships),
- Submit a personal statement,
- Submit a current resume, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 580 (paper-based), 237 (computer-based), or 92 (Internet-based) are required. Scores from the International English Testing Language System (IELTS) will be accepted in place of the TOEFL exam. The minimum acceptable score is 7.0. The TOEFL or IELTS requirement is waived for native speakers of English and for those submitting transcripts and diplomas from American institutions. For additional information on the IELTS, visit www.ielts.org.

Accepted students can defer enrollment for up to one year. After one year, a new application must be submitted and will be re-evaluated based on the most current admission standards.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services at least four weeks prior to registration for the next academic quarter for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Finance, MS

http://saunders.rit.edu/graduate/ms_finance.php

Program overview

The master of science degree in finance is designed to prepare students for managerial careers in corporate finance, investment analysis and portfolio management, financial consulting, and financial institutions. The courses prepare students to sit for the Certified Financial Analyst exam. To complete the program in one year, full-time students must begin their studies in the fall quarter.

Curriculum

The program of study consists of 12 courses and a comprehensive exam. Candidates must successfully complete the comprehensive field exam.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Finance, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0101-703	Accounting for Decision Makers	4
0103-705	Economics for Managers	4
0104-721	Financial Analysis for Managers	4
0104-722	Financial Management II	4
0104-725	Securities and Investment Analysis	4
0104-740	Options and Futures	4
0104-742	Financial Modeling and Analysis	4
0104-760	Finance in a Global Environment	4
0106-782	Statistical Analysis for Decision Making	4
	Finance Elective	4
	Free Electives	8
Total Quarter Credit Hours		**48**

Finance, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ACCT-703	Accounting for Decision Makers	3
FINC-721	Financial Analysis for Managers	3
FINC-725	Securities and Investment Analysis	3
FINC-760	Finance in a Global Environment	3
FINC-722	Financial Management II	3
FINC-740	Options and Futures	3
FINC-742	Financial Modeling and Analysis	3
	One 700-level Statistics Course	3
	One 700-level Economics Course	3
	One 700-level Finance Course	3
FINC-790	Field Exam	1
Total Semester Credit Hours		**31**

Admission requirements

To be considered for admission to the MS program in finance, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE) (GMAT preferred for international applicants and those applying for scholarships),
- Submit a personal statement,
- Submit a current resume, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign

Language (TOEFL). Minimum scores of 580 (paper-based), 237 (computer-based), or 92 (Internet-based) are required. Scores from the International English Language Testing System (IELTS) are accepted in place of the TOEFL exam. The minimum acceptable score is 7.0. The TOEFL or IELTS requirement is waived for native speakers of English and for those submitting transcripts and diplomas from accredited American institutions. For additional information on the IELTS, visit www.ielts.org.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services at least four weeks prior to registration for the next academic quarter for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Additional information

Deferment

Accepted students may defer enrollment for up to one year. After one year, a new application must be submitted and will be re-evaluated based on the most current admission standards.

Innovation Management, MS

http://saunders.rit.edu/graduate/ms_innovation_management.php

Program overview

The master of science degree in innovation management supports the development of technology workers as they move into leadership roles in the high-technology domains in the world economy. Graduates of the program will have a unique combination of technical and business expertise and will be able to communicate at all levels of an organization.

Curriculum

The program requires students to complete 46-48 quarter credit hours consisting of:

- six required business core courses designed to increase a student's knowledge of accounting, organizational behavior and leadership, technology management, entrepreneurship, marketing, and product commercialization;
- Two innovation courses that allow students to pursue organizational, research, product, or project management expertise;
- One two-course sequence from a technology specialization area; and
- A capstone experience, which serves as an opportunity for students to integrate their business and technology expertise through a full-quarter applied project or research paper.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change

Effective fall 2013, the program in innovation management will be renamed entrepreneurship and innovative ventures. This change will not affect currently matriculated students.

Innovation management, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0101-703	Accounting for Decision Makers	4
0102-720	Entrepreneurship and New Venture Creation	4
0102-740	Organizational Behavior and Leadership	4
0102-742	Technology Management	4
0105-761	Marketing Concepts	4
0105-778	Commercialization and Marketing of New Products	4
0102-794	Innovation Management Capstone Preparatory	4
0102-795	Innovation Management Capstone	4
Choose two of the following innovation courses:		8
0102-741	Managing Organizational Change	
0102-761	Managing Research and Innovation	
0105-776	Product and Brand Management	
0106-744	Project Management	
	Technology Specialization Courses	6-8
Total Quarter Credit Hours		**46-48**

Entrepreneurship and innovative ventures, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MKTG-761	Marketing Concepts and Commercialization	3
MGMT-720	Entrepreneurship and New Venture Creation	3
BLEG-612	Legal and Accounting Issues for New Ventures	3
FINC-605	Financing New Ventures	3
MGMT-765	Applied Venture Creation*	3
Choose two of the following innovation courses:		6
DECS-744	Project Management	
GRDE-711	Design Theory and Methods Seminar	
MGMT-735	Managmemnet of Innovation in Products and Services	
MGMT-742	Technology Management	
MKTG-776	Product and Brand Mangement	
MKTG-778	Commercialization and Marketing of New Products	
	Graduate Electives†	6
Total Semester Credit Hours		**30**

* Students enrolled in Applied Venture Creation (MGMT-765) may work on their own project in the course or they may work on a project in conjunction with Venture Creations, RIT's business incubator.

† Graduate electives must be taken at RIT, but may be outside the Saunders College.

Admission requirements

To be considered for admission to the MS program in innovation management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit the results of the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE) (GMAT preferred),
- Submit a personal statement,
- Submit a current resume,
- Submit a capstone project proposal, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 580 (paper-based) or 92 (Internet-based) are required. Scores from the International English Language Testing System (IELTS) will be accepted in place of the TOEFL exam. The minimum acceptable score is 7.0. The TOEFL or IELTS requirement is waived for native speakers of English or for those submitting transcripts and diplomas from American institutions. For additional information on the IELTS, visit www.ielts.org.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services at least four weeks prior to registration for the next academic quarter for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Accepted students can defer enrollment for up to one year. After one year, a new application must be submitted and will be re-evaluated based on the most current admission standards.

Management, MS

http://saunders.rit.edu/graduate/ms_management.php

Program overview

The master of science in management is a specialized program designed to provide students with the knowledge and problem-solving skills needed to function effectively in a variety of management positions in complex organizations that are impacted by technological change and globalization. Students choose between two tracks of study: global management or technology management. After taking several courses in research tools, the program culminates with a two-course thesis or practicum. In place of a thesis or practicum, the candidate may successfully pass a comprehensive exam.

Full-time students must begin the program in the fall quarter in order to complete the program in 12 months. Part-time students may enter the program in any quarter.

Curriculum

The program consists of 12 courses, which includes a thesis or practicum.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Management, MS degree, (global management option), typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0113-710	Global Business Environments	4
0113-780	Global Issues and Strategy	4
Choose two of the following courses:		8
0104-760	Finance in a Global Environment	
0113-730	Managing in a Global Environment	
0113-750	Marketing in a Global Environment	
	Research Courses	8
	Breadth of Field Courses	16
	Thesis or Practicum*	8
Total Quarter Credit Hours		**48**

* In place of a thesis, the candidate may complete a comprehensive exam.

Management, MS degree, (global management option), typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MKTG-761	Marketing Concepts and Commercialization	3
INTB-710	Global Business Opportunities and Threats	3
INTB-780	Global Issues and Strategies	3
Choose two of the following courses:		6
INTB-730	Cross-Cultural Management	
FINC-760	Finance in a Global Environment*	
INTB-750	Global Marketing Management	
	Business Electives	12
Total Semester Credit Hours		**30**

* This course has a prerequisite of FINC-721, which must be taken as one of the student's business electives.

Management, MS degree, (technology management option), typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0102-742	Technology Management	4
0102-762	Managing New Process and Product Development	4
Choose two of the following courses:		8
0102-741	Managing Organizational Change	
0102-761	Managing Research and Innovation	
0105-776	Product and Brand Management	
0106-744	Project Management	
	Research Courses	8
0113-710	Global Business Environments	4
	Breadth of Field Courses†	12
	Thesis or Practicum*	8
Total Quarter Credit Hours		**48**

† See graduate adviser before choosing these courses.

* In place of a thesis, the candidate may complete a comprehensive exam.

Management, MS degree, (technology management option), typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MKTG-761	Marketing Concepts and Commercialization	3
MGMT-742	Technology Management	3
MGMT-761	Managing Research and Innovation	3
Choose three of the following courses:		9
MGMT-762	Managing New Process and Product Development	
MKTG-776	Product and Brand Management	
MKTG-778	Commercialization and Marketing of New Products	
DECS-744	Project Management	
	Business Electives	9
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit the results of the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE) (GMAT preferred),
- Submit a personal statement,
- Submit a current resume, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 580 (paper-based) or 92 (Internet-based) are required. Scores from the International English Language Testing System (IELTS) will be accepted in place of the TOEFL exam. The minimum acceptable score is 7.0. The TOEFL or IELTS requirement is waived for native speakers of English and for candidates submitting transcripts from American institutions. For additional information visit www.ielts.org.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services at least four weeks prior to registration for the next academic quarter for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Additional information

Deferment

Accepted students may defer enrollment for up to one year. After one year, a new application must be submitted and will be re-evaluated based on the most current admission standards.

Graduate Faculty

dt ogilvie, BA, Oberlin College; MBA, Southern Methodist University; Ph.D., University of Texas at Austin—Dean

Donald O. Wilson, BS, Oklahoma State University; MS, MPA, University of Southern California; Ph.D., University of California at Irvine—Associate Dean for Academic Programs; Director, EMBA Program; Assistant Professor

Jerry H. Curnutt, AB, William Jewell College; MS, Ph.D., University of Illinois—Assistant Dean for Administration; Minors Adviser

Accounting

Mithu Dey, BBA, Howard University; MBA, Ph.D., George Washington University; CPA, Maryland—Assistant Professor

William H. Dresnack, BS, Long Island University; MS, Binghamton University; JD, University of Buffalo—Professor

William T. Evans, BS, Rensselaer Polytechnic Institute; MBA, University of Rochester—Senior Lecturer

Roberta L. Klein, BS, State University College at Brockport; MBA, Rochester Institute of Technology; CPA, New York—Lecturer

Rachna Prakash, B. Comm., University of Delhi; MBA, University of Rochester; MS, Massachusetts Institute of Technology; Ph.D., Emory University—Assistant Professor

Qian Song, B.Sc., M.Sc., Qingdao University; Ph.D., Washington State University—Assistant Professor

Daniel D. Tessoni, BBA, St. John Fisher College; MS, Clarkson University; Ph.D., Syracuse University; CPA, New York—Benjamin Forman Chair for Collaboration

Rong Tang, BS, MS, Tianjin University of Finance and Economics; MBA, Ph.D., Rutgers University—Assistant Professor

Decision Science

John Angelis, BE, Youngstown State University; Ph.D., Case Western Reserve University—Assistant Professor

John E. Ettlie, BS, MS, Ph.D., Northwestern University—Benjamin Forman Chair for Research; Professor

A. Erhan Mergen, BS, Middle East Technical University; MS, Ph.D., Union College—Professor

Brian F. O'Neil, BS, Syracuse University; MS, Ph.D., Purdue University—Distinguished Lecturer

William J. Stevenson, BS, MBA, Ph.D., Syracuse University—Associate Professor

Finance and Economics

Steven C. Gold, BA, BS, Rutgers University; MA, Ph.D., State University of New York at Binghamton—Professor

Chun-Keung (Stan) Hoi, BA, MS, University of North Texas; Ph.D., Arizona State University—Associate Professor

Archana Jain, B. Comm., M. Comm., University of Rajasthan; MBA, Ph.D., University of Memphis—Assistant Professor

Jeffrey P. Lessard, BS, BA, University of New Hampshire; MBA, Plymouth State College; MA, Ph.D., University of Arkansas—Associate Professor

Ashok J. Robin, B.Comm, University of Madras; MBA, Ph.D., State University of New York at Buffalo—Madelon & Richard Rosett Chair for Research; Professor

Hao Zhang, BA, MA, Xiamen University; Ph.D., State University of New York at Buffalo—Assistant Professor

Management

Robert J. Barbato, BA, Le Moyne College; Ph.D., Michigan State University—Professor

Richard DeMartino, BA, Roanoke College; MPA, Ph.D., University of Virginia—Simone Chair for Innovation and Entrepreneurship; Associate Professor

A. Clyde Hull, BA, Yale University; MB, MBA, Ph.D., Indiana University—Associate Professor

Shalini Khazanchi, BS, South Gujarat University; MBA, University of Pune; Ph.D., University of Cincinnati—Associate Professor

Martin Lawlor, BA, State University of New York at Buffalo; MBA, Rochester Institute of Technology—Director, Online EMBA; Senior Lecturer

Steven Luxmore, BA, MA, University of Guelph; Ph.D.; University of Toronto—Assistant Professor

Joy Oguntebi, BS, Georgia Institute of Technology; MS, Ph.D., University of Michigan—Assistant Professor

Michael Palanski, BS, Grove City College; MA, Covenant Theological Seminary; Ph.D., Binghamton University—Assistant Professor

Sandra L. Rothenberg, BS, Syracuse University; MS, Ph.D., Massachusetts Institute of Technology—Director, Saunders College Institute of Business Ethics; Professor

Delmonize Smith, BBA, Faulkner University; MS, Troy University; Ph.D., University of Alabama—Assistant Professor

Zhi Tang, BA, Shandorun University; MA, Fudon University; Ph.D., University of Alabama—Associate Professor

Donald O. Wilson, BS, Oklhoma State University; MS, MPA, University of Southern California; Ph.D., University of California at Irvine—Associate Dean for Academic Programs; Director, EMBA Program; Assistant Professor

Management Information Systems

A. James Baroody, BS, University of Richmond; MS, College of William and Mary; MS, Ph.D., University of Wisconsin at Madison—Distinguished Lecturer

Sean William Hansen, BA, Harvard University; MBA, Ph.D., Case Western Reserve University—Assistant Professor

Manlu Liu, BS, Jiangsu University; MS, Zhejiang University; MBA, The Hong Kong University of Science & Technology; Ph.D., University of Arizona—Assistant Professor

Victor J. Perotti, BS, MS, MA, Ph.D., The Ohio State University—Associate Professor

Quiang (John) Tu, BS, MS, Xian Jiaotong University; Ph.D., University of Toledo—Professor

Marketing

Robert B. Boehner, BA, MA, Siena College; JD, University of North Carolina at Chapel Hill—Benjamin Forman Chair for Teaching Excellence; Senior Lecturer

Adriana M. Boveda-Lambie, BS, University of Maryland at College Park; MA, University of Texas at Austin; Ph.D., University of Rhode Island—Assistant Professor

Deborah Colton, BA, State University of New York at Buffalo; MBA, Rochester Institute of Technology; Ph.D., University of South Carolina—Associate Professor

Neil Hair, BS, University of Wales; MS, Sheffield Hallam University; Ph.D., Cranfield University—Associate Professor

Joseph C. Miller, BA, Grand Valley State University; MBA, Wayne State University; Ph.D., Michigan State University—Assistant Professor

Rajendran Sriramachandra Murthy, BE, University of Madras; MBA, Ph.D., Southern Illinois University—Assistant Professor

John D. Ward, BS, Georgia Institute of Technology; MS, Purdue University—Lecturer

Quarter Courses

2012–2013 Academic Year

Accounting

0101-703 Accounting for Decision Makers
An introduction to accounting concepts and the use of accounting information by decision makers. Topics include financial statements; measurement of assets, liabilities, equities, and income; financial statement analysis, cost behavior and measurement; profitability analysis; relevant costs for special decisions; budgeting; and responsibility accounting. Consideration is given to the role of information technology in the development and use of accounting information. **Credit 4**

0101-704 Corporate Financial Reporting I
A comprehensive exposure at an intermediate level to accounting theory and practice. Emphasis is placed on applying underlying accounting theory to complex accounting measurement problems. The effects of alternative methods are considered throughout the entire course. (0101-703) **Credit 4**

0101-705 Corporate Financial Reporting II
Continuation of Corporate Financial Reporting I with emphasis on equity and special measurement and reporting problems. Topics include statement of cash flows, pensions, leases, revenue recognition and investments. (0101-704) **Credit 4**

0101-706 Cost Management
The development and use of cost data for external reporting and internal cost management (planning and control). Topics include job costing, process costing, joint product costing, cost reassignments, standard costs, activity based costing, decentralization and transfer pricing, and cost variances. Consideration is given to manufacturing, service and retail organizations. (0101-703) **Credit 4**

0101-707 Advanced Accounting
Investigates the application of generally accepted accounting principles and international financial reporting standards to business enterprises, including corporations with investments in subsidiaries, domestic and international, and partnerships. Issues involving consolidated financial statements, including international topics, are considered. Also examined are objectives for not-for profit and governmental entities, and how these objectives affect their financial accounting and reporting. (0101-705 or equivalent) **Credit 4**

0101-708 Auditing
The theory and practice of auditing is examined. Auditing procedures and standards governing current practice are reinforced by case studies. Audit reports and legal liability issues are discussed. The course is designed for students planning to enter public accounting upon graduation and become CPAs. (0101-705) **Credit 4**

0101-709 Basic Taxation
A basic introductory course in federal income taxation. Emphasis is on taxation of individuals and sole proprietorships. Topics include income measurement and deductibility of personal and business expenses. (0101-703) **Credit 4**

0101-710 Advanced Taxation
A continuation of Basic Taxation. Emphasis is on the tax treatment of property transactions and the taxation of business entities. Also covers the use of technology to prepare complex returns and to research tax issues. (0101-709) **Credit 4**

0101-722 Advanced Cost Management
A study of alternative approaches to identifying and proactively managing the costs of providing services and/or manufacturing and distributing products. The focus is on the development of cost data in ambiguous situations to assist managers in decision-making about future activities. Current issues in cost management receive special attention. (0101-706 or permission of instructor) **Credit 4**

0101-738 Information Systems Auditing and Assurance Services
An examination of the unique risks, controls, and assurance services resulting from and related to auditing financial information systems with an emphasis on enterprise resource systems. (0101-708 or equivalent) **Credit 4**

0101-745 Accounting Information Systems
Emphasis is on developing a conceptual understanding of accounting information systems. Combines information systems concepts, computer technology, and accounting issues. Topics include computer security, information privacy, accounting cycles, specialized journals, systems development, computer crime, database applications, e-commerce, and other information systems issues. Includes discussion of current literature and use of a computerized accounting system. Students analyze accounting information systems topics through problem solving, essays, presentations, exams and case studies. (0101-703) **Credit 4**

0101-758 Seminar in Accounting
Special topics seminars offer an in-depth examination of current events, issues and problems unique to accounting. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from quarter to quarter. (Depends upon topic) **Credit 4**

0101-794 Cost Accounting in Technical Organization
A first course in accounting for students in technical disciplines. Topics include the distinction between external and internal accounting, cost behavior, product costing, profitability analysis, performance evaluation, capital budgeting, and transfer pricing. Emphasis is on issues encountered in technology intensive manufacturing organizations. This course is not intended for Saunders College of Business students. **Credit 4**

0101-795 Financial Accounting Theory and Research
This course examines the theoretical concepts, definitions, and models espoused in the accounting literature and relevant to analyzing various contemporary issues in financial accounting and reporting. (0101-705 or equivalent) **Credit 4**

Management

0102-710 Managing for Environmental Sustainability
Environmental sustainability means satisfying today's ecological needs without compromising the ability to meet tomorrow's needs. This course will examine how firms can use sustainable practices, such as pollution prevention and green design, and still be successful in a competitive marketplace. The course will look at the concept of environmental sustainability and the current state of social and political pressures for more sustainable business practices. It will also explore successful sustainable business strategies, and the management processes needed to support them. **Credit 4**

0102-720 Entrepreneurship and New Venture Creation
This course studies the process of creating new ventures with an emphasis on understanding the role of the entrepreneur in identifying opportunities, seeking capital and other resources, and managing the formation and growth of a new venture. Students will typically write a business plan in this course. **Credit 4**

0102-735 Strategic Management of Technological Innovation
This course addresses the management of global sustainable technological innovation. The course integrates two major themes: The management of innovation and the management of technology. Emphasis is on the role of both innovation and technology in creating global competitive advantage. The course also addresses the responsibility of businesses related to sustainability. (Must have completed at least four graduate business courses.) **Credit 4**

0102-740 Organizational Behavior and Leadership
This course examines why people behave as they do in organizations and what managers can do to improve organizational performance by influencing people's behavior. Students will be exposed to the impact of organizations on leaders, individuals, groups, and cultures, and to different frameworks for diagnosing and dealing with problems in organizational settings. Topics include leadership, motivation, team building, conflict resolution, organizational change, and managing organizational cultures, creativity and ethical leadership. **Credit 4**

0102-741 Managing Organizational Change
This course examines various theories and approaches currently used to assist organizations in achieving planned change. The features of successful change in organizations will be discussed, with an emphasis on the structural, motivational, interpersonal, and social aspect of organizational change. Topics include the processes of envisioning and implementing change, as well as, the roles and perspectives of change agents and change recipients. (0102-740) **Credit 4**

0102-742 **Technology Management**
This course is an introduction to the technological process in organizations and the factors, both internal and external, which influence the rate, timing and success of industrial innovations. The interrelationship between science and technology and the importance of these two disciplines to the process of technological innovation is examined. Also discussed is the process of R&D management, the strategic management of technology, the dynamics of technology life cycles and organizational influences on engineering and manufacturing processes. **Credit 4**

0102-745 **Social and Political Environment of Business**
This class focuses on the interactions among business, government and society. The course illuminates the role of ethics, social ideology and government policy in guiding business decisions and in providing the conditions for successful competitive activity. Attention is given to understanding the reason for government regulation, as well as the pros and cons of various regulatory approaches. The class also looks at current debates on corporate social responsibilities with regard to stakeholders, including government, consumers, employees, communities and the environment. **Credit 4**

0102-750 **Human Resource Management**
This course focuses on the importance of managing human resources with an awareness of the legal and regulatory environment. Attention is given to the increasing importance of cooperation among top management, HR managers, line managers and employees. Students will become familiar with workplace planning and employment, human resource development, compensation and benefits, employment and labor relations, occupational health and safety, and managing diversity. (0102-740) **Credit 4**

0102-753 **Field Experience in Business Consulting**
Students work in consulting teams to assist startup ventures and/or small businesses. Problems are isolated and solutions are then developed. Affiliated course projects may focus on a number of areas. For example, they may seek to develop commercialization plans for specific technologies, products or services; focus on unique problems associated with small businesses, and develop growth strategies. Recommended for students nearing the completion of their program. (0101-703, 0104-721, 0105-761 for business majors; permission of instructor for other colleges) **Credit 4**

0102-755 **Negotiations**
This course is designed to teach the art and science of negotiation so that one can negotiate successfully in a variety of settings, in day-to-day experiences and, especially, within the broad spectrum of negotiation problems faced by managers and other professionals. Individual class sessions will explore the many ways that people think about and practice negotiations skills and strategies in a variety of contexts. **Credit 4**

0102-756 **Power and Influence**
Power and influence processes are pervasive and an important part of organizational life. This course has as its objectives enhancing the understanding of these processes and increasing the student's skills in using them. Topics covered include the conditions under which power and politics are more likely to dominate decision processes, assessing the relative power of various actors, understanding the basis for their positions on issues, the sources of both individual and departmental power, power and influence strategies and tactics, and some functional and dysfunctional aspects of organizational politics for both individuals and the organizations involved. (0102 - 740) **Credit 4**

0102-758 **Seminar in Management**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to management. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from quarter to quarter. (Prerequisite depends on topic) **Credit 4**

0102-759 **Competitive Strategy**
This course reviews the techniques and tools firms use to create a sustainable competitive advantage in the global economy. Cross functional analysis is a core element in the course. Topics covered include the mission and vision of the firm, analysis of the external environment, analysis of internal resources and capabilities, the role of innovation in strategy development, analysis of global business trends, developing business level and corporate level strategies, strategy implementation, and the role of ethics in strategy development and execution. (All other required core courses) **Credit 4**

0102-761 **Managing Research and Innovation**
This course deals with the responsibilities of, and operating problems faced by managers responsible for the research function within high- technology firms. Topics will include: internal technology assessments, the acquisition of technology, domestic and international technology transfer, and the selection and management of R&D projects. Particular attention will be given to motivating and managing creative individuals, organizational alternatives for R&D, and techniques for overcoming barriers to innovation. (0102-742 or 0102-735 or permission of instructor) **Credit 4**

0102-762 **Managing New Process and Product Development**
The course deals with the internal organizational challenges faced by managers of technology-intensive companies. Particular attention is given to management techniques for successfully developing and introducing into the marketplace new products and services. Also discussed is the management of technical groups and project teams, cross-functional integration, organizational support of innovation and creativity and organizational alternatives such as matrix management and skunk works. (0102-742 or 0102-735 or permission of instructor) **Credit 4**

0102-763 **Behavioral Skills for Managers and Professionals**
This course provides the opportunity to develop individual and interpersonal skills that enhance managerial performance in today's high-performance organization. Each student will perform in each of the major skill dimensions and will be given evaluative feedback and the opportunity to incorporate the implications of that feedback into additional performance opportunities. Course participants are also provided with the opportunity to assess their career work preferences and to compare them with the performance expectations of managerial positions. The management styles of each participant are also assessed, and the impact is clarified of the behaviors that flow from each style on the perceptions and performance of others in the organization. (0102-740) **Credit 4**

0102-765 **Applied Venture Creation**
This project oriented course enables students to gain multi- disciplinary experience in entrepreneurship, venture creation, or product/service commercialization through a number of alternative venues. Student teams gain applied and practical knowledge by participating in an actual entrepreneurial or commercialization project. These projects could include: advancing/maturing a student originated business concept through the RIT Student Business Development Laboratory, developing commercialization plans in partnership with various RIT college product/service development projects, or creating commercial business plans for RIT generated intellectual property. Students meet with supervising faculty on a weekly basis. (Faculty permission is required to enroll in the course. See a COB graduate advisor for details.) **Credit 4**

0102-770 **Business Research Methods**
This course concerns the development, presentation and use of research in managerial decision making. Included are the processes by which meaningful research problems are generated, identification of the relevant literature, rationalizing of the research design and interpretation of findings. Students typically work in small groups to execute a research project in one of the functional areas of business. (0106-782 or equivalent) **Credit 4**

0102-775 **Business Ethics**
This course examines business ethics from both an organizational and managerial perspective. Students will examine the goal of business organizations, as well as individual conduct in business settings. Ethical reasoning and ethical leadership will guide debate on topics such as: creating an ethical climate in an organization, honesty, affirmative action, environmental ethics, ethics in advertising and sales, financial management, personnel management, and the role of character and virtues in effective leadership. **Credit 4**

0102-794 **Innovation Management Capstone Preparatory**
This is the first of two courses (0102-794 and 0102-795) that must be taken in consecutive quarters. The course is limited to students in the Master of Science in Innovation Management program only. Students will begin to analyze an innovation issue and develop a plan to commercialize the innovation. Students will further define the innovation and the project, collect and analyze relevant data and information, develop alternative solutions, and make recommendations to the professor and outside experts as appropriate. Students will develop skills in both the technical and business aspects of managing innovation. NOTE: Students will be required to write and have approved by the program director a one-page description of their proposed innovation before they register for the class. (Four program classes and permission of program director; corequisite: three additional program classes.) **Credit 4**

0102-795 **Innovation Management Capstone**
In this MS in Innovation Management capstone course, students work with faculty and industry advisors to integrate their business and technology learning through an applied project. In these projects, real-world business problems will be identified, and solutions will be planned and developed. These projects may be entrepreneurial in nature, or they may be carried out within an existing company. Projects will be conducted under the supervision of the course instructor and other advisors as appropriate. Learning from the applied project will be generalized so that the importance of the work in a broader business context will be clear. NOTE: Students will be required to write and have approved by the program director a one-page description of their proposed innovation before they register for the class. (0102-794 and seven other program courses, permission of the program director; corequisite any remaining courses for MS) **Credit 4**

Economics

0103-705 **Economics for Managers**
The course focuses on the fundamental economic theories most useful for the management of a firm in a global environment. Microeconomic theories and current events are used to explain the performance of the market system and help managers formulate effective pricing and business decisions. Macroeconomic theories and current events are used to explain the direction of the domestic and global economy to help managers understand the implications, including foreign direct investment, for their companies. Students will learn to explain and predict changes in economic growth, inflation, interest rates, international trade and foreign exchange rates. (0106-066 algebra or equivalent) **Credit 4**

0103-711 **Microeconomics**
Microeconomics introduces the principles of economic analysis as applied to micro decisions to determine how an organization can achieve its aims most efficiently. This course applies statistical and quantitative tools and the methodological approaches commonly used by economists to business problems such as demand estimation, product pricing, profit maximizing level of output, cost minimizing level of input use, and forecasting. (0103-705 or two economics courses, one in microeconomics and one in macroeconomics with a grade of B or better) **Credit 4**

0103-712 **Macroeconomics**
This is an intermediate macroeconomics course with a focus on the global environment. A framework of product and money market equilibrium is developed that recognizes all economies are linked through international markets for goods, services and capital. Open economy models are developed to explain economic growth, inflation, interest rates, foreign exchange rates and trade balances. (0103-705 or two economics courses, one in microeconomics and one in macroeconomics with a grade of B or better) **Credit 4**

Finance

0104-721 **Financial Analysis for Managers**
An examination of basic financial theories, techniques, and practices. Topics include: time value of money, valuation, capital asset pricing, risk and diversification, cost of capital, capital budgeting techniques. (Co-requisites: 0101-703, 0106-782) **Credit 4**

0104-722 **Financial Management II**
This advanced course in corporate finance focuses on financing policies, financial planning/control, and other advanced corporate topics. Specific topics include the financing process, alternative financing instruments, restructuring, cost of capital, corporate applications involving options, working capital management and the use of financial budgets/forecasts. (0104-721) **Credit 4**

0104-725 **Securities and Investment Analysis**
Study of securities and other investment media and their markets. Analysis of investment values based on fundamental analytic procedures, technical analytic procedures, and the impact that modern portfolio theory has on the value of financial assets. Topics include return, growth, risk, accounting procedures, tax considerations and the impact of various institutional arrangements on value determination. (0104-721) **Credit 4**

0104-730 **Financial Institutions and Markets**
An examination of the role of financial intermediation in the economy. The existence of regulations and the expanding level of competition among intermediaries are discussed. The importance of interest rate risk and hedging such risk is extensively covered. Topics include regulatory laws, gap analysis, hedging duration gap exposure, bank performance, pension funds, insurance companies and mutual funds. (0104-721) **Credit 4**

0104-732 **Portfolio Management**
This course extends the knowledge of risk and return in a portfolio context to active portfolio management. The measurement and evaluation of portfolio performance are analyzed. The importance of asset allocations, international diversification, pension fund management and the use of a wide range of derivative securities to manage risk are explored. (0104-721) **Credit 4**

0104-734 **Working Capital Management**
This course is an examination of the management of current assets and current liabilities. Emphasis is placed upon cash and marketable securities management, cash budgeting, inventory control, accounts receivable management, and short-term and intermediate-term financing. (0104-721) **Credit 4**.

0104-740 **Options and Futures**
This course focuses on financial derivative securities. Their role in financial management is becoming increasingly important, especially in portfolio management. This course covers valuation of various options and futures as well as their use in risk management. Specific topics include option and futures pricing models, option strategies and contemporary topics such as index arbitraging. (0104-721) **Credit 4**

0104-742 **Financial Modeling and Analysis**
Students apply computer technology to solve finance-related problems using a variety of analytical methods. Analytical methods include spreadsheet modeling, mathematical optimization, regression, decision tree analysis and Monte Carlo Simulation. Typical topics covered are financial forecasting, pro-forma financial statements, equity valuation, cash budget forecasts, and portfolio analysis. This is a hands-on course that focuses on collecting, managing and analyzing financial data. (0104-721, 0104-725; corequisite 0104-722) **Credit 4**

0104-744 **Innovation in Financial Markets and Securities**
Advanced course exploring the twin-issue of (a) innovation in market structures and security design and (b) use of complex securities by market participants. Topics include financial engineering, market microstructure, debt and equity market innovations, securitization, interest rate/credit derivative applications, and hedging methods. (0104-721, 0104-725; corequisite 0104-740) **Credit 4**

0104-760 **Finance in a Global Environment**
This course has a specific focus on international business problems that are financial in nature. Topics include an examination of the international environment the firm operates in, international investment, exchange rates and the management of risks arising from shifting exchange rates, and the problems of short and long term asset and liability management. (pre- or corequisite 0104-721) **Credit 4**

Marketing

0105-761 **Marketing Concepts**
An introduction to contemporary principles and practices of marketing. The course is structured around the process of marketing planning leading to the development of successful marketing strategies, including the commercialization of products and services in domestic and international environments. Focus is on environmental scanning techniques, setting and evaluating measurable objectives, innovating and controlling the interrelated components of product/service offering, planning and executing the marketing mix (channels of distribution, price, and promotion), and enhancing customer relationships through the delivery of customer value. **Credit 4**

0105-762 **Advanced Marketing Management**
A course designed to give the student an in-depth knowledge of middle- and upper-level marketing problems and processes. Topics include the tools used by marketing managers in the development, implementation, and control of marketing plans and strategies. (0105-761) **Credit 4**

0105-763 **Buyer Behavior**
The course reviews the major theories that frame the understanding of both consumer (end-user) and business buying behavior. Topics include the buying decision process, the impact of emotion, product knowledge and product involvement on purchasing decisions. In addition, behavioral and social psychology perspectives will be discussed. All perspectives will be applied to designing marketing strategy. (0105- 761; corequisite 0106-782) **Credit 4**

0105-767 Advertising and Integrated Marketing Communication
An in-depth view of tools of advertising, sales promotion, public relations, personal selling, direct marketing and Internet marketing. Basic concepts of advertising using print, broadcast, Internet and outdoor media are studied. Planning, budgeting and the roles of advertising agencies are also covered. Students develop a comprehensive promotion plan beginning with the marketing strategy and ending with implementation and evaluation. The project, in which the student plans and prepares a promotion/advertising campaign for a product or service in consultation with the instructor, is an integral part of the course. (0105-761) **Credit 4**

0105-771 Marketing Research Methods
This course provides an overview of marketing research and practices especially the methods of measuring, examining, and predicting factors that affect the marketing process. Students will learn about the process of conducting surveys and experiments that includes the following: determining customer requirements, questionnaire design, telephone, mail and electronic surveys, sampling plan design and data analysis. (0105-761, 0106-782 or equivalent) **Credit 4**

0105-772 Internet Marketing: Strategy and Tactics
This course examines the impact that the Internet has on traditional and contemporary business-to-consumer marketing activities. It explores these implications in both strategic and tactical terms to enhance organizations' levels of competitiveness. The course identifies the use of the Internet in enhancing value for consumers and considers the leverage of: the latest technologies, trends, e culture and innovation through the medium of the Internet. (0105-761) **Credit 4**

0105-775 Business-To-Business E-Marketing
The focus of this course is on the effective integration and coordination of various business to business marketing operations within the realm of e-commerce. The course explores from a marketing perspective factors critical to the success of e-business operations and examines the strategies and tactics that organizations can use to build and/or enhance their business to business relationships using electronic tools. (0105-761) **Credit 4**

0105-776 Product and Brand Management
An essential element of corporate success is the management of products and brands. Firms in both consumer and commercial industries often manage their marketing strategies and tactics through the activities of their product and brand managers. This course will examine the role of product and brand managers in the development and execution of strategies that deliver value to targeted customers and grow the business. The role of product and brand managers will be examined through all phases of the firm's product and brand life cycle. The course emphasizes the decisions that firms expect product and brand managers to make to achieve market share and financial objectives. (0105-761) **Credit 4**

0105-778 Commercialization and Marketing of New Products
This course emphasizes the marketing and product strategy-related activities required to create, develop and launch successful new products. Topics covered include identifying the market opportunity for new products, defining the product strategy, understanding customer requirements, developing and updating the product business plan, marketing's role in the firm's product development process, developing the marketing plan for launching new products, and managing the product life cycle. The course emphasizes best practices in marketing-related activities required for successful new product commercialization. (0105-761) **Credit 4**

Decision Science

0106-743 Operations and Supply Chain Management
Study of the management of operations and supply chain management. Encompasses both manufacturing and services. Topics include operations and supply chain strategy, ethical behavior, forecasting; work systems, inventory management, capacity and materials planning, lean operation, supply chain design and closed-loop supply chains, global operations, quality management, quality control, and quality improvement, project management; and current issues. (0106-782 or equivalent) **Credit 4**

0106-744 Project Management
A study in the principles of project management and the application of various tools and techniques for project planning and control. This course focuses on the leadership role of the project manager, and the roles and responsibilities of the team members. Considerable emphasis is placed on statements of work and work breakdown structures. The course uses a combination of lecture/discussion, group exercises, and case studies. **Credit 4**

0106-745 Quality Control and Improvement
Study of total quality management (TQM), including Deming's philosophy, quality planning, quality cost principles, problem solving methods and tools, the use of statistical methods for quality control and improvement, supplier relations, reliability concepts, and recent developments in quality. The course focus is on the management and continuous improvement of quality and productivity in manufacturing and service organizations. (0106-782 or equivalent) **Credit 4**

0106-782 Statistical Analysis for Decision Making
This is a course in applied statistics emphasizing an understanding of variation and inference (estimation and testing). Topics to be covered include: review of descriptive statistics, normal distribution, sampling distributions, estimation, test of hypothesis for single and two populations, analysis of variance (ANOVA), linear regression, multiple regression and model building. Students will apply these concepts using mini-cases and problem sets that involve both structured and unstructured data sets. The application of appropriate tools will be required. (0106-066) **Credit 4**

Business Legal Studies

0110-730 Business Legal Concepts
This course provides an introduction to legal procedure and the substantive laws that govern businesses. The course explores the background and origin of the U.S. legal system as well as its legal and regulatory agencies. Representative topics will include review of the U.S. Constitution and the U.S. court system, basics of civil and criminal procedures, torts, contracts, criminal law, bankruptcy, antitrust, intellectual property, and business and consumer protection. **Credit 4**

0110-731 Commercial Law
Explores the impact of the Uniform Commercial Code on business operations. Emphasis on topics included on certified public accounting exam. Topics covered include sales, commercial paper, corporations, partnerships, joint ventures, sole proprietorships, bailment and agency. Topical cases and examples are used to help the student grasp the business implications of the law and its nomenclature. A research project on legal issues is an important aspect of this course. (0110-730 or equivalent) **Credit 4**

0110-745 Legal and Ethical Issues in Technology Intensive Environments
The course confronts graduate students with a wide variety of legal and ethical issues in organizational environments that are technologically intensive, such as information technology and the life sciences. Impacts of intellectual property legislation and legal cases in national and international venues are investigated. Legal and social issues involving individual privacy are argued. This exposure to legal and ethical dilemmas is an important tool as the graduates encounter such situation throughout their careers. Coupled with technical proficiency the ability to deal with legal and ethical issues shapes professional successes and failures. Not available to students who have completed 0102-775. **Credit 4**

Management Information Systems

0112-710 Information Systems Concepts
This course is an introduction to the conceptual and theoretical foundations of management information systems and their role in modern organizations. The course will provide students with the concepts, tools and techniques needed to understand and interpret information management issues, such as how to best incorporate information technology into an organization, from a managerial perspective.

0112-725 Data Management
This course discusses issues associated with data capture, organization, storage, extraction, and modeling for planned and ad hoc reporting. Enables student to model data by developing conceptual and semantic data models. Techniques taught for managing the design and development of large database systems including logical data models, concurrent processing, data distributions, database

0112-755 Information Technology and Strategy Management
Information systems increasingly have a strategic role in organizations, both public and private. Information technology has changed the ways organizations interact internally and externally, the management of production processes and how organizations compete. Students examine how IT is used to support the management of and to support the firm's core business processes. Topics include the nature of IT, its role in supporting business strategy, the impacts of information systems to organizations, IT governance processes and the strategic use of information technology in leading organizations. **Credit 4**

0112-760 **Integrated Business Systems**
This course emphasizes the concepts and technologies associated with integrated business information systems and the managerial decisions related to their implementation and application in managing organizations. Students gain an understanding of the scope of these integrated systems that reach across organizational boundaries and how they can change how a company does business. Topics covered include business integration, business processes, systems integration, enterprise resource planning systems and the role of real-time information in business management. Hands-on experience with enterprise systems, such as SAP R/3, is used to enable students to demonstrate concepts related to integrated business systems. **Credit 4**

0112-761 **Business Process Analysis and Workflow Design**
A common theme held in business today is identifying opportunities for improvement. By analyzing, redesigning and where possible, automating business processes, companies look to add value, improve operating efficiencies and reduce costs. Students explore approaches to analyzing and designing processes and apply graphic modeling techniques that allow for clear and simple definition, analysis and improvement of processes. Systems used for automating process workflow are introduced, such as workflow tools or SAP's R/3 workflow application. (0112-760) **Credit 4**

International Business

0113-710 **Global Business Environment**
In this introduction to global business we consider the opportunities and threats posed by global changes, especially those of major market groupings such as NAFTA and EU and the emergence of China as an economic force. In response to these changes, new modes of doing business as well as categories of business are developing and these will be studied, specifically: drivers to globalization, alternative business environments and risk, foreign exchange risk, trade theory, market entry strategies, alliances, foreign direct investment, outsourcing, intellectual property (IP) and its protection. **Credit 4**

0113-730 **Managing in a Global Environment**
An analysis of comparative global business behavior and organization with particular emphasis on values, authority, individual and group relations, labor-management ties, risk tolerance, and motivational techniques. The course will prepare students to recognize different values and cultural factors in the global business community and how these shape and determine appropriate management behavior. The problems and opportunities of transferring management practices from one culture to another will also be examined. (0102-740) **Credit 4**

0113-750 **Marketing in a Global Environment**
This course has a specific focus on the international marketing challenges facing firms operating in developing and developed country markets. Topics will include an examination of the international environment and its impact on marketing decisions, international pricing and promotion, product-market entry and penetration strategies, and how to organize international marketing operations for maximum effectiveness. (0105-761) **Credit 4**

0113-780 **Global Issues and Strategies**
This capstone course will focus on either contemporary issues or problems in international business or regional studies analysis (e.g., Europe, Eastern Bloc, Pacific Basin). It will emphasize faculty-directed students' research projects. (0113-710) **Credit 4**

Semester Courses

Effective fall 2013

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Accounting

ACCT-703 **Accounting for Decision Makers**
A graduate-level introduction to the use of accounting information by decision makers. The focus of the course is on two subject areas: (1) financial reporting concepts/issues and the use of general-purpose financial statements by internal and external decision makers and (2) the development and use of special-purpose financial information intended to assist managers in planning and controlling an organization's activities. Generally accepted accounting principles and issues related to International Financial Reporting Standards are considered while studying the first subject area and ethical issues impacting accounting are considered throughout. **Credit 3 (F, S, Su)**

ACCT-704 **Corporate Financial Reporting I**
A comprehensive exposure at an intermediate level to accounting theory and practice. Emphasis is placed on applying underlying accounting theory to complex accounting measurement problems. The effects of alternative methods are considered throughout the entire course. (ACCT-703 or equivalent) **Credit 3 (S)**

ACCT-705 **Corporate Financial Reporting II**
Continuation of Corporate Financial Reporting I with emphasis on equity and special measurement and reporting problems. Topics include the statement of cash flows, earnings per share issues, pensions, leases, revenue recognition, and investments. (ACCT-704 or equivalent) **Credit 3 (F)**

ACCT-706 **Cost Management**
The development and use of cost data for external reporting and internal cost management (planning and control). Topics include job costing, process costing, joint product costing, cost reassignments, standard costs, activity-based costing, decentralization and transfer pricing, and cost variances, consideration is given to manufacturing, service and retail organizations. (ACCT-703 or equivalent) **Credit 3 (S)**

ACCT-707 **Advanced Accounting**
Study of the application of generally accepted accounting principles and international financial reporting standards to business enterprises, including corporations with investments in subsidiaries, domestic and international, and partnerships. Issues involving consolidated financial statements, including international topics, are considered. Also examined are objectives for not-for-profit and governmental entities, and how these objectives affect their financial accounting and reporting. (ACCT-705 or equivalent) **Credit 3 (S)**

ACCT-708 **Auditing and Professional Responsibility**
A study of the legal, ethical, and technical environment in which the auditor works. Current auditing theory, standards, procedures, and techniques are studied. The audit process is studied to ascertain how it leads to the development of an audit opinion. (ACCT-705 or equivalent, ACCT-738 or corequisite) **Credit 3 (F)**

ACCT-709 **Basic Taxation**
A basic introductory course in federal income taxation. Emphasis is on taxation of individuals and sole proprietorships. Topics include income measurement and deductibility of personal and business expenses. (ACCT-703 or equivalent) **Credit 3 (S)**

ACCT-710 **Advanced Taxation**
A continuation of Basic Taxation. Emphasis is on tax treatment of property transactions and taxation of business entities. Also covers the use of technology to prepare complex returns and to research tax issues. (ACCT-709 or equivalent) **Credit 3 (F)**

ACCT-711 **Internal Auditing**
Course explores the role of the internal audit function in the management of companies. Topics include internal vs. external auditing, internal control issues, reliability and integrity of information; compliance with policies, procedures, laws and regulations; efficiency of operations. Ethical considerations affecting the internal audit function are introduced. (ACCT-703 or equivalent) **Credit 3 (F)**

ACCT-738 Information Systems Auditing and Assurance Services
An examination of the unique risks, controls, and assurance services resulting from and related to auditing financial information systems with an emphasis on enterprise resource systems. (ACCT-705 or equivalent, ACCT-708 pre- or corequisite) **Credit 3 (S)**

ACCT-740 Financial Statement Analysis
This course is designed to prepare students to interpret and analyze financial statements effectively. Explores in greater depth some of the financial reporting topics introduced in the core accounting course. (ACCT-703, FINC-721) **Credit 3 (F)**

ACCT-741 Cases in Forensic Accounting and Fraud Examination
Overview of the nature of occupational fraud and how it is committed including an introduction to the actions that can be taken to determine the presence of occupational fraud and procedures that can be implemented to deter fraud. Also covered is the proper manner in which allegations of fraud should be investigated and documented to meet the requirements of civil/criminal court procedure. Course is principally taught through case study. (ACCT-703) **Credit 3 (S)**

ACCT-745 Accounting Information Systems
This course combines information systems concepts and accounting issues. In this course, we discuss the conceptual foundations of information systems, their applications, the control and auditing of accounting information systems, and the system development process. Topics include the business process, e-business, relational database, database design, computer fraud and security, accounting cycle, system analysis and AIS development strategies. Students analyze accounting information systems topics through problem solving, group projects, presentations, exams, and case studies. (ACCT-703 or equivalent) **Credit 3 (S)**

ACCT-758 Seminar in Accounting
Special topics seminars offer an in-depth examination of current events, issues and problems unique to accounting. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from quarter to quarter. (Depends on topic) **Credit 3**

ACCT-794 Cost Management in Technical Organizations
A first course in accounting for students in technical disciplines. Topics include the distinction between external and internal accounting, cost behavior, product costing, profitability analysis, performance evaluation, capital budgeting, and transfer pricing. Emphasis is on issues encountered in technology intensive manufacturing organizations. (This course is not intended for Saunders College of Business students.) (This course is for matriculated graduate students only.) **Credit 3**

ACCT-795 Financial Accounting Theory and Research
This course examines the theoretical concepts, definitions, and models espoused in the accounting literature and relevant to analyzing various contemporary issues in financial accounting and reporting. It also considers the historical development of accounting standards, contemporary issues in financial reporting including international standards, and research methods used to determine the appropriate methods to comply with accounting standards. Course requires writing and student presentations. (ACCT-705 or equivalent) **Credit 3 (S)**

Management

MGMT-601 Foundations of Business Ethics
This course uses cases, readings, and class discussions to apply concepts of ethics to business at the macro level and at the micro level. At the macro level the course examines competing business ideologies exploring the ethical concerns of capitalism as well as the role of business in society. At the micro level the course examines the role of the manager in establishing an ethical climate with an emphasis on the development of ethical leadership in business organizations. The following topics are typically discussed: the stakeholder theory of the firm, corporate governance, marketing and advertising ethics, the rights and responsibilities of employees, product safety, ethical reasoning, business's responsibility to the environment, moving from a culture of compliance to a culture of integrity, and ethical leadership. **Credit 1 (F, S, Su)**

MGMT-710 Managing for Environmental Sustainability
Environmental sustainability means satisfying today's ecological needs without compromising the ability to meet tomorrow's needs. This course will examine how firms can use sustainable practices, such as pollution prevention and green design, and still be successful in a competitive marketplace. The course will look at the concept of environmental sustainability and the current state of social and political pressures for more sustainable business practices. It will also explore successful sustainable business strategies, and the management processes needed to support them. **Credit 3 (S)**

MGMT-720 Entrepreneurship and New Venture Creation
This course studies the process of creating new ventures with an emphasis on understanding the role of the entrepreneur in identifying opportunities, seeking capital and other resources, and managing the formation and growth of a new venture. **Credit 3 (F, S, Su)**

MGMT-735 Management of Innovation in Products and Services
This course addresses the management of innovation, sustainable technology, and the importance of technology-based innovation for the growth of the global products and services industries. The course integrates three major themes: (1) leading-edge concepts in innovation, (2) the role of technology in creating global competitive advance in both product-based and services-based industries, and (3) the responsibility of businesses related to sustainability. The importance of digital technology as an enabler of innovative services is covered throughout the course. (completion of four graduate business courses) **Credit 3 (F, S)**

MGMT-740 Organizational Behavior and Leadership
This course examines why people behave as they do in organizations and what managers can do to improve organizational performance by influencing people's behavior. Students will learn a number of frameworks for diagnosing and dealing with managerial challenges dynamics at the individual, group and organizational level. Topics include leadership, motivation, team building, conflict, organizational change, cultures, decision making and ethical leadership. **Credit 3 (F, S, Su)**

MGMT-741 Managing Organizational Change
This course addresses the importance of organizational change in maintaining a flexible, dynamic, and responsive organization, by examining various theories and approaches currently used to assist organizations in achieving planned change. The role of the leader in achieving organizational change is emphasized. The features of successful change in organizations will be discussed, including the structural, motivational, interpersonal, and social aspects of organizational change. (MGMT-740) **Credit 3 (F, S)**

MGMT-742 Technology Management
This course is an introduction to the technological process in organizations and the factors, both internal and external, which influence the rate, timing and success of industrial innovations. The interrelationship between science and technology and the importance of these two disciplines to the process of technological innovation is examined. Also discussed is the process of R&D management, the strategic management of technology, the dynamics of technology life cycles and organizational influences on engineering and manufacturing processes. **Credit 3 (F, S)**

MGMT-745 Social and Political Environment of Business
This class focuses on the interactions among business, government and society. The course illuminates the role of ethics, social ideology and government policy in guiding business decisions and in providing the conditions for successful competitive activity. Attention is given to understanding the reason for government regulation, the pros and cons of various regulatory approaches, and the role of the firm in the policy making process. The class also looks at current debates on corporate social responsibility with regard to stakeholders, including government, consumers, employees, communities and the environment. **Credit 3 (F)**

MGMT-750 Human Resource Management
This course focuses on the importance of managing human resources with an awareness of the legal and regulatory environment. Attention is given to the increasing importance of cooperation among top management, human resource managers, line managers and employees. Students will become familiar with workplace planning and employment, human resource development, compensation and benefits, employment and labor relations, occupational health and safety, and managing diversity. (MGMT-740) **Credit 3 (F, S)**

MGMT-753 Field Experiences in Business Consulting
Students work in consulting teams to assist startup ventures and/or small businesses. Students focus on multiple aspects of consulting including client engagement, negotiating statements of work, project management, and final briefings and reports. From problem identification through the application of relevant analytical models, course projects may focus on a number of areas. For example, they may seek to develop commercialization plans for specific technologies, products, or services; craft marketing plans; focus on unique problems associated with small businesses; and develop growth strategies. Recommended for students nearing the completion of their program. (ACCT-703, FINC-721, MKTG-761, for business students; permission of instructor for students in other programs) **Credit 3 (S)**

MGMT-755 Negotiations
This course is designed to teach the art and science of negotiation so that one can negotiate successfully in a variety of settings, within one's day-to-day experiences and, especially, within the broad spectrum of negotiation problems faced by managers and other professionals. Individual class sessions will explore the many ways that people think about and practice negotiation skills and strategies in a variety of contexts. **Credit 3 (F, S)**

MGMT-756 **Power and Influence**
Power and influence processes are pervasive and an important part of organizational life. This course has as its objectives enhancing the understanding of these processes and increasing the student's skills in using them. Topics covered include the conditions under which power and politics are more likely to dominate decision processes, assessing the relative power of various actors, understanding the basis for their positions on issues, the sources of both individual and departmental power, power and influence strategies and tactics, and some functional and dysfunctional aspects of organizational politics for both individuals and the organizations involved. (MGMT-740) **Credit 3 (Su)**

MGMT-758 **Seminar in Management**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to management. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from quarter to quarter. (Depends on topic) **Credit 3**

MGMT-759 **Competitive Strategy**
This course reviews the techniques and tools firms use to create a sustainable competitive advantage in the global economy. Cross-functional analysis is a core element in the course. Topics covered include the mission and vision of the firm, analysis of the external environment, analysis of internal resources and capabilities, the role of innovation in strategy development, analysis of global business strategies, developing and implementing business-level and corporate-level strategies, and managing strategy in the multi-business corporation. (all MBA core courses) **Credit 3 (F, S, Su)**

MGMT-761 **Managing Research and Innovation**
This course deals with the responsibilities and operating problems of managers responsible for research and innovation within firms. Topics will include: internal technology assessments, the acquisition of technology, domestic and international technology transfer, and the selection and management of research and development projects. Managerial techniques for stimulating and managing innovation are discussed, based on descriptive and prescriptive readings and cases. Particular attention will be given to managing creative individuals, the nature of disruptive technical innovations, and techniques for overcoming barriers to innovation. (MGMT-742 or MGMT-735) **Credit 3 (S)**

MGMT-762 **Managing New Process and Product Development**
The course deals with the internal organizational challenges faced by managers of innovative and technology-intensive companies. Particular attention is given to management techniques for successfully developing and introducing into the marketplace new products and services. Also discussed are the management of technical groups and project teams, cross-functional integration, and organizational processes and procedures that support innovation and creativity. (MGMT-742 or MGMT-735 or permission of instructor) **Credit 3 (S)**

MGMT-763 **Behavioral Skills for Managers and Professionals**
This course provides the opportunity to develop individual and interpersonal skills that enhance managerial performance in today's high-performance organization. Each student will perform in each of the major skill dimensions, and will be given evaluative feedback and the opportunity to incorporate the implications of that feedback into additional performance opportunities. Course participants are also provided with the opportunity to assess their career work preferences and to compare them with the performance expectations of managerial positions. The management styles of each participant are assessed, and the impact is clarified of the behaviors that flow from each style on the perceptions and performance of others in the organization. (MGMT-740; no prerequisite for MS in Manufacturing Leadership students) **Credit 3 (F, Su)**

MGMT-765 **Applied Venture Creation**
This project-oriented course enables students to gain multi-disciplinary experience in entrepreneurship, venture creation, or product/service commercialization through a number of alternative venues. Student teams gain applied and practical knowledge by participating in an actual entrepreneurial or commercialization project. These projects include: advancing/maturing a student-originated business concept, developing commercialization plans in partnership with various RIT college product/service development projects, or creating commercial business plans for RIT-generated intellectual property. Students meet with supervising faculty on a weekly basis. (Instructor permission required. Prerequisites contingent on project and team mix. See a Saunders College graduate adviser for details.) **Credit 3 (F, S, Su, other)**

MGMT-770 **Business Research Methods**
This course concerns the development, presentation and use of research in managerial decision making. Included are the processes by which meaningful research problems are generated, identification of the relevant literature, rationalization of the research design and interpretation of findings. Students typically work in small groups to execute a research project in one of the functional areas of business. (DECS-782 or equivalent) **Credit 3 (F, S)**

MGMT-775 **Business Ethics**
This course uses cases, readings, and class discussions to apply concepts of ethics to business at the macro level and at the micro level. At the macro level the course examines competing business ideologies exploring the ethical concerns of capitalism as well as the role of business in society. At the micro level the course examines the role of the manager in establishing an ethical climate with an emphasis on the development of ethical leadership in business organizations. The following topics are typically discussed: the stakeholder theory of the firm, corporate governance, marketing and advertising ethics, the rights and responsibilities of employees, product safety, ethical reasoning, business's responsibility to the environment, moving from a culture of compliance to a culture of integrity, and ethical leadership. MBA students who take this course will not be required to take the 1-credit course in Business Ethics. This course should not be taken by MBA students who take the 1-credit course in Business Ethics. **Credit 3 (F, S, Su)**

MGMT-791 **Graduate Project**
This course is used to fulfill the graduate project requirement for the MS degree in management. The candidate must obtain approval from an appropriate faculty member to supervise the paper before registering for this course. A corporate-oriented research project designed by the candidate and his or her advisor to explore a salient management-related issue. **Credit 3–6 (S, Su)**

MGMT-794 **Innovation Project**
This course is limited to students in the Master of Science in Innovation Management Program. It is the first of two courses (Innovation Project and Innovation Capstone) that complete the degree program. Students will analyze an innovation issue and develop a plan to put the innovation into practice. Circumstances permitting, they may test the plan. Students will further define the innovation and the project, collect and analyze relevant data and information, develop alternative solutions, and make recommendations to the professor and outside experts as appropriate. Students will integrate knowledge of innovation, creativity, and business practice while developing and applying innovation skills. Students will receive a grade of incomplete. NOTE: Students will be required to write and have approved by the program firector a one-page description of their proposed innovation before they register for the class. (Four program classes and permission of program director; corequisite: three additional program classes)

MGMT-795 **Innovation Capstone**
Students work with faculty and industry advisors to integrate their business and innovation learning through an applied project. In this project, real-world business problems will be addressed, and solutions will be planned, developed, and potentially deployed. The project may be entrepreneurial in nature, or it may be carried out within an existing company. The project will be conducted under the supervision of the course instructor and other advisors as appropriate. Learning from the applied project will be generalized so that the importance of the work in a broader business context will be clear. Students are required to formally present and defend their proposed innovation to the program director and capstone committee at least six weeks before they start this course. Students may not register for the course unless they have successfully completed this defense. (MGMT-794 or MGMT-765 and permission of program director) **Credit 3 (F, S, Su)**

Economics

ESCB-705 **Economics and Decision Modeling**
The course focuses on the fundamental economic theories most useful for the management of a firm in a global environment. Microeconomic theories and current events are used to explain the performance of the market system and help managers formulate effective pricing and business decisions. Macroeconomic theories and current events are used to explain the direction of the domestic and global economy to help managers understand the implications, including foreign direct investment, for their companies. Students will learn to explain and predict changes in economic growth, inflation, interest rates, international trade and foreign exchange rates. (DECS-066 or equivalent) **Credit 3 (F, S, Su)**

ESCB-711 **Microeconomics**
Microeconomics introduces the principles of economic analysis as applied to micro decisions to determine how an organization can achieve its aims most efficiently. This course applies statistical and quantitative tools and the methodological approaches commonly used by economists to business problems as demand estimation, product pricing, profit maximizing level of output, cost minimizing level of input use, and forecasting. (ESCB-705 or two previous economics courses, one in microeconomics and one in macroeconomics with a grade of B or better.) **Credit 3 (S)**

ESCB-712 **Macroeconomics**
This is an intermediate macroeconomics course with a focus on the relationship between economic performance and financial markets in a global environment. A framework of product and money market equilibrium is developed that recognizes all economies are linked through international markets for goods, services, and capital. Open-economy models are developed to explain economic growth, inflation, interest rates, foreign exchange rates, trade balances, and the attractiveness of an economy for business investment. (ESCB-705 or two previous economics courses, one in microeconomics and one in macroeconomics with a grade of B or better.) **Credit 3 (F)**

ESCB-758 **Seminar in Economics**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to Economics. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. (Instructor determined) **Credit 3 (F, S)**

Finance

FINC-605 **Financing New Ventures**
Financing New Ventures focuses on financial issues affecting an entrepreneur. The course emphasizes, identifies and follows the wealth creation cycle. The wealth creation cycle begins with an idea for a good, product or service, progresses to an initial company startup, passes through successive stages of growth, considers alternative approaches to resource financing, and ends with harvesting the wealth created through an initial public offering, merger or sale. Identification and valuation of business opportunities, how and from whom entrepreneurs raise funds, how financial contracts are structured to both manage risk and align incentives, and alternative approaches by which entrepreneurs identify exit strategies are reviewed. **Credit 3 (F)**

FINC-721 **Financial Analysis for Managers**
An examination of basic financial theories, techniques, and practices. Topics include: time value of money, valuation, capital asset pricing, risk and diversification, cost of capital, capital budgeting techniques and spreadsheet analysis. (ACCT-703 pre- or corequisite) **Credit 3 (F, S)**

FINC-722 **Financial Management II**
This advanced course in corporate finance focuses on financing policies, financial planning/control, and other advanced corporate topics. Specific topics include the financing process, alternative financing instruments, restructuring, cost of capital, corporate applications involving options, working capital management and the use of financial budgets/forecasts. (FINC-721) **Credit 3 (F, S)**

FINC-725 **Securities and Investment Analysis**
A survey of topics in investment analysis, including the study of financial markets, features of various financial assets and security pricing. Focus is on individual security analysis (as distinct from portfolio analysis). Asset pricing theory is used in valuing securities. Practical issues in equity valuation are discussed including risk evaluation, macroeconomic/industry/competitive analysis and the use of corporate SEC filings. (FINC-721) **Credit 3 (F, S)**

FINC-732 **Portfolio Management**
This course extends the knowledge of risk and return in a portfolio context to portfolio management. Topics include portfolio optimization, diversification strategies, hedging strategies and performance evaluation. A variety of investment tools (e.g., fixed income securities) and investment contexts (e.g., pensions) will be studied. (FINC-725) **Credit 3 (F, S)**

FINC-740 **Options and Futures**
This course focuses on financial derivative securities. Their role in financial management is becoming increasingly important, especially in portfolio management. This course covers valuation of various options and futures as well as their use in risk management. Specific topics include options and futures pricing models, options strategies, and contemporary topics such as index arbitraging. (FINC-721), **Credit 3 (F, S)**

FINC-742 **Financial Modeling and Analysis**
Students apply computer technology to solve finance-related problems using a variety of analytical methods. Analytical methods include spreadsheet modeling, mathematical optimization, regression, decision tree analysis and Monte Carlo Simulation. Typical topics covered are financial forecasting, pro-forma financial statements, equity valuation, cash budget forecasts, and portfolio analysis. This is a hands-on course that focuses on collecting, managing and analyzing financial data. (Pre- or corequisite FINC-721, FINC-722, FINC-725) **Credit 3 (F, S)**

FINC-744 **Innovation in Financial Markets and Securities**
Advanced course exploring the twin-issue of (a) innovation in market structures and security design and (b) use of complex securities by market participants. Topics include financial engineering, market microstructure, debt and equity market innovations, securitization, interest rate/credit derivative applications, and hedging methods. (Pre- or corequisite FINC-721, FINC-725, FINC-740) **Credit 3 (F, S)**

FINC-758 **Seminar in Finance**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to Finance. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. (Instructor-determined) **Credit 3**

FINC-760 **Finance in a Global Environment**
This course has a specific focus on international business problems that are financial in nature. Topics include an examination of the international environment the firm operates in, international investment, exchange rates and the management of risks arising from shifting exchange rates, and the problems of short and long-term asset and liability management. (pre- or corequisite FINC-721) **Credit 3 (F, S)**

Marketing

MKTG-758 **Seminar in Marketing**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to marketing. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from quarter to quarter. (varies according to topic) **Credit 3**

MKTG-761 **Marketing Concepts and Commercialization**
An introduction to contemporary principles and practices of marketing. The course is structured around the process of marketing planning leading to the development of successful marketing strategies, including the commercialization of products and services in domestic and international environments. Focus is on environmental scanning techniques, setting and evaluating measurable objectives, innovating and controlling the interrelated components of product/service offering, planning and executing the marketing mix (channels of distribution, price, and promotion), and enhancing customer relationships through the delivery of customer value. **Credit 3 (F, S, Su)**

MKTG-762 **Advanced Marketing Management**
This course is an advanced study of the strategic and operational decisions facing a marketing executive today. Topics covered include marketing management problems, branding and positioning, digital marketing, marketing analytics, marketing research and marketing in the new economy. The course will present various concepts and tools for evaluating the marketplace (external environment, competitors, marketing opportunities and threats), and for analyzing marketing strategies. (MKTG-761) **Credit 3, (S)**

MKTG-763 **Buyer Behavior**
The course reviews the major theories that frame the understanding of both consumer (end-user) and business buying behavior. Topics include the buying decision process, the impact of emotion, product knowledge, and product involvement on purchasing decisions. In addition, behavioral, social and psychological perspectives will be discussed. All perspectives will be applied to designing marketing strategy. (MKTG-761) **Credit 3 (F)**

MKTG-764 **Channel Management**
This course involves a study of the elements and management of marketing channels. A marketing channel is viewed as an inter-organizational system involved with the task of making goods, services and concepts available for consumption by enhancing their time, place and possession utilities. The course focuses on ways channels can be developed and managed to improve efficiency and effectiveness increasing firm profitability. (MKTG-761) **Credit 3**

MKTG-767 **Advertising and Integrated Marketing Communications**
An in-depth view of tools of advertising, sales promotion, public relations, personal selling, direct marketing and Internet marketing. Basic concepts of advertising using print, broadcast, Internet and outdoor media are studied. Planning, budgeting and the roles of advertising agencies are also covered. Students develop a comprehensive promotion plan beginning with the marketing strategy and ending with implementation and evaluation. The project, in which the student plans and prepares a promotion/advertising campaign for a product or service in consultation with the instructor is an integral part of the course. (MKTG-761) **Credit 3 (S)**

MKTG-771 **Marketing Research Methods**
This course provides an overview of marketing research and practice, especially the methods of measuring, examining, and predicting factors that affect the marketing process. Students will learn about the process of conducting surveys and experiments that includes the following: determining customer requirements, questionnaire design, telephone, mail and electronic surveys, sampling plan design and data analysis. (MKTG-761, DECS-782 or equivalent) **Credit 3 (F, S)**

MKTG-772 **Internet Marketing: Strategy and Tactics**
This course examines the impact that the Internet has on traditional and contemporary business-to-consumer marketing activities. It explores these implications in both strategic and tactical terms to enhance organizations' levels of competitiveness. The course identifies the use of the Internet in enhancing value for consumers and considers the leverage of: the latest technologies, trends, e-culture and innovation through the medium of the Internet. (MKTG-761) **Credit 3 (F, S)**

MKTG-773 **Database Marketing**
This course provides the student with the application of database management to the challenges of relationship marketing. The students will be taught data mining tools which they will use to conduct an analysis of a database and apply it to the design of a relationship marketing plan. (MKTG-761, DECS-782) **Credit 3 (F, S)**

MKTG-775 **Business-to-Business E-Marketing**
The focus of this course is on the effective integration and coordination of various business to business marketing operations within the realm of e-commerce. The course explores from a marketing perspective factors critical to the success of e-business operations and examines the strategies and tactics that organizations can use to build and/or enhance their business to business relationships using electronic tools. (MKTG-761) **Credit 3**

MKTG-776 **Product and Brand Management**
An essential element of corporate success is the management of products and brands. Firms in both consumer and commercial industries often manage their marketing strategies and tactics through the activities of their product and brand managers. This course will examine the role of product and brand managers in the development and execution of strategies that deliver value to targeted customers and grow the business. The role of product and brand managers will be examined through all phases of the firm's product and brand life cycle. The course emphasizes the decisions that firms expect product and brand managers to make to achieve market share and financial objectives. (MKTG-761) **Credit 3 (F, S)**

MKTG-778 **Commercialization and Marketing of New Products**
This course emphasizes the marketing and product strategy-related activities required to create, develop, and launch successful new products. Topics covered include identifying the market opportunity for new products, defining the product strategy, understanding customer requirements, developing and updating the product business plan, marketing's role in the firm's product development process, developing the marketing plan for launching new products, and managing the product life cycle. The course emphasizes best practices in marketing-related activities required for successful new product commercialization. (MKTG-761) **Credit 3 (S)**

Decision Science

DECS-743 **Operations and Supply Chain Management**
Study of the management of operations and supply chain management. Encompasses both manufacturing and services. Topics include operations and supply chain strategy, ethical behavior, forecasting; work systems, inventory management, capacity and materials planning, lean operation, supply chain design and closed-loop supply chains, global operations, quality management, quality control, and quality improvement, project management; and current issues. (basic course in statistics or DECS-066) **Credit 3 (F, S, Su)**

DECS-744 **Project Management**
A study in the principles of project management and the application of various tools and techniques for project planning and control. This course focuses on the leadership role of the project manager, and the roles and responsibilities of the team members. Considerable emphasis is placed on statements of work and work breakdown structures. The course uses a combination of lecture/discussion, group exercises, and case studies. **Credit 3 (F, S)**

DECS-745 **Quality Control and Improvement**
Study of total quality management (TQM), including Deming's philosophy, quality planning, quality cost principles, problem-solving methods and tools, the use of statistical methods for quality control and improvement, supplier relations, reliability concepts, and recent developments in quality. The course focus is on the management and continuous improvement of quality and productivity in manufacturing and service organizations. (DECS-782 or equivalent) **Credit 3 (S)**

DESC-758 **Seminar in Decision Science**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to Decision Science. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. (instructor-determined) **Credit 3**

DECS-782 **Statistical Analysis for Decision Making**
This is a course in applied statistics emphasizing an understanding of variation and inference (estimation and testing). Topics to be covered include: review of descriptive statistics, normal distribution, sampling distributions, estimation, test of hypothesis for single and two populations, analysis of variance (ANOVA), linear regression, multiple regression and model building. Students will apply these concepts using mini-cases and problem sets that involve both structured and unstructured data sets. The application of appropriate tools will be required. **Credit 3 (F, S, Su)**

Business Legal Studies

BLEG-612 **Legal and Accounting Issues for New Ventures**
An introduction to basic legal and accounting issues that managers and developers of new business ventures must understand at the outset. Topics include financial statements prepared using both the cash basis and GAAP, differences among basic legal forms of business organization and related income tax issues, budgeting and cash flow management, and product costing. The focus is on understanding the legal and accounting components of the business plan. **Credit 3 (S)**

BLEG-730 **Business Legal Concepts**
An introduction to legal principles and their relationship to business organizations. Explores the U.S. legal system, the U.S. court system, civil and criminal procedure, the role of government agencies, legal research, and the substantive areas of law most relevant to business, including constitutional law, tort law, criminal law, contract law, intellectual property, debtor-creditor relations, bankruptcy, business entities, securities regulation and antitrust law. Extensive legal research projects are an essential part of the course. **Credit 3 (S)**

BLEG-731 **Commercial Law and Professional Skills**
Explores the impact of the Uniform Commercial Code and other substantive areas of law on business operations. Emphasis is on topics included on the certified public accounting exam, including provisions of the Uniform Commercial Code dealing with the sale and lease of goods, product warranties, commercial paper, negotiable instruments and secured transactions. Other topics include business entities, creditors' rights, bankruptcy, and insurance law. A research project on legal issues is an important aspect of this course. (BLEG-730 or equivalent) **Credit 3 (F)**

BLEG-745 **Legal and Ethical Issues in Technology-intensive Environments**
The course confronts graduate students with a wide variety of legal and ethical issues in organizational environments that are technologically intensive, such as information technology and the life sciences. Impacts of intellectual property legislation and legal cases in national and international venues are investigated. Legal and social issues involving individual privacy are argued. This exposure to legal and ethical dilemmas is an important tool as the graduates encounters such situations throughout their careers. Coupled with technical proficiency, the ability to deal with legal and ethical issues shapes professional successes and failures. (Not available to students who have completed MGMT-775.) **Credit 3 (F, S)**

BLEG-758 **Seminar in Business Legal Studies**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to Business Legal Studies. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. (Instructor determined) **Credit 3**

Management Information Systems

MGIS-710 Information Systems Concepts
This course is an introduction to the conceptual and theoretical foundations of management information systems and their role in modern organizations. The course will provide students with the concepts, tools and techniques needed to understand and to interpret information management issues, such as how to best incorporate information technology into an organization, from a managerial perspective. **Credit 3 (F, S)**

MGIS-715 Information Technology and Globalization
This course explores the professional and organizational implications of managing in an era of expanding globalization and revolutionary change in Information Technology (IT). Course participants will: 1) develop awareness of critical intersections between IT and globalization; 2) address the challenges facing world business through a series of timely projects that address an individual culture's adoption of IT. A unique aspect of the course is the interaction of two very current business forces, around which revolve some of the most significant business questions of our time. **Credit 3 (S)**

MGIS-720 Information Systems Design
This course provides students with fundamental knowledge and skills required for successful analysis of problems and opportunities related to the flow of information within organizations and the design and implementation of information systems to address identified factors. Students are provided with knowledge and experience that will be useful in determining systems requirements and developing a logical design. **Credit 3 (F)**

MGIS-725 Data Management
This course discusses issues associated with data capture, organization, storage, extraction, and modeling for planned and ad hoc reporting. Enables student to model data by developing conceptual and semantic data models. Techniques taught for managing the design and development of large database systems including logical data models, concurrent processing, data distributions, database administration, data warehousing, data cleansing, and data mining. **Credit 3 (S)**

MGIS-730 Information Systems Consulting
This course provides students with fundamental knowledge and skills required for information systems consulting. Topics covered include client relationship management, information systems requirements analysis, proposal development, scope negotiation, costing, knowledge acquisition and management, system design, solutions deployment and systems integration, outsourcing and change management. (pre- or corequisite: MGIS-720) **Credit 3 (S)**

MGIS-745 Information Systems Development
Systems Development provides MBA students with the fundamental techniques and concepts necessary for programming in a modern programming language. Emphasis will be placed on object-oriented programming concepts. By the end of the course, students will demonstrate core programming concepts, and will be able to write simple business applications. **Credit 3 (F, S)**

MGIS-755 Information Technology Strategy and Management
Information systems increasingly have a strategic role in organizations, both public and private. Information technology has changed the ways organizations interact internally and externally, the management of production processes, and how organizations compete. Students examine how IT is used to support the management of the firm's core business processes. Topics include the nature of IT, its role in supporting business strategy, the impacts of information systems on organizations, IT governance processes, and the strategic use of information technology in leading organizations. **Credit 3 (F, S)**

MGIS-758 Seminar in Management Information Systems
Special topics seminars offer an in-depth examination of current events, issues and problems unique to MIS. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. (Instructor determined) **Credit 3 (F, S)**

MGIS-760 Integrated Business Systems
This course focuses on the concepts and technologies associated with Integrated Business Information Systems and the managerial decisions related to the implementation and ongoing application of these systems. Topics include business integration and common patterns of systems integration technology including Enterprise Resource Planning (ERP), Enterprise Application Integration (EAI) and Data Integration. The key managerial and organizational issues in selecting the appropriate technology and successful implementation are discussed. Hands-on experience with the SAP R/3 system is utilized to enable students to demonstrate concepts related to integrated business systems. (familiarity with MS Office suite and Internet browsers) **Credit 3 (S)**

MGIS-761 Business Process Analysis and Workflow Design
A common theme held in business today is identifying opportunities for improvement. By analyzing, redesigning and where possible, automating business processes, companies look to add value, improve operating efficiencies and reduce costs. Students explore approaches to analyzing and designing processes and apply graphic modeling techniques that allow for clear and simple definition, analysis and improvement of processes. Systems used for automating process workflow are introduced, such as workflow tools or SAP's R/3 workflow application. (MGIS-760) **Credit 3 (S)**

International Business

INTB-710 Global Business Opportunities and Threats
This course is designed to keep students informed of the current trends of global business, develop students with the necessary theoretical foundations and analytical skills to compete in the global environment, and equip students with the knowledge base to take advantage of global opportunities and avoid risks in international business. Subject areas include how to discover opportunities and analyze risks in international trade, foreign investment, foreign exchange, and regional integrations. **Credit 3 (F, S)**

INTB-730 Cross-Cultural Management
An analysis of comparative global business behavior and organization with particular emphasis on values, authority, individual and group relations, labor-management ties, risk tolerance, and motivational techniques. The course will prepare students to recognize different values and cultural factors in the global business community and how these shape and determine appropriate management behavior. The problems and opportunities of transferring management practices from one culture to another will also be examined. (MGMT-740) **Credit 3**

INTB-750 Global Marketing Management
A managerial-focused course that examines global marketing from a strategic perspective. This course provides a framework for identifying and analyzing the cultural and environmental differences of countries and regions that impact global marketing. Students will evaluate opportunities and challenges in global markets to develop appropriate marketing programs and market-entry strategies. Topics include foreign market opportunity assessment, commercialization and entry strategy development, customer analysis, distribution channels, and promotion in global markets. (MKTG-761) **Credit 3 (F, S)**

INTB-758 Seminar in Global Business
This course offers an in-depth analysis of the global institutional environment and provides students the opportunity to research a variety of global business issues, such as regional business studies, emerging markets, and global industry analysis. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific semester will be announced prior to the course offering. (Instructor determined) **Credit 3 (S)**

INTB-780 Global Issues and Strategies
This course will focus on contemporary international and global business issues, such as governance, outsourcing and off shoring, role of non-governmental organizations (NGOs), etc. It will emphasize faculty-directed student research projects. (INTB-710) **Credit 3 (S)**

B. Thomas Golisano College of Computing and Information Sciences

Andrew L. Sears, Dean

www.gccis.rit.edu

Programs of study

Online learning option available

*No new students will be admitted to these programs for the 2012-13 academic year.

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The B. Thomas Golisano College of Computing and Information Sciences is one of the most comprehensive computing colleges in the United States. The college offers 17 bachelor's, master's, and doctoral degrees in computing. With its focus on interdepartmental and intercollege cooperation, the college directs its energy and effort toward discovering new, innovative methods and research opportunities in solving complex, present-day and future computing challenges.

The college's programs address the growing need for experts in the fields of computational science, gaming, simulation, computer security and forensics, edutainment, management of complex information technology infrastructures, and software engineering. These programs offer the most current thinking in computing and information sciences and technology, and are supported by extensive laboratory facilities.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

The college's faculty is a dedicated group of teacher-scholars and scholar-teachers, performing scholarly work with an emphasis on student involvement and career preparation. Faculty members provide leadership by implementing innovative teaching techniques and anticipating and meeting the needs of students and our industrial partners. Many have significant industrial experience in addition to outstanding academic credentials.

Research

The Golisano College supports learning and research across disciplines where students, faculty, and industry converge to develop and advance cutting-edge computing technology and innovative applications of computing across science, engineering, business, and even the social sciences. Project teams, often multi-disciplinary, are formed consisting of faculty and students of complementary computing and domain expertise.

Facilities

The college houses extensive laboratories containing powerful computing. Labs are available to students 16 to 18 hours a day. Network, wireless, and Web access also are available throughout the college, ensuring that our students have the tools necessary to complete their assignments and projects.

The college is equipped with more than 2,000 workstations and more than 50 classrooms, labs, and studio labs. There are labs and studios dedicated to networking, security, entertainment technology, human-computer interaction, computer vision, and robotics.

Study options

Courses are available during the day and evening, allowing for full- or part-time study. Several master's degrees and advanced certificate programs are available online. Please refer to each individual program for more information.

Computer Science, MS

http://www.cs.rit.edu/
Hans-Peter Bischof, Ph.D., Graduate Program Director
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Program overview

The computer science program is designed for students who have an undergraduate degree (or minor) in computer science, as well as those who have a strong background in a field in which computers are applied, such as engineering, science, or business.

The degree is offered on a full- or part-time basis. Courses are generally offered in the afternoon and evening to accomodate part-time students. A full-time student, one who takes three courses per quarter, may be able to complete the course work in one year; part-time students may finish in two to four years. The time required to complete a master's thesis or project varies according to the student and the scope of the project; two quarters is typical.

Curriculum

The program consists of 45 credit hours of course work plus the completition of a thesis or project. Students with a strong background in a core area may receive permission from the graduate program director to replace a core course with another course, generally in the same area.

Concentration

Students can concentrate in intelligent systems, languages and tools, distributed systems, security, theory, databases/data mining, or graphics.

Electives

Electives provide breadth of experience in computer science and applications areas. Students who wish to include courses from departments outside of computer science need prior approval of the graduate program director. Refer to the course descriptions in the departments of computer science, engineering, mathematical sciences, and imaging science for possible elective courses.

Master's thesis or project

A thesis paper or project forms a capstone to the program. A student must complete the graduate seminar and submit an acceptable proposal to the computer science faculty before registering for, or initiating, a thesis or project.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Computer science (thesis option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
4005-800	Theory of Computer Algorithms	4
4005-893	Graduate Seminar	4
	Cluster Course 1, 2, 3, 4	16
	Elective 1, 2, 3, 4	16
	Thesis	7
Total Quarter Credit Hours		**45**

Computer science (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
CSCI-665	Foundations of Algorithms	3
CSCI-687	Graduate Research Seminar	3
	Cluster Course 1, 2, 3	9
	Elective 1, 2, 3	9
CSCI-790	Thesis	6
Total Semester Credit Hours		**30**

Computer science (project option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
4005-800	Theory of Computer Algorithms	4
4005-893	Graduate Seminar	4
	Cluster Course 1, 2, 3, 4	16
	Elective 1, 2, 3, 4, 5	20
	Project	3
Total Quarter Credit Hours		**45**

Computer science (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
CSCI-665	Foundations of Algorithms	3
CSCI-687	Graduate Research Seminar	3
	Cluster Course 1, 2, 3	9
	Elective 1, 2, 3, 4	12
CSCI-788	Project	3
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS in computer science, candidates must fulfill the following requirements:

- Hold a baccalaureate or equivalent degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Exam*,
- Have a minimum grade point average of 3.0 (B), and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. A minimum score of 570 (paper-based) or 88 (Internet-based) is required.

*GRE scores will be considered for applicants whose undergraduate grade point average is lower than 3.0.

Prerequisites

Applicants must satisfy prerequisite requirements in mathematics (differential and integral calculus, probability and statistics, discrete mathematics, and computer science theory) and computing (experience with a modern high-level language [e.g., C++, Java], data structures, assembly language programming, software design methodology, introductory computer architecture and digital logic, operating systems, and programming language concepts).

Additional information

Bridge program

If an applicant lacks any prerequisites, bridge courses may be recommended to provide students with the required knowledge and skills needed for the program. If any bridge courses are indicated in a student's plan of study, the student may be admitted to the program on the condition that they will successfully complete the bridge program courses with a grade of B or better (courses with lower grades must be repeated). Generally, formal acceptance into the program is deferred until the applicant has made significant progress in this additional course work. The bridge program courses are not counted as part of the 45 quarter credit hours required for the master's degree.

A bridge program can be designed in different ways. Often, other courses can be substituted, and courses at other colleges may be applied. See the Computer Science Graduate Studies Handbook for more details. All programs must be approved in advance by the graduate program director.

Faculty

Faculty members in the department are actively engaged in research in the areas of artificial intelligence, computer networking, pattern recognition, computer vision, graphics, visualization, data management, theory, and distributed computing systems. There are many opportunities for graduate students to participate in these activities toward thesis or project work and independent study.

Facilities

The computer science department provides extensive facilities that represent current technology, including:

- a graduate lab with more than 15 Mac's and a graduate library;
- specialized labs in graphics, computer vision, pattern recognition, security, database, and robotics; and
- six general purpose computing labs with more than 100 workstations running Linux, Windows, and Mac, OSX; plus campus-wide wireless access.

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Game Design and Development, MS

igm.rit.edu/
Andrew Phelps, Director
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Christopher Egert, Associate Director/Graduate Program Director
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Program overview

The master of science degree in game design and development allows students to explore the entertainment technology landscape, along with other related areas of software development. The program has its technical roots in the computing and information science disciplines, while simultaneously covering the breadth of the game development field through course work in topics such as computer graphics design, human-computer interaction, interactive narrative, and game design. The degree is specifically for students whom aspire to careers within the professional games industry or a related field such as simulation, edutainment, or visualization.

This is a two-year, on-campus, cohort-based program in which students are admitted through a portfolio review process. Upon completion of their course work, students form development teams that construct a working game engine and software title as the program capstone experience. This requirement includes both individual and group expectations. The capstone culminates in a private defense before program faculty, as well as a public exhibition. Combined, these requirements provide a unique and comprehensive educational experience for individuals who aspire to a career in the game development industry.

Curriculum

The program's curriculum consists of a seminar sequence of required courses followed by a core course sequence, a minor, and a capstone experience.

Seminar sequence

Students will complete a sequence of five required courses that provide a foundation in game design and development. The sequence is designed to bring students of various cohorts together to investigate industry issues. The required courses are: History and Critical Analysis of Computer Games and Interactive Entertainment (4085-791), Online Identity, Social and Community Behavior (4085-794), Emerging Themes in Entertainment Technology (4085-790), Development Processes in the Games Industry (4085-792), and Business and Legal Aspects of Game Development (4085-793).

Capstone experience

During the second year, students complete a 20-week, team-based capstone experience where students present and defend their work. This presentation includes a private faculty review, which constitutes the capstone defense, a public presentation, and a demonstration.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Game design and development, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4085-791	History and Critical Analysis of Computer Games and Interactive Entertainment	4
4085-794	Online Identity, Social and Community Behavior	4
4085-790	Emerging Themes in Entertainment Technology	4
	Core Sequence Course 1, 2, 3	12
	Minor Course 1, 2, 3	12
Second Year		
4085-792	Development Processes in the Games Industry	4
4085-793	Business and Legal Aspects of Game Development	4
	Core Sequence Course 4, 5, 6	12
4085-887	Capstone Design	4
4085-888	Capstone Development	2*
Total Quarter Credit Hours		**62**

* The number of capstone credits does not fully represent the expected level of effort and work involved (i.e. more than 6 credits of course work) in successfully completing the development of a game.

Game design and development, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IGME-601	Game Development Processes	3
IGME-602	Game Design	3
IGME-603	Gameplay and Prototyping	3
IGME-695	Colloquium in Game Design and Development	2
	Advanced Elective I, 2, 3	9
Second Year		
IGME-788	Capstone Design	3
	Advanced Elective 4, 5	6
IGME-795	Game Industry Themes and Perspectives	1
IGME-789	Capstone Development	3
Total Semester Credit Hours		**33**

Core course sequence

Students choose one of the following core course sequences: game engine development or artificial intelligence. These courses provide a foundational focus for the student's study in the program.

COURSE		QUARTER CREDIT HOURS
Game engine development		
4005-761	Computer Graphics I	4
4005-762	Computer Graphics II	4
4085-834	2D Graphics Programming	4
4085-835	3D Graphics Programming	4
4005-763	Computer Animation: Algorithms and Techniques	4
4085-836	Game Engine Design and Development	4
Artificial intelligence and simulation		
4005-750	Introduction to Artificial Intelligence	4
4085-891	Advanced AI: Evolutionary Computing	4
4005-752	Artificial Intelligence for Interactive Environments	4
4005-759	Topics in Artificial Intelligence	4
4005-756	Genetic Algorithms	4
4005-755	Neural Networks and Machine Learning	4

Minor

Students complete a minor consisting of three courses. The minor gives students an opportunity to investigate a game-related specialty track of the student's interest. Students may select one of the pre-approved minors, or they may create a minor with the approval of the program director.

COURSE		QUARTER CREDIT HOURS
Asset creation and management		
2014-721	3DDG Modeling	4
Plus two courses from the following:		
2014-722	3DDG Interactive Motion	4
2014-731	3DDG Lighting	4
2014-732	3DDG Shading	4
2014-733	3DDG Character Design	4
2014-747	3DDG Rendering	4
2014-798	Production Pipeline	4
Content authoring for games		
4085-728	Interactive Narrative	4
4085-732	Game Design	4
4085-744	Building Online Communities	4
Human-computer interaction		
4004-745	Foundations of Human Computer Interaction	4
4004-748	Usability Engineering	4
4004-749	Usability Testing	4
Database architecture and design		
4002-720	Data Object Development	4
4002-784	Foundations of Database Client/Server Connectivity	4
4002-785	Fundamentals of DBMS Architecture and Implementation	4

Admission requirements

To be considered for admission to the MS in game design and development, candidates must fulfill the following requirements:

- Hold an undergraduate degree in a relevant field, such as information technology, computer science, software engineering, or computer graphics. Students with undergraduate degrees in related disciplines such as computer animation or human computer interaction may be considered.
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work.
- Have a minimum GPA of 3.25 or a first-class international degree with distinction.
- Submit a portfolio that includes evidence of individual and group projects (clearly marked as such) relevant to the area that the individual wishes to study within the degree program.
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 570 (paper-based) or 88 (Internet-based) is required. Scores from the Graduate Record Exam (GRE) must also be submitted.

Due to the cohort nature of the program, students are admitted in the fall quarter only. Admission to the program is highly competitive, and applicants are selected in a manner that ensures balance among the various curricular tracks and specialties. Students may use GRE scores to strengthen their application and those applicants with a GPA below 3.25 are required to submit GRE scores.

Additional information

Prerequisites

Students are expected to have at least one year of significant programming experience in a current object-oriented language—preferably C++ or Java—and a solid working knowledge of website development and interactive multimedia concepts. If students do not have these prerequisites, additional course work may be recommended to bridge any educational gaps.

Maximum time limit
University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.Prerequisite courses are excluded.

Computing and Information Sciences, Ph.D.

http://phd.gccis.rit.edu/
Pengcheng Shi, Program Director
(585) 475-6147, pengcheng.shi@rit.edu

Program overview

The doctoral program in computing and information sciences is designed to produce independent scholars, well-prepared educators, and cutting-edge researchers poised to excel in their work in computing and interdisciplinary academic, industrial, or government environments. The degree highlights two of the most unique characteristics of the Golisano College: its breadth of program offerings and its scholarly focus on discovering solutions to real-world problems by balancing theory and practice.

The program focuses on the theoretical and practical aspects of cyberinfrastructure as applied to specific problems across multiple domains. It is a blend of intra-disciplinary computing knowledge areas and inter-disciplinary domain areas.

Cyberinfrastructure

Cyberinfrastructure (CI) is a comprehensive infrastructure integrating hardware, data, networks, and digitally-enabled sensors to provide secure, efficient, reliable, accessible, usable, and interoperable suites of software and middleware services and tools. Our doctorate program plays a leadership role in CI research by providing human-centered tools for the science and engineering communities. These tools and services focus on such areas as high performance computing, data analysis and visualization, cyberservices and virtual environments, and learning and knowledge management.

Intra-disciplinary knowledge

There are three intra-disciplinary computing knowledge areas: interaction, informatics, and infrastructure.

Interaction

Interaction refers to topics related to the combined action of two or more entities (human or computational) that affect one another and work together when facilitated by technology. It encompasses several subtopics relating to how people and technology interact and interface. Several common threads weave through all of these areas, many of which rely heavily and build upon foundations in the social and behavioral sciences with an emphasis on understanding human and social/organizational phenomena. To some extent, these fields follow an engineering approach to the design of interactions in which solutions are based on rules and principles derived from research and practice, but require analyses that go beyond the analytical approach. From this perspective, solutions can be measured and evaluated against goals and intended outcomes. However, while efficiency and effectiveness are often the watchwords of these fields in practice, this is also where science meets art in computing. Creative design and sensitivity to human needs and aesthetics are critical. Some of the specialties available in this area are human-computer interaction, computer-based instructional systems, and access technologies.

Informatics

Informatics is the study of computational/algorithmic techniques applied to the management and understanding of data-intensive systems. It focuses on the capture, storage, processing, analysis, and interpretation of data. Topics include algorithms, complexity, and discovery informatics. Data storage and processing require investigation into tools and techniques for modeling, storage, and retrieval. Analysis and understanding require the development of tools and techniques for the symbolic modeling, simulation, and visualization of data. The increased complexity of managing vast amounts of data requires a better understanding of the fundamentals of computation. These fundamentals include complexity, theory to determine the inherent limits of computation, communication, cryptography, and the design and analysis of algorithms to obtain optimal solutions within the limits identified. Some of the specialties available in this area are core informatics, discovery informatics, and intelligent systems.

Infrastructure

Infrastructure comprises aspects related to hardware, software (both system software and applications), communications technology, and their integration with computing systems through applications. The focus is on the best organization of these elements to provide optimal architectural solutions. On the hardware side it includes system-level design (e.g., for system-on-a-chip solutions) and their building block components. On the software side it covers all aspects of systems and applications software development, including specification and design languages and standards; validation and prototyping, and multi-dimensional Quality-of-Service management; software product lines, model-driven architectures, component-based development, and domain-specific languages; and product estimation, tracking, and oversight. The communications subtopic includes sensor networks and protocols; active, wireless, mobile, configurable, and high speed networks; and network security and privacy, quality of service, reliability, service discovery, and integration and inter-networking across heterogeneous networks. At the system level there are issues related to conformance and certification; system dependability, fault tolerance, verifiable adaptability, and reconfigurable systems; real-time, self adaptive, self-organizing, autonomic systems. Some of the specialties available in this area are networks and security, digital systems and VLSI, software design and productivity, and systems software.

Interdisciplinary domains

The program focuses on domain-specific computing, or the interaction between computing and non-computing disciplines, in the areas of science, engineering, medicine, arts, humanities, and business. By incorporating domain-specific computing, the research conducted in this program applies computing and information science principles to the solution of problems in application domains that lie outside of the scope of the traditional computing discipline. The research requirement incorporates fundamental concepts in cyberinfrastructure that are necessary for understanding the problems commonly encountered in advancing scientific discovery and product development in cross-disciplinary domains.

Active research areas

Computing technology

- Algorithm and theory
- Grid and cloud computing
- Communication and networking
- Computer vision and pattern recognition
- Database and data mining
- Graphics and visualization
- Human-computer interaction
- Machine learning
- Security and cryptology
- Software engineering

Domain applications

- Access technology
- Biomedical computing
- Computational astrophysics
- Environmental informatics
- Green computing
- Imaging and image informatics
- Service sciences
- Social computing

Curriculum

The program requires a minimum of 99 quarter credit hours beyond the baccalaureate level. These credit hours are comprised of graduate-level coursework, including seminar attendance and research credits.

Required courses

Students will complete 24 quarter credit hours of required courses and 3 quarter credit hours of teaching skills courses.

Electives

Elective courses provide foundation support of the student's dissertation research area. These courses will come from the intra-disciplinary knowledge areas courses (interaction, informatics, infrastructure), domain courses, and other electives.

Dissertation and research

Students are required to conduct original research involving two of the three intra-disciplinary knowledge areas (interaction, informatics, and infrastructure) and applied to a domain.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Computing and information sciences, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4040-810	Research Methods	4
4040-811	Introduction to Research	4
4040-820	Discovery	4
4040-896	Colloquium	0
4040-890	Dissertation and Research	12
	Electives	44
Second Year		
4040-840	Security and Trust	4
4040-830	Connectivity	4
4040-807	Teaching Skills Workshop I	2
4040-809	Teaching Skills Apprenticeship	1
4040-850	Design	4
4040-896	Colloquium	0
4040-890	Dissertation and Research	20
	Electives	16
Third Year and Beyond		
4040-890	Continuation of Dissertation and Research	0
Total Quarter Credit Hours		**99**

Computing and information sciences, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CISC-810	Research Foundations	3
CISC-820	Quantitative Foundations	3
CISC-830	Cyberinfrastructure Foundations	3
CISC-890	Dissertation and Research	6
	Infrastructure Core Elective	3
	Interaction Core Elective	3
	Informatics Core Elective	3
Second Year		
	Graduate Electives	9
CISC-890	Dissertation and Research	7
CISC-807	Teaching Skills Workshop	2
Third Year		
CISC-890	Dissertation and Research	18
Fourth Year (and beyond)		
	Continuation of Dissertation and Research	0
Total Semester Credit Hours		**60**

Assessments

Each student must pass three assessment examinations in the following order:

Research potential assessment

Completed after the first year, this assessment evaluates the research tasks students have worked on in their first year in the program. Passing this assessment will qualify students to continue in the doctoral program.

Thesis proposal defense

This is an oral qualifying examination completed after the thesis proposal is written. Formal admission to candidacy will be granted after successfully passing the research potential assessment requirement and having a research proposal approved by the dissertation committee. The dissertation committee will have a minimum of four members including the student's adviser.

Dissertation defense

This is the final examination. The dissertation defense includes the dissertation committee and an external reader from outside RIT. The exam consists of a formal, oral presentation of the thesis research by the student, followed by questions from the audience.

Admission requirements

To be considered for admission to the doctorate program in computing and information sciences, candidates must fulfill the following requirements:

- Hold a baccalaureate degree or its equivalent,*
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,

- Submit scores from the Graduate Record Examination (GRE)†,
- Submit a statement of purpose, containing, but not limited to, research experiences and interests, motivation to pursue doctorate, and long-term goals,
- Submit a recent curriculum vitae or resume,
- Submit two recommendations from individuals who are well qualified to assess the student's potential for doctoral study,
- Submit professional or research paper sample(s), if available, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 570 (paper-based)or 88 (Internet-based) is required.

* Since the program encompasses a wide variety of disciplines, students with diverse backgrounds (e.g.: engineering, science, humanities, fine arts, business, and disciplines with sufficient computing backgrounds) are encouraged to apply. Applicants should have the following minimum course work requirements: one full year of study in programming and computing concepts; strong mathematical background in subjects such as discrete mathematics, and probability and statistics; and aptitude, vision, and experience (if applicable) in computing and information sciences related research.

† Basic exam score; taken within last 5 years.

Interview

An interview by one or more members of the doctoral program faculty and/or admissions committee may be required for candidates considered for admission prior to final selection. This interview may be conducted via telephone.

Additional information

Residency requirement

One year of full-time residency (minimum of 12 credits per quarter for three consecutive quarters, not including summer) is a requirement of the program.

Transfer credit

Students with previous graduate course work, or a master's degree in a computing and information sciences discipline or in a related domain-specific discipline, may be granted up to 28 quarter credit hours towards the degree requirements. The transfer credit evaluation will not be made until after the first year of study. Consideration for transfer credit will include the appropriateness to the student's intra- and inter-disciplinary program of study and research interests.

Assistantships

Assistantships, which include tuition and stipend, are available and awarded on a competitive basis. Students working on funded research projects are required to be available during the day for project commitments.

Computing Security and Information Assurance, MS

http://www.nssa.rit.edu/

Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

Developers and practitioners need to understand the importance of building security and survivability into systems, rather than trying to add it once systems are installed.

The MS in computing security and information assurance gives students an understanding of the technological and ethical roles of computer security in society. Students develop a specialization in one of several areas by selecting four related elective courses under the guidance of a faculty adviser. Students conclude their program of study with a thesis, completed under the guidance of program faculty. The program enables students to develop a strong foundation, preparing them for leadership positions in both the private and public sectors of the computer security industry, for academic or research careers in computer security and information assurance, or for an advanced degree.

The program is designed for students who have an undergraduate degree in computer science, information technology, or software engineering, as well as those who have a strong background in a field in which computers are applied, such as computer or electrical engineering.

Curriculum

The program consists of core courses, electives, and a thesis for a total of 48 quarter credit hours.

Electives

Electives provide breadth of experience in security-related areas within computer science, information technology, and software engineering. Students who wish to include courses from departments outside of approved program electives need permission from the graduate program director. Students also may choose elective courses from departments in other RIT colleges; however, these courses may require additional prerequisites.

Master's thesis

The capstone for this program is a thesis. In order to register, a student must complete Research Methods (4055-726) and submit an acceptable proposal to the program faculty.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in computing security and information assurance will be renamed information assurance and forensics. This change will not affect currently matriculate students.

Computing security and information assurance, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
4055-726	Research Methods	4
4055-755	Secure Wireless and Wired Data Networks	4
4055-780	Computer System Security	4
4005-705	Cryptography I	4
4005-774	Secure Database Systems	4
4010-748	Secure Software Engineering: Requirements and Design	4
0110-745	Ethics in Technology	4
	Technical Elective 1, 2, 3, 4	16
4055-897	Thesis	4
Total Quarter Credit Hours		**48**

Information assurance and forensics (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-603	Enterprise Security and Forensics	3
NSSA-604	Cryptography and Authentication	3
	Technical Elective 1, 2, 3, 4	12
NSSA-790	MS Thesis	3
Second Year		
	Technical Elective 5	3
NSSA-790	MS Thesis	3
Total Semester Credit Hours		**30**

Information assurance and forensics (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-603	Enterprise Security and Forensics	3
NSSA-604	Cryptography and Authentication	3
	Technical Elective 1, 2, 3, 4, 5	15
Second Year		
	Technical Elective 6	3
	NSSA Project	3
Total Semester Credit Hours		**30**

Information assurance and forensics (capstone option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-603	Enterprise Security and Forensics	3
NSSA-604	Cryptography and Authentication	3
	Technical Elective 1, 2, 3, 4, 5	12
Second Year		
	Technical Elective 6	3
NSSA-793	Capstone in Information Assurance and Forensics	3
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS in computing security and information assurance, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in computer science, software engineering, information technology, computer engineering, electrical engineering, applied mathematics, or computer engineering technology (exceptional students from other fields may be admitted on a contingent basis),
- Have a minimum grade point average of 3.0,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a minimum of two recommendations from well-qualified individuals who are able to assess the applicant's potential for success, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

Applicants who have completed course work at foreign universities must submit Graduate Record Examination (GRE) scores. GRE scores are also recommended for applicants whose undergraduate GPA is below 3.0.

Prerequisites

Applicants must satisfy prerequisite requirements in mathematics (integral calculus, discrete mathematics) and computing (computer programming [e.g. C++], operating systems, OS scripting, software engineering, and computer networking).

Bridge program

Students whose undergraduate preparation or employment experience does not satisfy the prerequisites required for the program may make up these deficiencies through up to one year of additional study. Bridge courses, designed to close any gaps in a student's preparation, could cover curriculum in mathematics, computing, or programming languages. Generally, formal acceptance into the program is deferred until the applicant has made significant progress through this additional course work.

Students may be admitted to the program on the condition that bridge courses are completed with a grade of B or better. Courses with lower grades must be repeated. Bridge courses are not counted toward the 48 credit hours required for the master's degree. Grades earned from bridge courses are not included in a student's graduate grade point average.

A bridge program can be designed in different ways. Other courses may be substituted, and courses at other colleges may be applied. All bridge course work must be approved in advance by the graduate program director.

Additional information

Study options

Students may pursue the degree on a full- or part-time basis. Some of the courses are available online. A full-time student, who takes three courses per quarter, may be able to complete the course work in five quarters; part-time students may finish in two to four years. The time required to complete a master's thesis varies according to the student and the scope of the thesis; however, two quarters is typical.

Faculty
Faculty members are actively engaged in consulting and research in the information assurance areas, including cryptography, databases, networking, and software engineering. There are many opportunities for students to participate in research activities toward thesis or independent study work.

Maximum time limit
University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Information Assurance, Adv. Cert.

http://nssa.rit.edu/
Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

This advanced certificate provides the fundamental knowledge and expertise in network security and forensics necessary to provide information assurance in networked environments. Students learn to make computers and networks resistant to attack by closing off vulnerabilities and by monitoring intrusions. The application of forensics allows successful attacks on computer systems to be detected. This involves gathering information on the nature and extent of the attack for presentation in court, as well as assessing the extent of the damage to an organization. Courses taken as part of this certificate can transfer into the MS in networking and systems administration or the MS in computing security and information assurance.

This certificate is intended for part-time study; therefore RIT cannot issue I-20 paperwork. International students may study part-time through online learning.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Information assurance, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4055-755	Secured Wireless and Wired Networks	4
4055-780	Computer System Security	4
4055-841	Advanced Computer Forensics	4
4055-882	Enterprise Security	4
Total Quarter Credit Hours		**12**

Information assurance, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-744	Network Security	3
NSSA-603	Enterprise Security and Forensics	3
NSSA-742	Computer System Security	3
NSSA-730	Advanced Computer Forensics	3
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate program in information assurance, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution with course work or extensive work experience in networking, systems administration, programming (C++) and OS scripting (Perl preferred),
- Have a minimum grade point average of 3.0 (or a first class degree from a foreign university),
- Submit transcripts (in English) of all previously completed undergraduate and graduate course work,
- Complete a graduate application.

While GRE scores are not required, they are strongly suggested for applicants with an undergraduate degree but with a lower GPA than required. Strong scores, or a proven record of achieving a grade of B or better in more recent course work, could strengthen a candidate's application for admission.

Human-Computer Interaction, MS

http://www.ist.rit.edu/
Dianne Bills, Graduate Program Director
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Program overview

Human-computer interaction (HCI) is a professional discipline that addresses the design, evaluation, and implementation of interactive computing and computing-based systems for the benefit of human use. HCI research is driven by technological advances and the increasing pervasiveness of computing devices in our society. With an emphasis on making computing technologies more user-friendly, HCI has emerged as a dynamic, multifaceted area of study that merges theory from science, engineering, and design–as well as concepts and methodologies from psychology, anthropology, sociology, and industrial design–with the technical concerns of computing.

The master of science in human-computer interaction provides the knowledge and skills necessary for conceptualizing, designing, implementing, and evaluating software applications and computing technologies for the benefit of the user, whether the user constitutes an individual, a group, an organization, or a society. Throughout the curriculum human, technological, and organizational concerns are interwoven and addressed in team- and project-based learning experiences.

Curriculum

This 52 quarter credit hour program is comprised of five required core courses, four advanced electives, two application domain courses, and an 8 quarter credit hour capstone experience.

Core courses
The core courses provide knowledge and skills in the conceptual and methodological frameworks of HCI and HCI research. Emphasis is on understanding human cognition as it applies to information systems and on interface design, prototyping, and evaluation.

Advanced electives

Upper-level electives expose students to cutting-edge research and applications in the HCI discipline. The application domain courses provide foundational knowledge in a computing or computing-related domain to which HCI theories and practices may be applied during the capstone experience.

Application domain courses

To gain breadth in a technical area to which HCI concepts can be applied, students complete two courses in any of the following application domain areas: website development, interactive multimedia development, computer game design, application development, learning and human performance, bioinformatics, or ergonomics and safety. Special topic courses are offered by the IST department or from graduate-level coursework offered by other departments at RIT, or other universities with faculty approval.

Capstone thesis/project

The multi-term, 8 credit capstone may be completed as a thesis, which is an empirical study of a HCI problem, or as a project which can be the development of a software product through user-centered design processes. The results are either published in a peer-reviewed journal or publically disseminated in an appropriate professional venue.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Human-computer interaction, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4002-726	Research Methods	4
4004-745	Foundations of Human-Computer Interaction	4
4004-748	Usability Engineering	4
4004-749	Usability Testing	4
4002-765	User-centered Design Methods	4
Choose four of the following electives:		16
4002-823	Agent-Based Modeling	
4002-892	CSCW and Groupware	
4004-755	Advanced Topics in HCI	
4004-744	Eye Tracking: Theory, Methodology and Applications	
4004-781	Usability Economics	
4085-757	Graphical Elements of the User Experience	
4085-855	Innovation and Invention	
0514-785	Advanced Perception*	
0514-787	Advanced Cognition*	
	Application Domain Course 1, 2	8
Choose one of the following:		8
4004-897	MS HCI Thesis	
4004-898	MS HCI Project	
Total Quarter Credit Hours		**52**

* Course offered by the department of psychology.

Human-computer interaction (capstone project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HCIN-600	Research Methods	3
HCIN-610	Foundations of Human-Computer Interaction	3
HCIN-620	Information and Interaction Design	3
	Application Domain Course 1, 2	6
HCIN-630	Usability Testing	3
	Program Elective 1, 2	6
Second Year		
	Program Elective 3	3
HCIN-795	MS HCI Project	3
Total Semester Credit Hours		**30**

Human-computer interaction (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
HCIN-600	Research Methods	3
HCIN-610	Foundations of Human-Computer Interaction	3
HCIN-620	Information and Interaction Design	3
	Application Domain Courses 1, 2	6
HCIN-630	Usability Testing	3
	Program Electives 1, 2	6
Second Year		
HCIN-796	MS HCI Thesis	6
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in human-computer interaction, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent) degree from a regionally accredited institution,
- Have a minimum cumulative GPA of 3.0 (B average),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have prior study or professional experience in computing; however, study in other disciplines will be given consideration, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

Applicants with a GPA that is below 3.0 may be considered, but are required to submit standard Graduate Record Exam (GRE) scores.

Additional information

Prerequisites

The program requires strong technical and social science skills. Knowledge of quantitative statistical methodologies is important since students review research studies as well as analyze the results of their own usability evaluations. Students are also expected to have a solid background in computer programming and interactive multimedia development. These competencies may be demonstrated by previous course work, technical certifications, or comparable work experience. Bridge courses are available to fulfill gaps in an applicant's qualifications. Applicants will be made aware of any areas where additional course work may be necessary.

Maximum time limit

All requirements for the degree must be completed within seven years of the date of the oldest course counted toward the student's program of study. Bridge courses are excluded.

Online option

The program can be completed on campus or through distance learning.

Information Technology, MS

http://www.ist.rit.edu/
Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

The master of science degree in information technology is a unique and flexible program that allows students to craft their own program of study within the broad range of the IT computing discipline. Students build upon a core requirement that investigates current information technology directions and opportunities. The specialty areas include website design and interactive multimedia development, application development, usability and interface design, database theory and practice, software project management, eLearning technologies, and computer networking. In addition, students have the option of choosing courses from among the wide variety of fields offered within RIT, such as computer animation and computer graphics, telecommunications technology, and business.

Curriculum

The program consists of 48 quarter credit hours of graduate study, and includes one core course, concentrations, an elective, and a capstone experience. Some of the courses are offered online. Please consult the course descriptions for more information on availability and prerequisites.

Concentrations

Concentrations are availbale in the follwing areas: Web development, XML data management, multimedia application development, human-computer interaction, media and interaction, application development, eLearning technologies, project management, databases and data management, bioinformatics, networking, systems administration, and system survivability. With the permission of the graduate program director, students complete one concentration (a maximum of 12 graduate credits) from another department at RIT. Some of the available concentrations areas are: technology management, information systems, eCommerce, telecommunications technology, automated manufacturing, and computer graphics. Students can use the special topics option to design a concentration with approval from the graduate program director.

Electives

Electives are typically chosen from courses in information technology. However, with prior approval, graduate courses from other departments such as computer science, computer engineering, electrical engineering, or business may also be appropriate.

Capstone experience

A master's project or thesis that builds upon the student's concentration areas is required. Students register for either 4 or 8 quarter credits for the capstone experience, depending on the depth and scope of their investigations.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in information technology will be renamed information sciences and technologies. This change will not affect currently matriculated students.

Information technology (project option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4002-718	Current Themes in Information Technology	4
	Concentration 1	20-24
	Concentration 2	12-16
	Technical Elective	4
4002-898	Project	4
Total Quarter Credit Hours		**48**

Information sciences and technologies (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISTE-605	Scholarship in Information Sciences and Technologies	3
ISTE-610	Knowledge Representation Technologies	3
ISTE-612	Knowledge Processing Technologies	3
ISTE-600	Analytical Thinking	3
	Technical Domain Elective 1, 2, 3	9
ISTE-791	Project in Information Sciences and Technologies	3
Second Year		
	Technical Domain Elective 4	3
ISTE-791	Project in Information Sciences and Technologies	3
Total Semester Credit Hours		**30**

Information technology (thesis option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4002-718	Current Themes in Information Technology	4
	Concentration 1	20-24
	Concentration 2	12-16
4002-897	Thesis	4
Total Quarter Credit Hours		**44-48**

Information sciences and technologies (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISTE-605	Scholarship in Information Sciences and Technologies	3
ISTE-610	Knowledge Representation Technologies	3
ISTE-612	Knowledge Processing Technologies	3
ISTE-600	Analytical Thinking	3
	Technical Domain Elective 1, 2, 3	9
ISTE-790	Thesis in Information Sciences and Technologies	3
Second Year		
	Technical Domain Elective 4	3
ITSE-790	Thesis in Information Sciences and Technologies	3
Total Semester Credit Hours		**30**

Information sciences and technologies (capstone option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
ISTE-605	Scholarship in Information Sciences and Technologies	3
ISTE-610	Knowledge Representation Technologies	3
ISTE-612	Knowledge Processing Technologies	3
ITSE-600	Analytical Thinking	3
	Technical Domain Elective 1, 2, 3, 4	12
Second Year		
	Technical Domain Elective 5	3
ISTE-795	Capstone in Information Sciences and Technologies	3
Total Semester Credit Hours		**30**

Concentrations

COURSES		QUARTER CREDIT HOURS
Application development		
4002-710	Object Technologies	4
4002-720	Data Object Development	4
4002-725	Component Development	4
4002-784	Fundamentals of Database Client/ Server Connectivity	4
4002-542, 890	Native App Mobile Development	4
Bioinformatics		
4002-762	Introduction to Bioinformatics Computing	4
4002-763	Computing in Functional and Translational Bioinformatics	4
Databases and data management		
4002-720	Data Modeling and Database Implementation	4
4055-744	*NIX Fundamentals for the Application Domain	4
4002-774	Information Assurance Fundamentals	4
4002-784	Fundamentals of Database Client/ Server Connectivity	4
4002-785	Fundamentals of DBMS Architecture and Implementation	4
4002-787	Database Performance and Tuning	4
4002-789	Data Warehousing	4
eLearning technologies		
4002-722	Fundamentals of Instructional Technology	4
4002-723	Interactive Courseware	4
4002-724	Performance Support Systems Design	4
4002-823	Agent-Based Modeling	4
Human-computer interaction		
4004-745	Foundations of Human-Computer Interaction	4
4004-748	Usability Engineering	4
4002-749	Usability Testing	4
4004-755	Advanced Topics in HCI	4
4002-765	User-Centered Design Methods	4
4002-823	Agent-Based Modeling	4
Media and interaction		
4085-757	Graphical Elements of the User Experience	4
4085-744	Building Online Communities	4
4085-794	Online Identity and Community Behavior	4
4085-855	Innovation and Invention	4
Multimedia application development		
4085-727	Digital Audio and Computer Music	4
4004-730	Interactive Media Implementation	4
4085-746	Programming for Interactive Multimedia	4
4085-738	Multi-User Media Spaces	4
Networking		
4055-761	Principles of System Administration	4
4055-755	Secure Wireless and Wired Data Networks	4
4055-815	Introduction to Routing and Switching	4
Project management		
4002-830	Project Management	4
4002-831	Process Management	4
4002-820	Economics of Software Development	4
Systems administration		
4055-721	Perl for System Administration	4
4055-761	Principles of System Administration	4
4055-780	Computer System Security	4
System survivability		
4055-761	Principles of System Administration	4
4055-780	Computer System Security	4
4055-755	Secure Wireless and Wired Data Networks	4
Web development		
4004-737	Website Design and Technology	4
4004-736	Web Client-Side Programming	4
4004-739	Programming for the World Wide Web	4
4004-751	Web-Database Integration	4
XML data management		
4002-770	Introduction to XML	4
4002-771	XML Programming	4
4002-772	XML Transformation and Presentation	4

Admission requirements

To be considered for admission to the MS program in information technology, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a minimum cumulative GPA of 3.0 (B),
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work,
- Submit a resume,
- Submit two letters of recommendation, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 570 (paper-based) or 88 (Internet-based) are required. Applicants with a lower TOEFL score may be admitted conditionally and will be required to complete a prescribed program in English, along with a reduced program course load.

Applicants from foreign universities must submit Graduate Record Examination (GRE) scores. These scores also may be required for applicants whose undergraduate grade point average is less than 3.0.

Additional information

Prerequisites

It is expected that students wishing to enter the program will have a background in fundamental information technology concepts, including: object-oriented programming, computer hardware and software architecture, networking, website design, and interactive multimedia concepts.

Students without the necessary background should complete the prerequisites before applying to the program. Bridge courses are available to satisfy the prerequisites.

Bridge program

Students whose undergraduate preparation or employment experience does not satisfy the prerequisites can make up these deficiencies by completing bridge courses as prescribed by the graduate program coordinator.

The bridge program's courses are not part of the 48 quarter credit hours required for the master's degree. Grades for bridge courses are not included in a student's graduate GPA if the courses are taken before matriculation; they are included if they are taken after matriculation.

A bridge program can be designed in a variety of ways. The graduate program director will assist students in planning and course selection.

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Medical Informatics, MS

http://www.ist.rit.edu/?q=node/56
Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

Medical informatics studies the nature of medical information and the use of information technology to manage health-related records and content in medical practice, education, and research. With increases in the application and uses of information technology to the medical industry, there is an unprecedented need for professionals who can use their knowledge of both information technology and health care to improve the safety and quality of health care delivery, plus help control costs.

Medical informatics is an emerging profession in which the power of information technology is creatively applied to the information needs of health care. This includes the acquisition, storage, and retrieval of patient data, as well as access to electronically maintained medical knowledge for use in patient care, research, and education. This field requires computing expertise; understanding formal medical terminology, clinical processes, and guidelines; and the application of information and communication systems that can successfully delivery patient information in a number of healthcare settings.

The program is offered jointly by RIT and the University of Rochester's School of Medicine and Dentistry. Students choose to matriculate at one of the universities, where they will earn their degree and receive a diploma bearing the seals of both institutions. Students take courses at both universities. The University of Rochester has an academic calendar based upon 15-week semesters, while RIT has 10-week academic quarters. However, all courses are scheduled so that students can attend courses offered by at each university without conflict.

The program is offered on a full- or part-time basis. The full-time program may be completed in approximately two years. For part-time students, competition may take three to four years.

Curriculum

The medical informatics degree is comprised of nine required core courses, a three-course concentration, plus a two-course capstone experience. Students may choose from a set of pre-approved concentrations or, with the pre-approval of the faculty, define a specialized concentration. Depending upon the student's background, some of the program's core courses may be replaced. For example, a physician may be allowed to replace a course such as The Practice of Health Care (4006-704/MFI 404) with one that will be more beneficial. Similarly, a database professional may be allowed to replace the foundation database course.

Concentrations

All students complete a three-course concentration for depth. The six pre-approved concentration options are: electronic health record development*, database systems†, clinical systems integration†, Web applications for medicine†, management†, or public health‡. With the approval of the faculty, the student may create a customized concentration by selecting courses from the existing concentrations or from related areas, such as bioinformatics or computer systems security.

* Courses for this concentration are available at both RIT and UR.
† Courses for this concentration are available at RIT only.
‡ Courses for this concentration are available at UR only.

Capstone

The capstone is a two-course experience, for a total of four academic credits, and is completed in two consecutive academic terms.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Medical informatics, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4002-726	Research Methods	4
4006-701	Introduction to Medical Informatics	4
4006-735	Clinical Information Systems (EHR)	4
4006-702	Perspectives of Health Informatics	4
4006-704	Practice of Health Care	4
4006-707	Clinical Decision Support	4
4002-720	Data Modeling and Database Implementation	4
4006-780	Design, Development, and Deployment of Applications	4
4002-820	Economics of Software Development	4
	Concentration Course 1, 2, 3	12
4006-887	Capstone in Medical Informatics I	2
4006-888	Capstone in Medical Informatics II	2
Total Quarter Credit Hours		**48**

Medical informatics, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HCIN-600	Research Methods	3
MEDI-701	Introduction to Medical Informatics	3
ISTE-608	Database Design and Implementation	3
MEDI-735	Clinical Information Systems	3
MEDI-704	Practice of Health Care	3
ISTE-760	Design, Development, and Deployment of Applications	3
	Technical Elective 1	3
Second Year		
MEDI-788	Capstone in Medical Informatics*	3
MEDI-707	Clinical Decision Support	3
	Technical Elective 2, 3	6
ISTE-762	Software Economics	3
MEDI-702	Perspectives of Health Informatics	3
Total Semester Credit Hours		**39**

* The capstone is purposely scheduled for the fall semester of the second year since the prerequisites are the first-year courses. Thus, students may complete their capstone work in the following spring semester should additional time be required.

Courses

RIT COURSE #	UR COURSE #	COURSE TITLE
4002-726	MFI 406	Research Methods†
4006-701	MFI 400	Introduction to Medical Informatics‡
4006-735	MFI 403	Clinical Information Systems (EHR)†
4006-702	MFI 402	Perspectives of Health Informatics‡
4006-704	MFI 404	Practice of Health Care‡
4006-707	MFI 407	Clinical Decision Support‡
4002-720	MFI 430	Data Modeling and Database Implementation†
4006-780	MFI 405	Design, Development, and Deployment of Applications†
4002-820	MFI 401	Economics of Software Development†
4006-887	MIF 408A	Capstone in Medical Informatics I†
4006-888	MIF 408B	Capstone in Medical Informatics II†

† Course offered at RIT.
‡ Course offered at UR.

Admission requirements

To be considered for admission into the MS in medical informatics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from a regionally accredited institution (with a minimum GPA of 3.0), a graduate degree, MD, RN, or other professional degree,

- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a professional essay describing relevant employment or other experience and career plans. Recent undergraduate students without extensive employment experience should discuss their career plans as well as any courses they have completed that are relevant to medical informatics, health care, or information technology.
- Submit three letters of recommendation from individuals who are able to assess the applicant's potential for success in the program,
- Have completed at least one year of computer programming in a current object-oriented language or equivalent work experience,*
- Have knowledge of the medical terminology/vocabulary, clinical processes, and information systems that are used to support health care activities and processes,*
- Have a familiarity with anatomy and physiology, including the major systems of the human body, including: the skeletal system, muscle tissue physiology, muscular system, nervous system, cardiovascular system, respiratory system, urinary system, and histology,*
- Have completed the equivalent of one statistics course that covers the fundamental statistical principles necessary to interpret data and present results, including: descriptive statistics, random sampling, normal distribution, confidence intervals, and hypothesis testing. (This prerequisite may be completed post-admission if necessary.)*
- Submit a current resume.
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

* These competencies may be demonstrated through previous coursework, technical certifications, or comparable employment experience. RIT and UR offer courses that may be used to bridge areas where gaps occur in an applicant's background. Prerequisite study must be completed with at least a 'B' grade to continue in the program. Contact the graduate coordinator for assistance.

Applicants without previous graduate study and with an undergraduate GPA that is less than 3.0 may be considered for admission, but will be required to submit Graduate Record Exam (GRE) scores. Applicants from international universities are required to submit GRE scores.

An interview with the program's admissions committee may also be required. This program may be started in fall terms only.

Additional information

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Networking and System Administration, MS

http://www.nssa.rit.edu/

Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

Effective technical leadership in a modern enterprise relies on a combination of technical knowledge and an understanding of basic business concepts and processes. The master of science in networking and systems administration enables students to study, develop, and become proficient in the practices, methodologies, and techniques used in the management of a modern IT networking infrastructures. The focus is on enterprise-scale problems and solutions, addressing the needs of a medium to large organization.

Curriculum

The program consists of seven required core courses, four elective courses (chosen from an approved list of electives), and a four-credit capstone thesis or project. Two quarters of cooperative education experience are optional.

Networking and system administration, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0102-740	Organizational Behavior and Leadership	4
0106-744	Project Management	4
4055-726	Research Methods	4
4055-755	Secured Wireless and Wired Networks	4
4055-817	Emerging Network Technologies	4
4055-850	Network Design and Performance	4
4055-882	Enterprise Security	4
Choose four of the following technical electives:		16
0101-703	Accounting for Decision Makers	
4055-760	Computer Viruses and Malicious Software	
4055-780	Computer System Security	
4055-818	Network Management	
4055-841	Advanced Computer Forensics	
4055-862	Advanced Routing Protocols	
4055-883	Enterprise Networking	
4055-884	Enterprise Service Provisioning	
Choose one of the following:		4
4055-897	NSSA Thesis	
4055-898	NSSA Project	
Total Quarter Credit Hours		**48**

Networking and system administration (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-602	Enterprise Computing	3
	Knowledge Domain Course 1, 2, 3	9
	Technical Elective 1, 2	6
NSSA-790	MS Thesis	3
Second Year		
	Technical Elective 3	3
NSSA-790	MS Thesis	3
Total Semester Credit Hours		**30**

Networking and system administration (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-602	Enterprise Computing	3
	Knowledge Domain Courses 1, 2, 3	9
	Technical Elective 1, 2, 3	9
Second Year		
	Technical Elective 4	3
NSSA-791	MS Project	3
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in networking and systems administration, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent) degree from an accredited institution,
- Have a minimum cumulative grade point average of 3.0 (B)*,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit two professional recommendations, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required. Applicants with a lower TOEFL score may be admitted conditionally, but will be required to complete a prescribed program in English preparation study along with a reduced program course load. Applicants from foreign universities also must submit Graduate Record Examination (GRE) scores. Visa forms cannot be issued by RIT for part-time or distance education.

* The GRE is recommended for those applicant's whose undergraduate grade point average is less than 3.0.

Additional information

Bridge courses

Students wishing to enter the program must have a solid educational or employment record in networking and in systems administration. If a student does not have the necessary background, bridge courses will be required to help students to meet these prerequisites. Formal acceptance into the program may be possible even though the applicant must complete bridge courses.

Students whose undergraduate preparation or industrial experience does not satisfy the technical prerequisites of this degree can make up this deficiency through study, taking one or more of the following RIT courses, as prescribed by the graduate program director: C++ for Networking and Systems Administration (4050-211), PERL for System Administration (4055-721), or Scripting in Perl (4050-302), Principles of System Administration (4055-761), and Telecommunications Network Protocols (4055-746).

Bridge courses are not part of the 48 credit hours required for the master's degree. Grades for these courses are not included in a student's graduate GPA, if the courses are taken before matriculation; courses competed after matriculation are included.

Bridge course work can be designed in a variety of ways. Other courses can be substituted, or courses at other colleges can be applied. Contact the graduate program director for approval.

Study options

This program is designed for full- or part-time study through on-campus instruction or through online learning. Students who take at least three courses per quarter are considered full-time and may be able to complete their course work in one year. Part-time students may take as few as one course per quarter, and may take approximately four years to complete the program.

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Networking and Systems Administration, Adv. Cert.

http://nssa.rit.edu/

Dianne Bills, Graduate Progam Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

The advanced certificate in networking and system administration consists of five courses that provide students with the ability to identify and deploy tools and techniques used in the administration of computer networks and to assume leadership roles in the administration of these networks. These courses also ensure that graduates will be able to discuss and develop policies, procedures, and standards needed to enhance the security of the networks. These courses may be completed as a stand alone certificate or can be used towards the prerequisites (12 credits) and the requirements (8 credits) of the MS program in networking and systems administration.

Curriculum

Program deactivated
Effective fall 2013, this program will no longer admit new students. This change will not affect currently matriculated students.

Networking and systems administration, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0102-740	Organizational Behavior	4
4055-721	PERL for System Administration	4
Choose one of the following:		4
4055-746	Telecom Network Protocols	
4055-815	Introduction to Switching and Routing	
4055-761	Principles of System Administration	4
4055-882	Enterprise Security	4
Total Quarter Credit Hours		**20**

Admission requirements

To be considered for admission to the advanced certificate in networking and system administration, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution with course work or extensive work experience in networking, systems administration, and programming in C++; experience in scripting is beneficial,
- Have a minimum grade point average of 3.0 (or a first class degree from a foreign university),

- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Graduate Record Exam (GRE) and the Test of English as a Foreign Langauge. Minimum TOEFL scores of 570 (paper-based exam) or 88 (Internet-based exam) are required.

While GRE scores are not required, they are strongly suggested for applicants with an undergraduate degree but with a lower GPA than required. Strong scores, or a proven record of achieving a grade of B or better in more recent course work, could strengthen a candidate's application for admission.

Additional information

Study options

Students may complete the advanced certificate program on a full- or part-time basis. The courses in this advanced certificate are available both online and on campus.

Network Planning and Design, Adv. Cert.

http://nssa.rit.edu/
Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program overview

The advanced certificate in network planning and design provides students with the knowledge and expertise needed to seek careers in project management, emerging network technologies, network design, and enterprise networking. Students completing this program will be able to design and implement project management plans for sophisticated network design projects; understand and work with emerging technologies in networking and system administration; develop, test, and implement a network model to simulate the performance of an enterprise scale network; and develop and implement the security policies and procedures that surround an enterprise scale network. This program consists of four courses. The certificate may be completed separately or these courses may be applied to the MS in networking and system administration.

This certificate is intended for part-time study; therefore, RIT cannot issue I-20 paperwork for it. International students may study part-time through online learning.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Network planning and design, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0106-744	Project Management	4
4055-817	Emerging Network Technologies	4
4055-850	Network Design and Performance	4
4055-882	Enterprise Networking	4
Total Quarter Credit Hours		**12**

Network planning and design, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-602	Enterprise Computing	3
DECS-744	Project Management	3
Second Year		
NSSA-620	Emerging Computing and Networking Technologies	3
NSSA-715	Network Design and Performance	3
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate in network planning and design, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution with course work or extensive work experience in networking, systems administration, and programming in C++; experience in OS scripting (Perl preferred) is beneficial,
- Have a minimum grade point average of 3.0 (or a first class degree from a foreign university),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Complete a graduate application.

While GRE scores are not required, they are strongly suggested for applicants with a lower undergraduate GPA than required. Strong scores, or a proven record of achieving a grade of B or better in more recent course work, could strengthen a candidate's application for admission.

Additional information

Study options

The courses for this advanced certificate are available both on campus and online.

Database Administration, Adv. Cert.

http://www.ist.rit.edu/
Dianne Bills, Graduate Program Director
(585) 475-2700, Dianne.Bills@rit.edu

Program deactivated
Effective fall 2013, this program will no longer admit new students. This change will not affect currently matriculated students.

Program overview

In today's information society, dependable information management systems are a vital strategic resource that supports sound business processes and effective decision-making. As one of the cornerstones of information technology, database systems facilitate capturing, processing, managing, and analyzing data in a structured and controlled manner that can provide both timely strategic information and insight into historical trends.

This certificate program provides an opportunity for individuals to gain the theoretical foundation, first-hand experience, and expertise to begin or expand upon a professional career in database administration. The courses are designed to provide the knowledge necessary to successfully create, deploy, and manage databases using major commercial database management systems.

Careers in database administration are available across all segments of the economy, in business and industry, academic institutions, and governmental agencies. Graduates of the certificate program can work as database developers, database engineers, database administrators, or engineering services technical specialist, to name a few.

The certificate is offered for part-time study in an on-campus format. It can be taken alone or in combination with graduate study in other programs such as the MS degrees in information technology or other programs that allow an external four-course concentration.

Curriculum

Database administration, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
4002-720	Data Modeling and Database Implementation	4
4055-744	NIX Fundamentals (for the database domain)	4
4002-785	Fundamentals of DBMS Architecture and Implementation	4
4002-787	Database Performance and Tuning	4
Total Quarter Credit Hours		**16**

With the appropriate background, the certificate can be completed in either three or four academic quarters, depending upon the number of courses taken concurrently. For individuals with solid relational theory background, another course can be substituted for Data Modeling and Database Implementation (4002-720).

All requirements for the certificate must be completed within the seven years of the date of the oldest course counted toward the degree. Bridge courses are excluded.

Admission requirements

To be considered for admission to the advanced certificate in database administration, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent) degree from a regionally accredited institution,
- Have a minimum cumulative GPA of 3.0 on a 4.0 scale (B average),
- Submit a current resume,
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work, and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 570 (paper-based) or 88 (Internet-based) is required.

  Since this is a part-time program, RIT cannot issue I-20 forms to international students.

Additional information

Prerequisites
Prior academic study or extensive work experience in object-oriented programming (OOP) is a prerequisite of the program. Solid programming skills, the equivalent of at least two programming courses in a current OOP language, such as Java (preferred), C++ or C#, is required. If students have equivalent work experience, sufficient detail should be included in the personal statement along with a current resume so that the applicant's depth of experience and knowledge can be determined. Some form of verification, such as in a confidential letter of recommendation, is also recommended. RIT offers courses that may be used to bridge areas where gaps occur in an applicant's application.

Interactive Multimedia Development, Adv. Cert.

http://www.ist.rit.edu/
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Program overview

As interactive technologies advance, the forms and approaches to human communication change—and the importance of enhancing the communication experience within electronic environments increases. This certificate provides an opportunity for students to gain firsthand knowledge and expertise in the art and science of interactive multimedia design. In this program, students explore the theories of interactive computing, the fundamentals of interactive multimedia, programming in an authoring language, multimedia design, and the impact of networked technologies in such areas as the Internet.

This certificate is intended for part-time study; therefore, RIT cannot issue I-20 paperwork for it. International students may study part-time through online learning.

Curriculum

Projects include the development of websites and interactive multimedia applications. The curriculum can be completed in as few as three quarters. Students have at their disposal a variety of computer, video, and digitizing equipment in our state-of-the-art interactive media laboratories.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in interactive multimedia development will be renamed Web development. This change will not affect currently matriculated students.

Interactive multimedia development, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4004-741	Fundamentals of Web-based Multimedia	4
4004-730	Interactive Media Implementation	4
4004-737	Website Design and Technology	4
4004-745	Foundations of Human-Computer Interaction	4
	Two Web, interactive multimedia, or related electives	8
Total Quarter Credit Hours		**24**

Interactive multimedia development, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HCIN-610	Foundations of HCI	3
ISTE-645	Foundations of Web Technologies I	3
ISTE-646	Foundations of Web Technologies II	3
HCIN-636	Interactive Programming	3
Total Semester Credit Hours		**12**

Maximum time limit

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. Bridge courses are excluded.

Prerequisites

Due to continuing advances in the technologies used for interactive multimedia, knowledge of programming is necessary in this field. Students must have object-oriented programming skills equivalent to at least one, but preferably two, undergraduate courses. Bridge courses are available to complete any requirements missing from the applicant's credentials.

Admission requirements

To be considered for admission to the advanced certificate in interactive multimedia development, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent) degree from an accredited institution,
- Have a minimum cumulative GPA of 3.0 (B),
- Submit official transcipts (in English) of all previously completed undergraduate and graduate course work,
- Submit two professional recommendations, and
- Complete a gradute application.

Software Engineering, MS

http://www.se.rit.edu/grad
Stephani Ludi, Graduate Program Director
(585) 475-7407, salvse@rit.edu

Program overview

The master of science in software engineering is designed to attract software professionals with a formal undergraduate background in software engineering, computer science, or computer engineering and at least one year of professional experience. The program's core content ensures that graduates will possess both breadth and depth of knowledge in software engineering. Specialization tracks in software quality and design provide the student with the opportunity to match their graduate education with their professional goals.

The MS in software engineering is available to professionals without a formal baccalaureate degree in computing, but who may otherwise have sufficient experience developing software professionally, and those who have earned an undergraduate computing degree and have at least one year of software development experience.

Curriculum

The program comprises 52 credit hours, anchored by a three-quarter (12 credit hour) practicum, where students work with peers and faculty on a long-term, moderately complex software development project. Initially students will serve in basic support and development roles, but as they progress through the practicum and accompanying course work, they will be assigned correspondingly greater responsibilities. The program combines fundamental and theoretical concepts taught in courses, with their application in a constrained but realistic setting.

Electives

Track electives: Students choose one of the following track electives: Software Quality Engineering (4011-760) or Software Architectures and Product Lines (4011-770).

Technical electives: Students choose three graduate-level courses from any of the following programs: computer science, software engineering, computer engineering, or business.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Software engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4011-700	Software Engineering Practicum I	4
4011-701	Software Engineering Practicum II	4
4011-702	Software Engineering Practicum III	4
4011-710	Research Methods	4
4011-720	Software Evolution and Re-engineering	4
4011-730	Process Engineering and Environments	4
4011-740	Empirical Software Engineering	4
4011-750	Software Modeling	4
4011-780	Experience and Research Report	4
Choose one of the following electives:		4
4011-760	Software Quality Engineering	
4011-770	Software Architectures and Product Lines	
	Technical Elective Course 1, 2, 3	12
Total Quarter Credit Hours		**52**

Software engineering (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SWEN-610	Foundations of Software Engineering	3
SWEN-745	Software Modeling	3
	Elective	3
SWEN-722	Process Engineering	3
SWEN-749	Software Evolution and Re-engineering	3
SWEN-640	Research Methods	3
Second Year		
SWEN-772	Software Quality Engineering	3
SWEN-755	Software Architectures and Product Lines	3
SWEN-799	Independent Study	3
SWEN-790	Thesis	6
	Elective	3
Total Semester Credit Hours		**36**

Software engineering (capstone option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
SWEN-610	Foundations of Software Engineering	3
SWEN-745	Software Modeling	3
	Elective	3
SWEN-722	Process Engineering	3
SWEN-749	Software Evolution and Re-engineering	3
SWEN-640	Research Methods	3
Second Year		
SWEN-772	Software Quality Engineering	3
SWEN-755	Software Architectures and Product Lines	3
	Elective	3
	Elective	3
SWEN-780	Capstone Research Project	6
Total Semester Credit Hours		**36**

Admission requirements

To be considered for admission to the MS program in software engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a cumulative grade point average of 3.0 or higher (Prospective students from institutions that do not use the GPA scale are expected to demonstrate an equivalent level of academic accomplishment. Formal academic background in software engineering, computer science, or computer engineering is a plus.),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,

- Submit a professional essay (1-4 pages) describing current job (if applicable), relevant experience, and career plans,
- Submit a current resume (including descriptions of significant software projects in which the candidate participated),
- Submit two letters of recommendation, and Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.
- International applicants must provide Graduate Record Exam (GRE) scores. Domestic students are encouraged to provide GRE scores.

Prospective students without a bachelor's degree in software engineering, computer science, or computer engineering are expected to submit evidence of professional experience developing software. For these individuals, a minimum of three years of professional experience is required.

Additional information

Bridge courses

Based on the evaluation of academic and relevant experience, the graduate program director may require some applicants to successfully complete bridge courses to fill in any gaps in their background. Successful completion of bridge courses is necessary for registration in graduate-level courses.

Graduate Faculty

Andrew L. Sears, BS, Rensselaer Polytechnic Institute, Ph.D., University of Maryland—Dean; Professor

Wiley McKinzie, BA, University of Wichita; MS, State University of New York at Buffalo—Vice Dean; Professor

Computer Science

Paul Tymann, BS, MS, Syracuse University—Department Chair; Professor

Peter G. Anderson, BS, Ph.D., Massachusetts Institute of Technology—Professor Emeritus

Reynold Bailey, BS, Midwestern State University; MS, Ph.D., Washington University—Assistant Professor

Ivona Bezakova, BS, Comenius University; Ph.D., University of Chicago—Associate Professor

Hans-Peter Bischof, BS, MS, University of Ulm; Ph.D., University of Osnabrück—Graduate Program Director; Professor

Zack Butler, BS, Alfred University; Ph.D., Carnegie Mellon University—Associate Professor

Roxanne Canosa, BS, State University College at Brockport; MS, Ph.D., Rochester Institute of Technology—Associate Professor

Warren Carithers, BS, MS, University of Kansas—Associate Professor

Henry Etlinger, BS, University of Rochester; MS, Syracuse University—Undergraduate Program Coordinator; Associate Professor

Matthew Fluet, BS, Harvey Mudd College; Ph.D., Cornell University—Assistant Professor

Roger S. Gaborski, BS, MS, State University of New York at Buffalo; Ph.D., University of Maryland—Professor

Joe Geigel, BS, Manhattan College; MS, Stevens Institute of Technology; Ph.D., George Washington University—Associate Professor

James Heliotis, BS, Cornell University; Ph.D., University of Rochester—Professor

Edith Hemaspaandra, BS, MS, Ph.D., University of Amsterdam—Professor

Chris Homan, AB, Cornell University; MS, Ph.D., University of Rochester—Associate Professor

Trudy Howles, BS, MS, Rochester Institute of Technology; Ph.D., Nova Southwestern University—Professor

Alan Kaminsky, BS, Lehigh University; MS, University of Michigan—Professor

Fereydoun Kazemian, BS, Queen Mary College; MS, Pittsburgh State University; Ph.D., Kansas State University—Associate Professor

Mineseok Kwon, BS, MS, Seoul National University; Ph.D., Purdue University—Associate Professor

Xumin Liu, BE, Dalian University; ME, Jinan University; Ph.D., Virginia Polytechnic Institute—Assistant Professor

Stanislaw Radziszowski, MS, Ph.D., University of Warsaw—Professor

Rajendra K. Raj, BS, Indian University of Technology; MS, University of Tennessee; MS, Ph.D., University of Washington—Professor

Leonid Reznik, MS, St. Petersburg Aircraft Academy; Ph.D., St. Petersburg Polytechnic Institute—Professor

Axel Schreiner, MS, Northern Illinois University; Ph.D., University of Illinois—Professor

Walter A. Wolf, BA, Wesleyan University; MS, Rochester Institute of Technology; MA, Ph.D., Brandeis University—Professor

Richard Zanibbi, BA, MS, Ph.D., Queens University (Canada)—Professor

School of Interactive Games and Media

Andrew Phelps, BFA, Bowling Green State University; MS, Rochester Institute of Technology—Director; Professor

Jessica Bayliss, BS, California State University at Fresno; MS, Ph.D., University of Rochester—Associate Professor

Kevin Bierre, BA, State University College at Geneseo; MS, Cornell University and Rochester Institute of Technology—Associate Professor

John A. Biles, BA, MS, University of Kansas—Professor

Nancy Doubleday, BS, MS, Rochester Institute of Technology—Associate Professor

Chris Egert, BS, MS, Rochester Institute of Technology; Ph.D., University at Buffalo— Associate Director; Associate Professor

Gordon Goodman, BS, State University of New York at Binghamton; MS (computer science), MS (information technology), Rochester Institute of Technology—Professor

W. Michelle Harris, BS, Carnegie Mellon University; MPS, New York University—Associate Professor

Tona Henderson, BS, Southwest Missouri State University; MS, University of Missouri—Associate Professor

Jay Alan Jackson, BS, MS, Ph.D., Florida State University—Associate Professor

Stephen Jacobs, BA, MA, New School for Social Research—Associate Professor

Anthony Jefferson, BS, State University College at Oswego; MS, Rochester Institute of Technology—Lecturer

Stephen Kurtz, BA, University of Miami; MS, MFA, Rochester Institute of Technology—Professor

Elizabeth Lane Lawley, AB, MLS, University of Michigan; Ph.D., University of Alabama—Professor

Elouise Oyzon, BFA, MFA, Rochester Institute of Technology—Associate Professor

Jonathan Schull, BS, Reed College; MA, Ph.D., University of Pennsylvania—Associate Professor

David I. Schwartz, BS, MS, Ph.D., University of Buffalo—Associate Professor

David Simkins, BA, Earlham College; MS, Ph.D., University of Illinois at Urbana Champaign—Assistant Professor

Erik Vick, BS, MS, Ph.D., University of Central Florida—Assistant Professor

Keith Whittington, BS, Rensselaer Polytechnic Institute; MS, Nova Southeastern University—Associate Professor

School of Informatics

Evelyn P. Rozanski, BS, State University College at Brockport; MS, Syracuse University; Ph.D., State University of New York at Buffalo—Director; Professor

Information Sciences and Technologies

Jeffrey A. Lasky, BBA, MBA, City College of New York; MS, University of Minnesota—Department Chair; Professor

Catherine I. Beaton, BA, BEd, MITE, Dalhousie University—Associate Professor

Dianne P. Bills, BA, University of Rochester; MS, Rochester Institute of Technology—Graduate Program Director; Associate Professor

Sean Boyle, BS, MS, Rochester Institute of Technology—Lecturer

Daniel S. Bogaard, BFA, Indiana University; MS, Rochester Institute of Technology—Associate Professor

Deborah Coleman, AAS, Rochester Institute of Technology; BS, Empire State College; MS, Rochester Institute of Technology—Associate Professor

Michael Floeser, AAS, BS, MS, Rochester Institute of Technology—Lecturer

Anne Haake, BA, Colgate University; MS, Rochester Institute of Technology; MS, Ph.D., University of South Carolina—Associate Professor

Edward Holden, BA, State University College at Oswego; MBA, Rochester Institute of Technology—Associate Professor

Jai Kang, BS, Seoul National University; MA, Kent State University; MS, Georgia Institute of Technology; Ph.D., State University of New York at Buffalo—Associate Professor

Jim Leone, BS, University of Cincinnati; MA, Ph.D., Johns Hopkins University—Professor

Rayno Niemi, BS, MS, Ph.D., Rensselaer Polytechnic Institute—Professor

Ronald Perry, BS, MS, Rochester Institute of Technology—Professor

Evelyn P. Rozanski, BS, State University College at Brockport; MS, Syracuse University; Ph.D., State University of New York at Buffalo—Professor

Jeffrey Sonstein, BA, MA, New College of California—Assistant Professor

Brian Tomaszewski, BA, University at Albany; MA, State University of New York at Buffalo; Ph.D., Pennsylvania State University—Assistant Professor

Nicholas Thireos, BS, Wabash College; MS, Utah State University—Medical Informatics Program Director

Ronald P. Vullo, BS, LeMoyne College; Ed.M., Ph.D., University at Buffalo—Associate Professor

Elissa M. Weeden, BS, MS, Rochester Institute of Technology—Faculty Associate for Undergraduate Affairs; Associate Professor

Michael A. Yacci, BS, Ithaca College; MS, Rochester Institute of Technology; Ph.D., Syracuse University—Professor

Qi Yu, BS, Zhejiang University; ME, National University of Singapore; Ph.D., Virginia Polytechnic Institute—Assistant Professor

Stephen Zilora, BS, University of Rochester; MS, New Jersey Institute of Technology—Associate Professor

Networking, Security, and Systems Administration

Sylvia Perez-Hardy, BS, MBA, Cornell University—Department Chair; Associate Professor

George Barido, BS, State University College at Brockport; MS, Rochester Institute of Technology—Lecturer

Charles B. Border, BA, State University College at Plattsburgh; MBA, Ph.D., State University of New York at Buffalo—Associate Professor

Tina Chapman-DaCosta, BA, State University College at Brockport; MS, Rochester Institute of Technology—Senior Lecturer

Bruce H. Hartpence, BS, MS, Rochester Institute of Technology—Associate Professor

Lawrence Hill, BS, MS, Rochester Institute of Technology—Associate Professor

Daryl Johnson, BS, St. John Fisher College; MS, Rochester Institute of Technology—Associate Professor

Daniel Kennedy, BS, MS, Rochester Institute of Technology—Lecturer

Jim Leone, BS, University of Cincinnati; MA, Ph.D., Johns Hopkins University—Professor

Peter Lutz, BS, St. John Fischer College; MS, Ph.D., State University of New York at Buffalo—Professor

Sharon P. Mason, BS, Ithaca College; MS, Rochester Institute of Technology—Associate Professor

Sumita Mishra, BS, Patna University; BS, Ph.D., State University of New York at Buffalo—Assistant Professor

Tae (Tom) Oh, BS, Texas Tech University; MS, Ph.D., Southern Methodist University—Associate Professor

Yin Pan, BS, MS, Shanghai Normal University; MS, Ph.D., State University of New York at Binghamton—Associate Professor

Nirmala Shenoy, BE, ME, University of Madras; Ph.D., University of Bremen—Professor

William Stackpole, BS, Roberts Wesleyan College; MS, Rochester Institute of Technology—Associate Professor

Luther Troell, BS, MS, Texas A&M University-Kingsville; Ph.D., University of Texas at Austin—Professor

Harris Weisman, BS, Cornell University; MBA, Rensselaer Polytechnic Institute—Lecturer

Kaiqi Xiong, MS, Ph.D., Claremont Graduate University; MS, Ph.D., North Carolina State University—Assistant Professor

Bo Yuan, BS, Shanghai Teachers' University; Ph.D., State University of New York at Binghamton—Associate Professor

Software Engineering

James Vallino, BE, The Cooper Union; MS, University of Wisconsin; Ph.D., University of Rochester—Department Chair; Professor

J. Scott Hawker, BS, MS, Texas Tech University; Ph.D., Lehigh University—Assistant Professor

Stephanie A. Ludi, BS, MS, California Polytechnic State University at San Luis Obispo; Ph.D., Arizona State University—Graduate Program Director; Associate Professor

Michael J. Lutz, BS, St. John Fisher College; MS, State University of New York at Buffalo—Professor

Andrew Meneely, BA, Calvin College; Ph.D., North Carolina State University—Assistant Professor

Thomas Reichlmayr, BS, MS, Rochester Institute of Technology—Associate Professor

LihuaXu, BS, Nanchang University; MS, Ph.D., University of California—Assistant Professor

Computing and Information Sciences

Pengcheng Shi, BS, Shanghai Jiao Tong University; MS, M.Phil., Ph.D., Yale University—Doctorate Program Director; Professor

Justin Domke, BS, Washington University in St. Louis; MS, Ph.D., University of Maryland at College Park—Assistant Professor

Huafeng Liu, BS, MS, Ph.D., Zhejiang University—Associate Professor

Linwei Wang, BS, Zhejiang University; M.Phil., Hong Kong University of Science and Technology; Ph.D., Rochester Institute of Technology—Assistant Professor

Quarter Courses

2012–2013 Academic Year

Information Sciences and Technologies

4002-710 Object Technologies
This is a course in the principles and techniques of designing and implementing software objects. Current software environments are used to explore effective design methods and concepts. Topics include basic object design, class definition and syntax, object-oriented design, software quality and object evaluation. Software design and programming projects are required. (4002-714 or permission) **Class 4, Distance Format, Credit 4**

4002-714 Java for Programmers
An intensive survey of the Java programming language for experienced programmers. This course covers the creation of application programs. Topics include: basic language concepts (declaring and evaluation of data, statements, expressions, control flow, and input/output), object-oriented fundamentals, GUI interfaces, exception handling, debugging, threads, and the client/server environment. Programming projects will be required. (A two-course object-oriented programming sequence in a language other than Java) **Class 6, Credit 4**

4002-716 C++ Programming Workshop
A workshop in the C++ programming language intended for students to gain programming experience. This course will focus on modern programming concepts such as reusability, data abstraction, information hiding, exception handling and object-oriented design. Programming projects will be required. (4002-710 or permission of instructor) **Class 4, Distance Format, Credit 4**

4002-718 Current Themes in Information Technology
This course provides entering graduate students in Information Technology with an overview of current theory and issues in the field. Topics covered would include social and cultural impacts of technology, virtuality digital communication, and online communities. Using reading from a variety of books and periodicals, students will be presented with views on information technology in a socioeconomic context. (MS-IT Bridge) **Class 4, Credit 4**

4002-720 Data Model and Database Implementation
This course provides a theoretical and practical introduction to the design and development of relational database systems. Current software environments are used to explore effective database design and implementation concepts. Topics include data modeling, database design, data query and manipulation, and transaction management along with current topics. Database design and implementation projects are required. (A two-course object-oriented programming sequence) **Class 4, Distance Format, Credit 4**

4002-722 Fundamentals of Instructional Technology
The world of information technology offers the possibility of transforming the way that instruction is designed and delivered. However, few information technology professionals understand the methods and materials of instructional design. As a professional in information technology, a student may be responsible for designing instruction either in a business or an educational context. This course enables the student to be able to plan, organize, and systematically develop instructional materials. The course uses an Instructional Systems Design (ISD) model to analyze, design, deliver, and evaluate instruction. (4002-770) **Class 4, Distance Format, Credit 4**

4002-723 Interactive Courseware
Computer software that teaches is referred to as courseware. This course was designed to help you make the transition from "general" Instructional Design (4002-722/510) into the actual application of these principles in a computer-based environment. Although the basic principles of instructional design hold true in all media environment, using these teaching and learning principles is somewhat different when developing instruction that will be delivered by computer. This course teaches procedures that have already been successful in the design and development of courseware. (4002-722) **Class 4, Distance Format, Credit 4**

4002-724 Performance Support Systems Design
An electronic performance support system (EPSS) is a software technology, designed to give each user what he or she needs when he or she needs it. It is designed to enable skilled performance without training. An EPSS can be defined functionally, by what it does. The job of an EPSS is to help a worker perform his or her job better. Typical components of an EPSS encompass tutorials, drills, simulations, and hypertexts, but often include expert systems, help systems, and intelligent job aids. This course examines some of the relevant literature supporting EPSS and provides students with the opportunity to design and develop several different components of a performance support system. (4002-722 and a two course programming sequence) **Class 4, Distance Format, Credit 4**

4002-725 Component Development
A programming course focused on the use, design and implementation of reusable software components. Students create and test components based on current technology. Issues of reusable design, quality, component libraries, and interoperability are included. Design and programming project is required. (4002-710) **Class 4, Distance Format, Credit 4**

4002-726 Research Methods
This course will prepare students to conduct research and to design experiments and analyze data for empirical studies in Information Technology. Students will explore qualitative and quantitative research methods, experimental and non-experimental design, theoretical framework development, statistical data analysis, sampling and data collection methods within the context of information technology research. Case studies, mini-research projects and scholarly writing assignments will be required. (0307-712 or equivalent) **Class 4, Distance Format, Credit 4**

4002-740 Geographic Information Science and Tech
This course provides a survey of the theory, concepts, and technologies related to representation and understanding of the earth—a scientific domain known as Geographic Information Science and Technology (GIS and T). Students will gain hands-on experience with technologies such as Global Positioning Systems (GPSs), Geographic Information Systems (GISs), remote sensing, Virtual Globes (Google Earth), and web mapping mash-ups. Furthermore, students will learn relevant GIS and T theory, concepts, and research trends such as spatial reasoning, spatiotemporal data representation, and spatial analysis. **Class 4, Credit 4**

4002-748 Spatial Model and Visual
This geographic analysis course explores the spatial and temporal modeling and visualization of natural and engineered systems and their interactions in the context of disaster management. Course topics include characterization of spatial and networked data from remote sensing platforms and sensor networks, three- and four-dimensional spatial analysis, network analysis, and approaches to predictive modeling and uncertainty analysis. Students will examine use of models and spatial data for decision support as they apply within a GIS. Students will collaborate on an in-depth, interdisciplinary, group project that will explore use of geographic analysis in a real environment or man-made disasters. Projects will be developed in a collaboration with a government planning agency and/or geospatial industry partner. (4002-740, or permission of instructor) **Class 4, Credit 4**

4002-752 Themes in Software Development and Mange
This course will present prominent and emerging views of technologies, approaches, and issues in application development to entering graduate students in the Software Development and Management Program. The range of topics will encompass a broad spectrum of the software development life cycle using readings from a variety of books and periodicals, independent research, and presentations by leading experts on application development. **Class 4, Distance Format, Credit 4**

4002-763 Advanced Bioinformatics Computing
This course will provide an in-depth exposure to advanced techniques in computational genomics. Topics may include: gene finding, genetic algorithms, hidden Markov models, neural networks, gene expression analysis, clustering algorithms, probabilistic models of evolution, phylogenetic trees, simple and complex diseases: gene mapping, SNP analysis, machine learning, molecular network analysis, probabilistic framework for modeling and interference, systems biology. (One year object oriented programming sequence, Discrete Math I (1016-265), Data Analysis I (1016-319) **Class 2, Lab 3, Credit 4**

4002-765 User Centered Design Methods
This course will focus on the major user centered design methodologies used in the development of applications and environments. Topics include: evolution of software design methods, emergence of user centered design, and key concepts and attributes of contextual, scenario-based, and performance-centered design. Case studies will be used to illustrate the different design methods. Software design projects will be required. (4004-745 or by instructor approval) **Class 4, Distance Format, Credit 4**

4002-770 Introduction to XML
This course will focus on the development and use of the extensible markup language (XML) to create structured data. Emphasis will be placed on the conceptual framework of XML, key components and practices of XML design, XML standards and methods of creating structured data and metadata, research issues in XML development and use. (4004-737 and 4004-739) **Class 4, Credit 4**

4002-771 XML Programming
Exchange of information between disparate programs is a significant problem in industry. Students will learn how to leverage XML to achieve interoperability between programs. Topics covered in this hands-on course include parsing and generating XML, and web services. (4002-770 and 4002-714) **Class 4, Credit 4**

4002-772 XML Transformation and Presentation
This course will explore techniques and technologies for transforming XML documents using XSLT and XSL-FO. The emphasis will be on transformation of XML data into human-readable documents, such as HTML pages and PDF files. Topics covered will include XSLT syntax and processing, XPath and XPointer. Students will implement projects to present XML data using a variety of transformation tools and technologies. (4002-770) **Class 4, Credit 4**

4002-774 Information Assurance Fundamentals
This course provides an introduction to the topic of information assurance as it pertains to an awareness of the risks inherent in protecting digital content in today's networked computing environments. Topics in secure data and information access will be explored from the perspectives of software development, software implementation, data storage, and system administration and network communications. Current software exploitation issues and techniques for information assurance will be investigated. (Graduate standing in GCCIS) **Class 4, Credit 4**

4002-784 Fundamentals of Database Client/Server Computing
Students will investigate strategies for client-server and server communication against single or multiple database servers. Specifically, students will configure, test, and demonstrate successful communication between multiple database servers and multiple clients. Similarities and differences between commercially available connectivity packages, and issues impacting performance will be explored. Programming exercises are required. (4002-360 or 4002-720 and 4002-219 or 4002-414 or 4002-714) **Class 4, Credit 4**

4002-785 Fundamentals of DBMS Architecture and Implementation
Students will be introduced to issues in client/server database implementation and administration. Topics such as schema implementation, storage allocation and management, user creation and access security, transaction management, data backup and recovery, and performance measurement and enhancement will be presented in lecture and investigated laboratory environment. Students will configure and demonstrate successful management of a database server for client access. (4002-360 or 4002-720 and 4055-744) **Class 6, Credit 4**

4002-787 Database Performance and Tuning
Students will explore database theory as it applies to the performance and tuning of database systems. Topics in database performance will be explored including: physical and logical design issues, the hardware and software environment, SQL statement execution and front end application issues. Techniques in performance monitoring and tuning will be investigated. (4055-744 and 4002-785) **Class 5, Credit 4**

4002-789 Data Warehousing
This course covers the purpose, scope, capabilities, and processes used in data warehousing technologies for the management and analysis of data. Students will be introduced to the theory of data warehousing, dimensional data modeling, the extract/transform/load process, warehouse implementation, dimensional-data modeling, and summary-data management. The basics of data mining and importance of data security will also be discussed. Hands-on exercises include implementing a data warehouse. (4002-785) **Class 4, Credit 4**

4002-810 Simulations and Learning Environments
A learning environment is an electronic environment in which students are provided resources from which to learn. These resources may include tutorials, but are generally far more experimental in nature. A valuable component within a learning environment is an instructional simulation, which provides an opportunity for learners to interact with a safe, virtual world. Kolb's experiential learning theory is a theoretical framework that can be used for designing learning environments. This course provides theoretical background along with hands-on development. (4002-722 and 4002-218 or equivalent programming experience) **Class 4, Credit 4**

4002-819 Integration Technologies
This course is an in-depth study of the major interoperability technologies. Exercises are used to illustrate how modern integration technologies address the economic and technical issues related to the development of integrated systems. Programming projects are required. (4002-710, 4002-725) **Class 4, Distance Format, Credit 4**

4002-820 Economics of Software Development
This course is an analysis of the factors that determine software cost, quality, and time to delivery. Topics include fundamentals of software development, identification of cost drivers, and analysis of productivity and quality data. Students use models to estimate software cost, delivery time, and operational reliability. (2+ years of software development experience and SD&M Bridge) **Class 4, Distance Format, Credit 4**

4002-821 Data Architecture and Management
This course will focus on data architectures, issues, and strategies for managing enterprise data as an organizational information asset. The fundamental meaning and management of data is emphasized as an enabler to enterprise data integrity, enterprise data architecture, and satisfaction of enterprise business requirements. Topics include metadata management, business process integration, data and process governance, repository management, data quality, data architectures, and current technologies in information exchange. Data integration and programming projects are required. (4002-710, 4002-720) **Class 4, Distance Format, Credit 4**

4002-823 Agent-based Modeling
This course is intended as an introduction to the emerging area of Agent-Based Modeling, a subset of the study of complex adaptive systems. Agent-based modeling is at the intersection of research (theory development and confirmation) and computational simulation. This course will be an introduction to these topics, focusing on the research aspects of agent-based modeling: the use of computation as a test bed for developing and testing social science theories. The role of visualization in agent-based modeling development and analysis is presented. Students will analyze the social science literature for current models and theories and will develop computational models incorporating these theories. (4004-730; 0514-784) **Class 4, Credit 4**

4002-825 Systems Architectures
A programming course focused on the application of interoperability technologies. Students develop integrated systems based on software components, applications, databases, web sites, heterogeneous operating systems and networks. (4002-819) **Class 4, Distance Format, Credit 4**

4002-830 Project Management
This is a course in the methods and techniques of managing a software development project. Topics include defining project goals, work breakdown structure, defining tasks, project plans, estimation and scheduling techniques, work monitoring and measurements. (2+ years of software development experience and SD&M Bridge) **Class 4, Distance Format, Credit 4**

4002-831 Process Management
This is a course in the methods and techniques of managing a software development environment. Topics include development organization structure, team management, staff development, project selection and prioritization, cost/benefit analysis, role of standards, and organization communication. (2+ years of software development experience and SD&M Bridge) **Class 4, Distance Format, Credit 4**

4002-865 Program Evaluation
This course provides the structure for a graduate capstone experience. Students learn fundamental evaluation terminology and frameworks for program evaluation, such as the CIPP model. Designs for evaluating projects are discussed. Students will design and conduct a full scale evaluation of an online learning or knowledge management system, and will produce a formal, written document that functions as the capstone experience for the degree. (4002-810 and 4002-845) **Class 4, Distance Format, Credit 4**

4002-876 Secure E-commerce
This course covers the concepts required to implement a secure e commerce site. Topics include the assessment of security in a proposed or an existing site, the implications of decisions impacting security and the implementation considerations needed to establish a secure site. (4002-875) **Class 4, Distance Format, Credit 4**

4002-890 Graduate Seminar in IT
This is the IT seminar course to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours)will be determined by the faculty member(s) who propose a given special-topics offering. (As appropriate for topic proposed. Corequisites as appropriate for topic proposed.) **Credit 2–8**

4002-892 CSCW and Groupware
This course will examine the role of information technology in collaborative work settings. An overview of relevant theory, technologies, and standards will provide the context for examining the integration and strategic use of e-mail distributed networking, the World Wide Web, conferencing and enhanced messaging. (4004-745) **Class 4, Distance Format, Credit 4**

4002-893 Seminar in Thesis and Project Preparation
This course provides a structure, methodology and forum for the capstone experience proposal development and committee selection. (Two-thirds of graduate course work not including prerequisite courses) **Class 2, Distance Format, Credit 2**

4002-895 Software Development and Management Caps
A presentation demonstrating current awareness and understanding of trends impacting the software development and management field. Students prepare a portfolio summarizing their course work in the SD&M program and discuss the relationship of their course work to advances in software development technology and practice. (Enrollment in last quarter of study) **Distance Format, Credit 4**

4002-897 MS Thesis
Capstone experience for the Master of Science in Information Technology degree program. Students must submit an accepted thesis proposal in order to enroll. (Permission of graduate studies committee) **Credit 0–8**

4002-898 MS Project
Capstone experience for the Master of Science in Information Technology. Student must submit an accepted proposal in order to enroll. (Permission of the graduate studies committee) **Credit 0–8**

4002-899 Independent Study
The student will work independently under the supervision of a faculty adviser on a topic not covered in other courses. **Credit 0-**

4002-999 Graduate Co-op Education
An optional cooperative educational experience is available to graduate students to add practical employment experience to their studies to support their career objectives and personal goals. (Completion of program Bridge requirements and two-thirds of program of study with 3.0 GPA or better; or permission of graduate coordinator) **Credit 0**

4004-730 Interactive Media Development
Students will build on their understanding of basic media types to develop interactive user interfaces to rich-media content, such as video, audio, graphics, and text. They will learn to control and synchronize multiple media assets in a variety of environments utilizing authoring tools such as Macromedia Director. Students will design and implement applications that support a high level of interactivity and develop strategies for delivering these programs via CD-ROM and the World Wide Web. Programming will be required. (4004-741 or equivalent, and 4080-231 or 4002-218, or a two-course programming sequence) **Class 4, Credit 4**

4004-736 Web Client-side Programming
This course will explore the analysis, design, development, and implementation of client-side scripting in the context of internet technologies and Web-based client systems and applications. Students will learn to use native technologies for designing and building usable and effective interactive Web-based systems, clients, and interfaces. Key features addressed will include browser and platform compatibility, object reusability, bandwidth and communications issues, scripting environments, privacy and security, and related technologies and API's. Programming required. (4004-737) **Class 4, Credit 4**

4004-737 Website Design and Technologies
Assuming a basic knowledge of HTML coding and web page design, this class moves into large-scale site development, and an introduction to advanced web technologies. Building on the web page design concepts introduced in 4004-741, this course focuses on site design issues, including scalability, maintenance, and integration of web technologies into the business or organizational context. Technologies introduced include cascading style sheets, dynamic HTML, basic JavaScript, and streaming media. (4004-741) **Class 4, Credit 4**

4004-739 Programming for the World Wide Web
The World-wide Web is no longer just linked as static HTML documents. Web pages can be generated dynamically and can interact with a user to modify pages on-the-fly, validate user inputs and entertain. This course is an overview of several forms of programming that are used in the creation of interactive and dynamic web content. This course provides a practical overview of programming in the context of the World-wide Web. It will enable students to develop web pages and web sites that incorporate both client-side and server-side programming by installing and modifying existing scripts as well as writing new scripts. (4004-737 and a two-course programming sequence) **Class 4, Credit 4**

4004-741 Fundamentals of Web Based Multimedia
This class provides an introduction to web-based multimedia development and implementation. Topics covered include uses of web based multimedia in business and historical contexts, differences between web-based and stand-alone multimedia, basic HTML and web page design, digital image creation and manipulation, and the incorporation of audio, video, and animated components in web-based multimedia. Students will learn to use computer-mediated communication and internet utilities in support of multimedia development. (Computer literacy) **Class 4, Credit 4**

4004-745 Foundations of Human-Computer Interaction
Human-computer interaction (HCI) is a field of study concerned with the design, evaluation and implementation of interactive computing systems for effective human use and with the study of major phenomena surrounding them. This course surveys the foundation concepts and major issues of the HCI field including: cognitive psychology, human factors, interaction styles, user analysis, task analysis, interaction design methods and techniques, and evaluation. The primary focus of this course will be on the users and their tasks. **Class 4, Distance Format, Credit 4**

4004-748 Usability Engineering
This team project oriented course stresses the importance of good software interfaces and the relationship of user interface design to human computer interaction. Topics include: the usability engineering life cycle, effective system design and development, usability heuristics, testing, assessment methods, and international user interfaces. This course focuses on the design, testing, and development of effective user interfaces. (4004-745 and 4004-730) **Class 4, Distance Format, Credit 4**

4004-749 Usability Testing
This project-based course will focus on the formal evaluation of user interfaces. Topics include: usability test goal setting, recruitment of appropriate users, design of test tasks, design of the test environment, test plan development and implementation, analysis and interpretation of the results, and documentation and presentation of results and recommendations. (4004-748 and a statistics course) **Class 4, Distance with a visit, Credit 4**

4004-751 Web Database Integration
An introduction to technologies, techniques, and contexts for developing dynamic web sites that are driven by back-end databases. Builds on the concepts of web programming and multi-user relational databases introduced in prerequisite classes. (4004-737, 4004-739 and 4002-360 or 4002-720) **Class 4, Credit 4**

4004-755 Advanced Topics in HCI
Human-computer interface (HCI) is an evolving field. This course is designed to study the current themes and advanced issues of HCI. Topics will vary depending upon current research and developments in the field. (4004-745) **Class 4, Distance Format, Credit 4**

4004-774 Eye Tracking: Theory, Method. and Applications
This course will provide a theoretical and practical study of eye movements and eye tracking, and will focus on the application of eye tracking to usability testing. Course topics include: eye movements and visual perception; types of eye trackers and theory of operations; data analysis; and the application of eye tracking to various domains. Laboratory projects will be required. (4004-745 and Statistics) **Class 2, Lab 2, Credit 4**

4004-775 Remote Usability Development and Testing
This course will discuss the tools and procedures of remote usability testing and apply them to the development of an effective user interface. Topics include: the software development life cycle, design and development of effective interfaces, heuristic evaluations, assessment methods, usability testing procedures and protocols, remote testing tools and procedures, and analyze testing results and propose recommendations. (4004-745, 4004-730 and Statistics, not intended for students taking 4004-748 and 4004-749) **Distance Format, Credit 4**

4004-780 Application Domain in HCI
This course will provide a theoretical and case-based study of several areas of HCI, all considered within an application domain of information technology. Application domains may include medical informatics, bioinformatics, game design, and entertainment. Course topics include: a scientific approach to UI design (usability engineering), domain-specific user analysis and user profiles, social and cultural influences, general and domain-specific design issues, information visualization, data integration, mobile devices, security, privacy and ethics. (4004-745) **Class 4, Credit 4**

4004-781 Usability Economics
User-centered design methodologies are proven enablers for developing successful systems and are important to realizing enterprise benefits. An understanding of usability economics is needed to effectively integrate usability engineering into the systems development process. This course provides students with the necessary background and methods to prepare cost-benefit analysis of applying usability engineering in a variety of system development domains. Other topics include: strategies for introducing usability engineering life cycle into an organization; developing a usability culture; and developing enterprise usability standards. (4004-745, and 4004-748 or 4004-775) **Distance Format, Class 4, Credit 4**

4004-897 MS HCI Thesis
Capstone experience for the Master of Science in Human-Computer Interaction. Student must submit an accepted proposal in order to enroll. (Permission of the HCI graduate program coordinator) **Credit 0–8**

4004-898 MS HCI Project
Capstone experience for the Master of Science in Human-Computer Interaction. Student must submit an accepted proposal in order to enroll.(Permission of the HCI program coordinator) **Credit 0–8**

4006-766 Build Elec Health Record
This course explores the acquisition, storage, and use of information in the electronic health record (EHR) through hands-on development and programming. Students will learn about the types of information used in clinical care: text, structured data, images, and sounds. Other topics covered include: clinical vocabularies (existing schemes and their limitations); how clinical information is generated and utilized; methods of information storage and retrieval; departmental systems (laboratory, radiology, and hospital information systems); organizational systems (including scheduling, registration and financial systems); and the legal, social and regulatory problems of EHRs including security and confidentiality. (4004-745, MIF-410) **Class 4, Credit 4**

4006-887 Medical Informatics Capstone I Des
This team-based course is the first course in a two-course Medical Informatics Capstone sequence. The course provides students with the opportunity to apply the knowledge and skills learned in coursework to designing a solution to a real problem in the medical informatics domain. Project work initiated in this course will be completed in the Medical Informatics Capstone II (Development). (Completion of all year 1 program requirements) **Class 2, Credit 2**

4006-888 Medical Informatics Capstone II Dev
This team-based course is the second in a two-course Medical Informatics Capstone sequence. The course provides students with the opportunity to apply the knowledge and skills learned in coursework to implement a solution to a real problem in the medical informatics domain. Project work initiated in the Medical Informatics Capstone I (Design) course will be carried forward and completed in this Medical Informatics Capstone II (Development) course. (4006-887) **Class 2, Credit 2**

Computer Science

4003-700 Foundations of Computer Theory
Introduction to the classical and contemporary theory of computation covering regular, context-free, and computable (recursive) languages with finite state machines, pushdown automata, and Turing machines. Basic concepts of computability theory. (1016-265, 4003-242) **Class 4, Credit 4**

4003-703 Advanced C++ and Program Design
The course covers design techniques and advanced programming. Topics include the software development life cycle; analysis and design using the Unified Modeling Language (UML); advanced programming in the C++ programming language will be used; and implementation strategies for external data structures. Individual and group programming projects will be required. Homework assignments are an integral part of the course. (Programming Skills, 4003-561/4005-714) **Class 4, Credit 4**

4003-707 Advanced Programming
The goal of this course is to introduce the language Java. Topics include class design and implementation, inheritance, exceptions, files, threads, swing, network programming, and remote method invocation. We will use object-oriented technology as a means to an end to design and implement software solutions. Programming assignments are an integral part of the course. (Object-oriented Programming + C) **Credit 4**

4003-709 Programming Language Concepts
A study of the syntax and semantics of a diverse set of high-level programming languages. The languages chosen are compared and contrasted in order to demonstrate general principles of programming language design. This course emphasizes the concepts underpinning modern languages rather than the mastery of particular language details. Programming projects will be required. Alternative RIT offering: 4003-450 (4003-704, Algorithms and Data Structures, 4003-705 or 1016-265) **Class 4, Credit 4**

4003-710 Computer Organization
An introduction to computer architecture and assembly language programming concepts and techniques. Topics include Boolean algebra, combinational and sequential circuit design, storage mechanisms and their organization, the instruction cycle in a simple CPU, assembly language programming, programming at the device level, and the role of assembly language in understanding the hardware/software interface. Digital logic and software projects will be required. (4003-334, 1016-265) **Class 4, Credit 4**

4003-713 Operating Systems
A general survey of operating system concepts. Topics include process synchronization, interprocess communication, deadlock, multiprogramming and multiprocessing, processor scheduling and resource management, memory management, overlays, static and dynamic relocation, virtual memory file systems, logical and physical I/O, device allocation, I/O processor scheduling, process and resource protection. Programming projects will be required. Alternative RIT offering: 4003-440. (4003-704 or 4003-707) **Class 4, Credit 4**

4005-701 Computability
Computability is the heart of theoretical computer science for it is the theory which attempts to formalize the notion of computation. Topics include computation by while-programs, Turing machines, recursive function theory, symbol manipulation systems, program methodology, the limitation of the concept of effective computability. (4003-700) **Credit 4**

4005-702 Computational Complexity
This course is concerned with the mathematical analysis of computer algorithms. Topics include matrix operations, combinatorial algorithms, integer and polynomial arithmetic, NP-completeness, and lower bounds on algorithms involving arithmetic operations. (4003-700) **Credit 4**

4005-704 Complexity and Computability
This course provides an introduction to complexity theory and computability theory. It starts with an overview of basic complexity classes, with special focus on NP-theory. This is followed by a study of problems complete for NP and PSPACE, the Church-Turing thesis, and undecidability of a selection of classical problems. Some advanced topics in computability, like degrees of unsolvability, the recursion theorem, or Gödel's incompleteness theorem will be discussed. (4003-700) **Class 4, Credit 4**

4005-705 Cryptography
The course is devoted to the review of basic cryptographic algorithms, their implementation and usage. Classical encryption techniques and those of Rivest-Shamir-Adleman and EL Gamal will be seen in depth, and an overview of several others will be presented. This course also presents authentication schemes and interactive proof protocols. Students will write a term paper, either theoretical based on literature or reporting a student's own implementation or experiments with a chosen cryptographic scheme. Depending on the size of the group, some or all students will give a presentation to the class. (4003-334; 1016-265; set by instructor) **Class 4, Credit 4**

4005-706 Cryptography II
This course investigates advanced topics in cryptography. Topics include an overview of necessary background in algebra and number theory, private and public key cryptosystems, and basic signature schemes. Additional topics include number theory and basic theory of Galois fields used in cryptography; history of primality algorithms and the polynomial time test of primality; discrete logarithm based cryptosystems including those based on elliptic curves; interactive protocols including the role of zero-knowledge proofs in authentication; construction of untraceable electronic cash on the net; and quantum cryptography. Other topics may include digital watermarking, fingerprinting, and steganography. Programming will be required. (4005-705 Cryptography I or 4003-482 and permission of instructor) **Class 4, Credit 4**

4005-709 Topics in Computer Science Theory
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: arithmetic algorithms, data encryption, the Fast Frontier Transform, combinatorial optimization, logic. Programming projects may be required. (Set by instructor) **Credit 1–4**

4005-710 Programming Language Theory
An introduction to the basic concepts of programming language design. It begins with a survey of the issues that are involved in the design and implementation of languages. Specific tools for the description of syntactic and semantic structure are introduced. The balance of the course is an analysis of programming language structure, using these descriptive tools to give precise form to the discussion. Programming assignments will be required. (1016-265, 4003-709) **Class 4, Credit 4**

4005-711 Compiler Construction
This course discusses design and implementation of language processors and translators. Topics include lexical, syntactic, and sematic descriptions, algorithms for analysis tools, and programming techniques, as well as environment-, stack-, and heap-based interpreters and code generation for typical computer architectures. Teams of students will be required to design and implement a programming language with nested block structure and data aggregates. (4003-700, 4003-707, and 4003-709, or permission of instructor) **Class 4, Credit 4**

4005-713 XML-Architectures, Tools and Techniques
This course is a critical review of the XML standard and its major applications for data description, transformation, storage, and transport, and in its role as a meta language for little languages used within software development and network communication. XML as a tool for language design is compared to a parser-generator based approach. The implementation of XML parsing is compared to other forms of language recognition. Students are expected to complete programming assignments, some involving Java, and give a team presentation (which includes a demonstration and online presence) about an XML-based technology available from the internet. (4003-707 or permission of instructor) **Class 4, Credit 4**

4005-714 Programming Skills
The goal of this course is to introduce the student to a programming paradigm and an appropriate programming language chosen from those that are currently important in industry or that show high promise of becoming important. A significant portion of the learning curve occurs through programming assignments with exemplary solutions discussed later in class. Students must complete a separate term project which will require some skills not discussed in class. The instructor will post specifics prior to registration. With the approval of the program coordinator, this course can be taken for credit more than once, provided each instance deals with a different paradigm and language. (4003-707 or permission of instructor) **Class 4, Credit 4**

4005-715 Language Based Security
This course explores the two major roles played by programming language-based mechanisms in developing secure systems that share mobile data or code. First, the course covers principles and practice of secure coding including topics such as good versus bad code, design, and implementation; security principles and architectures; and automation and testing. Second, the course examines techniques based on language design and implementation including topics such as secure operating system structures; software based fault isolation; reference monitors; type-safe languages; certifying compilers; proof-carrying code; automated program analysis and program rewriting. Computing projects are required. (4003-440/713 and 4003-450/709 or permission of instructor) **Class 4, Credit 4**

4005-716 Software Development Tools
This course investigates and evaluates various software tools used in the development of software. Topics include simple dependency-based tools such as make and ant, as well as full-featured integrated development environments. Working with and proposing modeling languages for such tools is and important part of the course. Programming projects will be required. (Completion of CS Bridge courses or permission of instructor)

4005-719 Topics in Programming Languages
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: logic programming, data flow, functional or applicative, and object oriented languages, programming language semantics, formal verification. Programming projects will be required. (Permission of the instructor, completion of the Bridge program) **Class 1–4, Credit 1–4**

4005-720 Computer Architecture
Review of commercially available computer systems, including classical CPU and control unit design, register organization, primary memory organization and access, internal and external bus structures, and virtual memory schemes. Alternatives to classical machine architecture such as the stack machine and the associative processor are defined and compared. Parallel processors and distributed systems are also presented, along with an analysis of their performance relative to nonparallel machines. Programming projects are required. (4003-710, 4003-707, 4003-713) **Class 4, Credit 4**

4005-729 Topics in Computer Architecture
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Programming projects will be required. (Permission of the instructor, completion of the Bridge program) **Class 1–4, Credit 1–4**

4005-730 Distributed Systems
An introduction to the study of distributed systems. The course covers distributed system architectures such as client-server and peer-to-peer, distributed system design issues such as communication, fault tolerance, coordination, and deadlock, distributed system middleware such as Remote Method Invocation (RMI) and Tuple space, and the theory of distributed algorithms such as logical clocks and leader election. Programming projects are required. (4003-713 or equivalent, 4003-707 or equivalent) **Credit 4**

4005-731 Distributed Operating Systems II
This course addresses the practical issues involved in the design of a distributed operating system. The following topics are discussed: implementations of the process environment, processor scheduling, file systems, and the management of distributed memory. Examples of specific implementations will be discussed. Other topics (e.g., security) may be covered, at the discretion of the instructor. A group or individual project, involving the design and implementation of one or more components of a distributed operating system, will be a major component of this course. (4005-730) **Class 4, Credit 4**

4005-735 Parallel Computing I
A study of the hardware and software issues in parallel computing. Topics include an introduction to the basic concepts, parallel architectures and network topologies, parallel algorithms, parallel metrics, parallel languages, network topology, granularity, applications, parallel programming design and debugging. Programming projects will be required. (4003-713) **Class 4, Credit 4**

4005-736 Parallel Computing II
A study of selected topics in parallel algorithm design through the analysis of algorithms used in various areas of application. This course will investigate the interplay between architecture and algorithmic structure and will discuss the effect that these issues have on the complexity and efficiency of parallel algorithms. Programming projects are required. (4005-735) **Class 4, Credit 4**

4005-739 Topics in Operating Systems
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: Unix internals, concurrency methods, Petri Nets, parallel programming and algorithms, security, operating systems performance, software environments, communicating sequential processes (“CSP”). Programming projects will be required. (Permission of the instructor, completion of the Bridge program) **Credit 1–4**

4005-740 Data Communication and Networks I
This course is an introduction to the concepts and principles of computer networks. Students will design and implement projects using application protocols, and will study transport, network, and data link protocols and algorithms. This course also includes an introduction to local area networks, data transmission fundamentals, and network security. Programming projects will be required. (Probability, 4003-707) **Class 4, Credit 4**

4005-741 Advanced Computer Networking
This course explores state-of-the-art techniques and open research problems in computer and wireless networks. Topics include internet architecture design, peer-to-peer overlay networks, network security, routing protocols for wireless ad hoc networks, energy efficient issues in mobile networks, wireless sensor networks, routing protocols, and congestion control mechanisms. Reading research papers, presenting recent research results, conducting a team project, and writing term papers are required. (4005-740 Data Communications and Networks I or equivalent; 4003-703 Advanced C++ and Program Design or equivalent; 4003-707 Advanced Java Programming or equivalent; or permission of the instructor) **Credit 4**

4005-742 Ad-hoc Networks
This course explores serverless ad-hoc networks. Topics include authentication, confidentiality, routing, service discovery, middleware and key generation and key distribution. Programming projects are required. (CSI-CS3 or 4003-707, 4003-420 Data Communications and Networking) **Class 4, Credit 4**

4005-743 Secure Operating Systems Network
This course provides students with an introduction to the issues surrounding security aspects in operating systems and networks. Case studies will be used to illustrate security issues in operating systems and networks. Topics include but are not limited to the orange book, access control, firewalls, and an evaluation of the security aspects in a distributed system. Where appropriate, programming exercises will be used to improve understanding of security issues. Exercises may involve group as well as individual projects. It is expected that student presentations will be given during the quarter. (4005-740 and 4003-440 or permission of the instructor) **Class 4, Credit 4**

4005-746 Security Measurement and Testing
Regulatory, financial, and organization reasons drive the requirement to measure computer systems’ security performance. The course will introduce students to the algorithmic foundations and modern methods used for security evaluation and tool design. It will combine a theoretical review of the methods and models currently applied for computer security evaluation and an investigation of computer security through the study of user practice. Students will be required to complete homework, deliver a class presentation, implement a team project and lead the team’s work, and undertake research on the topic assigned. (4005-730 Distributed Systems, 4005-740 Data Communication and Networks I) **Credit 4**

4005-747 **Intelligent Security Systems**
The course will introduce students into the current state of artificial intelligence applications in computer security systems design. It will review different application areas such as intrusion detection and monitoring systems, access control and biological authentication, firewalls structure and design. The students will be required to conduct research and analysis of existing intelligent security applications and tools, as well as, to implement a course programming project on design of a specified security tool based on neural networks and/or fuzzy rules systems. (4005-750, Introduction to Artificial Intelligence, or by the permission of instructor) **Credit 4 (S)**

4005-749 **Topics in Data Communication**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: network reliability, special-purpose protocols, error-correcting codes. Programming projects will be required. (Permission of the instructor, completion of the Bridge program) **Class 1–4, Credit 1–4**

4005-750 **Introduction to Artificial Intelligence**
An introduction to the field of artificial intelligence, including both theory and applications. A programming language that allows effective symbolic manipulation (PROLOG) is used to demonstrate the capabilities and limitations of the material presented in class. Topics include search strategies and their implementation, logic, networks, frames and scripts, production, symbolic manipulation and list processing, problem-solving methods, expert systems, natural language understanding, and selections from vision, robotics, planning and learning. Programming assignments are an integral part of the course. (4003-709) **Class 4, Credit 4**

4005-751 **Knowledge Based Systems**
An introduction to the issues and techniques of building knowledge based systems. Topics will include a survey of existing expert system architectures and implementations, knowledge representation techniques, expert system building tools, and knowledge acquisition. In addition to examining existing expert systems, students will implement expert systems. Programming projects will be required. (4005-750) **Class 4, Credit 4**

4005-753 **Biologically Inspired Intelligent System**
This course examines contemporary topics in artificial intelligence in neuroscience, cognitive science and physiology. Students will focus on developing computer models that are biologically inspired and leverage current knowledge in these areas with the goal to develop systems that understand their environment. An in-depth research paper on a relevant topic, a programming project, and a presentation will be required. A background in biology is not required. (Permission of instructor) **Credit 4**

4005-754 **Image Understanding**
This course explores the theory and methodologies used to interpret images in terms of semantic content. Techniques from image processing and pattern recognition are extended for the purpose of scene understanding using both a bottom-up and top-down approach. Topics include human visual perception, knowledge representation, object recognition, contextual classification, scene labeling, constraint propagation, interpretation trees, semantic image segmentation, 3D models and matching, active vision, and reasoning about images. Programming projects are required. (4005-757 or 4003-457 or permission of instructor)

4005-755 **Neural Networks and Machine Learning**
Neural networks, systems with massively connected parallel primitive computing elements, are, metaphorically, computers structured after natural brains. Such systems promise much better performance than classical computers at pattern recognition and related areas. In this seminar, we will present several neural network models, introduce the current research activity, and develop some underlying mathematics. Students will have the opportunity to develop and present models, both paper and software simulated, and to utilize canned simulators. Students will be exposed to the current research literature. Programming projects will be required. (4003-700 and completion of Bridge) **Class 4, Credit 4**

4005-756 **Genetic Algorithms**
Genetic algorithms provide a powerful approach for searching large, ill-behaved problem spaces. In this course, we will study the theoretical foundations of genetic algorithms as well as their application to a variety of search and optimization problems. This course will cover topics from the current research literature, and students will be expected to do a library research review and perform an experimental project. Programming projects will be required. (4003-700, 4005-710) **Class 4, Credit 4**

4005-757 **Introduction to Computer Vision**
An introduction to the underlying concepts of computer vision and image understanding. The course will consider fundamental topics, including image formation, edge detection, texture analysis, color, segmentation, shape analysis, detection of objects in images and high level image representation. Depending on the interest of the class, more advanced topics will be covered, such as image database retrieval or robotic vision. Programming assignments are an integral part of the course. (Completion of Bridge) **Class 4, Credit 4**

4005-758 **Advanced Computer Vision**
This course examines advanced topics of current research interest in computer vision including motion analysis, video processing and model based object recognition. The topics will be studied with reference to specific applications, for example video interpretation, robot control, road traffic monitoring, and industrial inspection. A research paper, an advanced programming project, and a presentation will be required. (4005-757 or permission of instructor) **Credit 4**

4005-759 **Topics in Artificial Intelligence**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: logic programming, natural language processing, pattern recognition, specialized AI languages and programming paradigms, robotics. Programming projects will be required. (Permission of the instructor, completion of the Bridge program) **Class 1–4, Credit 1–4**

4005-761 **Computer Graphics I**
Computer Graphics I is a study of the hardware and software principles of interactive raster graphics. Topics include an introduction to the basic concepts, 2-D and 3-D modeling and transformations, viewing transformations, projections, rendering techniques, graphical software packages and graphic systems. Students will use a standard computer graphics API to reinforce concepts and study fundamental computer graphics algorithms. (4003-707 or 4003-243**) Class 4, Credit 4**

4005-762 **Computer Graphics II**
This course will investigate the theory of computer image synthesis. Seminal computer graphics papers will be used to describe the various components of the image synthesis pipeline and explain, just as in photography, how the path of lights in a virtual scene can be simulated and used to create photorealistic imagery. The course will emphasize the theory behind rendering tools and libraries available for image synthesis. The student will put theory into practice via programming assignments and a capstone project. Topics will include light and color, three-dimensional scene specification, camera models, surface materials and textures, rendering (local, ray tracing, radiosity), procedural shading and modeling, tone reproduction, and advanced rendering techniques. (4005-761 or 4002-735) **Class 4, Credit 4**

4005-763 **Computer Animation Algorithms and Techniques**
This course takes a look at Computer Animation from a programmer's perspective. It will investigate the theory, algorithms and techniques for describing and programming motion for virtual 3D worlds. Approaches that will be explored include keyframing systems; kinematics, motion of articulated figures, procedural and behavioral systems, and the use of motion capture data. This course is a programming-oriented course with major deliverables including the implementation of techniques presented in lecture as well as a final project concentrating on an area of a student's choice. Students enrolling in this course are expected to have proficiency in the use of a 3D API (e.g. OpenGL, DirectX, Java3D). The course will additionally prepare graduate students to do research in this area through reading, summary, and survey of papers from the animation literature. (4005-761 or 4002-735 or permission of instructor)

4005-764 **Procedural Shading**
This course will present the theory and algorithms behind procedural shading in computer graphics, as well as techniques for using shaders effectively in creating stunning visual effects. The course will compare and contrast real-time shader architectures and students will gain expertise in both environments. The format of the course delivery will be part lecture, part studio style, with weekly lab assignments based upon the techniques presented in the class. During the latter half of the course, students will be assembled into teams to implement, describe, and document a programming solution for a particular special effect based on a written specification. This final, team-based project will serve as the final exam for the course. Students enrolling in this course are expected to have proficiency in either OpenGL or DirectX. (4005-762: Computer Graphics II or 4002-735 3D Graphics Programming)

4005-765 **Applications in Virtual Reality**
This course will explore the application of virtual reality software and technologies within a given problem domain via team based collaboration on a large scale VR project. Focus of individual student teams may include: technical framework, viewing paradigms, VR devices, and use of audio. Reading and summarizing of articles from VR literature will be required in making design decisions. Students should have a strong programming background and a proficiency in a 3D API (OpenGL, DirectX, or Java3D). Students with expertise in distributed systems and an interest in graphics or virtual reality are also encouraged to register. **Class 4, Credit 4**

4005-769 **Topics in Computer Graphics**
This project-oriented course builds on topics developed in 4005-761, Computer Graphics I. Expanded topics include styandard graphics software, anomation techniques, 3D modeling methods, hidden surace and line algorithms, shading, antialiasing color models and design of the user interface. Student will be required to design and implement an interactive system for an application that incorporates several of the above areas. Programming projects will be required. (4005-761 or permission of instructor) **Class 4, Credit 4**

4005-771 Data Exploration and Management
This course provides a broad introduction to the exploration and management of large datasets being generated and used in the modern world. First, practical techniques used in exploratory data analysis and mining are introduced; topics include a data preparation, visualization, statistics for understanding data, and grouping and prediction techniques. Second, approaches used to store, retrieve, and manage data in the real world are presented; topics include traditional database systems, query languages, and data integrity and quality. Cause studies will examine issues in data capture, organization, storage, retrieval, visualization, and analysis in diverse settings such as urban crime, drug research, census data, social networking, space exploration. Data exploration and management projects, a term paper and presentation are required. (4003-707, or 4003-703, or permission of instructor) **Class 4, Credit 4**

4005-772 Database Systems Implementation
This course covers data structures and algorithms used to implement database management systems. Topics include physical data organizations, indexing and hashing, query processing and optimization, database recovery techniques, transaction management, concurrency control, and database performance evaluation. Current research topics in database system implementation are explored. Programming projects will be required. (4005-771) **Class 4, Credit 4**

4005-773 Data Cleaning and Preparation
This course provides an introduction to the concepts and techniques used in preparing data for subsequent data mining. Topics include the knowledge discovery process; data exploration and its role; data extraction, cleaning, integration and transformation; handling numeric, unstructured, text, web, and other forms of data; and ethical issues underlying data preparation and mining. Computing projects, a term paper and presentations are required. (4005-771 Database Systems and 1016-351 Probability, or permission of the instructor) **Credit 4**

4005-774 Secure Database Systems
This course explores policies, methods and mechanisms for protecting enterprise data. Topics include data reliability, integrity, and confidentiality; discretionary and mandatory access controls; secure database architectures; secure transaction processing; information flow, aggregations, and inference controls, and auditing; security models for relational, object-oriented, statistical, XML, and real time database systems. Programming projects are required. (4002-484, or 4003-485, or 4010-443 or equivalent) **Class 4, Credit 4**

4005-775 Data Mining
This course provides an introduction to the concepts and techniques used in the field of data mining. The course covers the knowledge discovery process that included data selection, cleaning, coding: different statistical, pattern recognition, and machine learning techniques: and reporting and visualization of general structures. Computing projects, a term paper, and presentations are required. (4005-771, and permission of instructor) **Credit 4**

4005-779 Topics in Data Management
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered each quarter will focus on current developments in database and transaction systems; covered areas could include, for instance, data mining, or secure database systems, or temporal database systems, or secure transaction processing. Programming projects are required. (4005-771, or permission of instructor)

4005-784 Privacy and Security
This course provides students with an introduction to the issues surrounding security of computer systems and privacy concerns in an increasingly information-based society. This class will consider numerous social issues in computing, including risks and liability involved in using information as well as ethical concerns. Case studies will be used to illustrate both common and historic problems in computer security. Group and individual programming projects will be used to improve understanding of security issues. Students will research specific areas of interest and report their results to the class. (4003-420 and 4003-713) **Class 4, Credit 4**

4005-785 Secure Coding
This course provides an introduction to principles and practice of secure coding including topics such as principles of secure coding, security architectures and design, operational practices and testing, and defenses against software exploitation. Basic cryptography including private and public key systems, encryption standards, crytosystems, and digital signatures is covered from a secure coding perspective. Other topics include software based fault isolation, type safe languages, certifying compilers; proof-carrying code, and automated program analysis and program rewriting. Presentations and computing projects will be required. (Completion of bridge courses in the MS Computer Science or permission of instructor) **Class 4, Credit, 4**

4005-800 Theory of Computer Algorithms
A study of techniques to design and analyze the complexity of algorithms. This course will make students aware of a large number of classical algorithms and their complexity and will introduce the area of NP-completeness. Programming projects will be required. (Algorithms and Data Structures and 4003-705 or 1016-265) **Class 4, Credit 4**

4005-801 Topics in Advanced Algorithms
This course focuses on advanced algorithms and data structures in a specialized area of computer science or in a specific scientific domain. Both practical and theoretical aspects of algorithms will be explored to provide coverage of the state of the art and shortcomings of computing in the specialized areas. This includes proofs of correctness and complexity analysis of the algorithms. Students will write a term paper that explores the current state of research in the area or reports on the student's implementation and experiments with algorithms for a chosen problem. Students will also be required to make presentations. The instructor will post the specifics of each course offering before the registration. With the approval of the program coordinator, this course can be taken for credit more than once, provided each instance concerns a different specialized area or domain. **Credit 4**

4005-810 E-science
An introduction to concepts, methods, and techniques for conducting scientific investigations with the aid of a computer. Topics include the e-Science method: discrete modeling and simulation; continuous modeling and simulation; data analysis; data storage and querying; data visualization; and high performance computing. Programming projects will be required. (1016-282, Calculus II or equivalent; or permission of instructor) **Credit 4**

4005-890 MS Thesis
Capstone of the Master's Degree Program. Students must submit an acceptable thesis proposal in order to enroll. (Permission of the graduate studies committee; 4005-893) **Credit 0–9**

4005-891 MS Project
Alternative capstone of the Master's Degree Program. Student must submit an acceptable project proposal in order to enroll. (Permission of the graduate studies committee. (4005-893) **Credit variable 2–5**

4005-893 MS Project/thesis Seminar
In this course the student will develop a Master's Project or Thesis topic. It will be necessary for the student to make presentations in the class, form a committee and write a Master's Proposal. This course must be completed prior to registering for 4005-891.(Complete 16 graduate hours with a minimum 3.0 GPA) **Class 2, Credit 2**

4005-898 Independent Study
A supervised investigation of selected topics within computer science. Consent of the sponsor and department approval are required.

4005-899 Seminar
Current advances in computer science (set by instructor). **Credit 4**

4005-999 Graduate Co-op Education
One block of full-time, paid employment in the computing field. See the CS graduate program coordinator or RIT's Office of Cooperative Education for further details. (Good standing, completion of Bridge and 16 graduate credits) **Credit 2**
nstructor and department) **Credit 1–3 (F, S, Su, Winter Intersession)**

Software Engineering

4010–710 Research Methods
Overview of the academic research methodologies used in graduate level work. Topics include: writing style, audience analysis, research planning, experimental design, document structure, research validation, and the process for submission and review to conferences and journals. **Credit 2–4**

4011–700 Software Engineering Practicum I
A project course where students practice what they have learned or are learning in class, through directed study. During the first week of class teams of students are assembled. The practicum is an ongoing project, in which students register to participate as "engineers" in a specific role in accordance to individual levels of expertise and profile. (Enrollment in the Software Engineering Master's Program) **Credit 4, Class 0, Lab 4**

4011–701 **Software Engineering Practicum II**
A project course where students practice what they have learned or are learning in class through directed study. During the first week of class teams of students are assembled. The practicum is an ongoing project, in which students register to participate as "engineers" in a specific role, in accordance to individual levels of expertise and profile. (4011–700) (Enrollment in the Software Engineering Master's Program) **Credit 4, Class 0, Lab 4**

4011-702 **Software Engineering Practicum III**
A project course where students practice what they have learned or are learning in class through directed study. During the first week of class, teams of students are assembled. The practicum is an ongoing project in which students register to participate as "Master Engineers" in a specific role in accordance to individual levels of expertise and profile. For this practicum students register as Master Engineers. (4011-701) **Credit 4, Class 0, Lab**

4011–710 **Research Methods**
Overview of the academic research methodologies used in graduate level work. Topics include; writing style, audience analysis, research planning, experimental design, document structure, research validation, and the process for submission and review to conferences and journals. (Admission to the MSSWE program. Students from graduate programs other than Software Engineering require departmental approval). **Credit 4, Class 4, Lab 0**

4011–720 **Software Evolution and Re-Engineering**
This course explores the concepts of software evolution and re engineering and introduces approaches and support tools used to extract the information needed to assess existing software systems. Major maintenance activities are presented including estimating maintenance costs, managing change and predicting maintainability with software quality metrics. Organizational issues relative to product maintenance are discussed. Principles of software reuse and reverse engineering techniques are demonstrated through the use of class activities, team projects and case studies. (4011 710 Research Methods and 4011–750 Software Modeling). **Credit 4, Class 0, Lab 4**

4011–730 **Process Engineering and Environments**
In this course, students will study the Software Process Engineering Metamodel (SPEM) standard as a tool for modeling and analyzing engineering processes. Students will use SPEM to characterize various process and organization models and patterns, and they will align these process characteristics to categories of needs for various organizations and projects. The students will study process engineering frameworks and the configuration and assembly of reusable process components into processes. Students will also study how tools and methods support the process and will identify issues in tool/artifact integration across the software development life cycle. They will apply their learning to engineer software engineering processes, tools, and methods appropriate for their graduate projects and course projects. (Admission to MSSWE program) **Credit 4, Class 0, Lab 4**

4011-740 **Empirical Software Engineering**
This course focuses on the application and analysis of Software Engineering (SE) experimentation as a means of improving both the technical and process-oriented aspects of SE; includes software quality and testing, software design, maintenance, and software development techniques. Topics of interest include, but are not limited analysis of empirical studies of software processes and products, evaluation and comparison of techniques and models (e.g. cost estimation, analysis and design methods, testing), analysis of reports on benefits derived from using studied technologies, examination of predictive models, and the characterization of research methods (measurement theory, experimental design, qualitative modeling, analysis approaches, grounded theory, protocol studies, families of experiments). (4011-710, students from graduate programs other than SE require departmental approval) **Credit 4, Class 0, Lab 4**

4011–749 **Graduate Seminar**

4011–750 **Software Modeling**
Modeling plays a pivotal role during thepre-construction and post construction activities of the software lifecycle. During the preconstruction, models help software engineers understand, specify, and analyze software requirements and design. During the post construction, models can be used to analyze software software systems while in operation. This kind of analysis includes reliability and safety issues as well as timing constraint analysis. (Admission to the MSSE program). **Credit 4, Class 0, Lab 4**

4011–760 **Software Quality Engineering**
This course begins with an exploration of the concepts underlying quality systems and the use of metrics. Students are encouraged to discuss the advantages as well as the limitations of systems and quantitative approaches, with a view to understanding the importance of interpretation in metrics usage and of matching quality systems choices to organizational objectives and culture. They learn the use of modern metrics such as DRE, PCE, COQ/COPQ, reliability objectives and SUMI scores through exercises in analyzing and interpreting charts. This is complemented with a project where they work in teams to design an appropriate quality system for a specific project/organizational situation. (4011–701, 4011–730. Students from graduate programs other than Software Engineering require departmental approval). **Credit 4, Class 0, Lab 4**

4011–770 **Software Architecture and Product Lines**
A system's software architecture is the first technical artifact that illustrates a proposed solution to a stated problem. For all but the simplest system, the achievement of qualities such as flexibility, modifiability, security and reliability is critically dependent on the components and interactions defined by the architecture. The course focuses on the definition of architectural structures, the analysis of architectures in terms of tradeoffs among conflicting restraints, the documentation of architecture for use over a product's life cycle, and the role of architecture in defining product lines based on reusable components. (4011–701, 4011–750. Students from graduate programs other than Software Engineering require departmental approval.) **Credit 4, Class 0, Lab 4**

4011–780 **Software Engineering Experience Research**
This course provides the student with an opportunity to reflect on his/her experience throughout this program and to relate that experience to his/her professional goals. The student builds a professional document during the last academic quarter of study. The report must include an in-depth research report on a topic selected by the student and in agreement with the student's experience report adviser. The report must be structured as a conference paper, and must be submitted to a conference selected by the student and his/her adviser. (Department authorization) **Credit 4, Class 0, Lab 4**

4011–899 **Independent Study**

4011–999 **Graduate Co-Op Education**

Computing and Information Sciences

4040-807 **Teaching Skills Workshop I**
Teaching is a valuable and desirable skill for Ph.D. students. This first of a series of workshops provides an introduction to the concepts and skills needed for quality teaching in higher education. Students will be provided with lecture, reading, and class activities centered on building skills in educational analysis, design, and assessment. **Credit 2**

4040-809 **Teaching Skills Apprenticeship**
This course provides students with an opportunity to work with an experienced faculty member as an assistant. Students will be provided with an opportunity to observe and discuss teaching techniques with an experienced faculty "mentor." Students will be provided with opportunities to contribute to the teaching of a course, and will receive feedback on their teaching techniques and materials. (4040-807) **Credit 1**

4040-810 **Research Methods**
This course provides the theoretical background and practical application of various research methods that can be used in computing and information sciences. The students will learn general approaches to scholarship in the computing and information sciences field, and will explore research methods and associated data analysis techniques; including correlational and experimental design research techniques. Additionally, students will gain an overview of a variety of research methods and terminology, and will conduct literature reviews. Students will analyze several existing research studies, and design and conduct studies. (0307-711 or permission of instructor) **Credit 4**

4040-811 **Introduction to Research**
The course will concentrate on best practices in research in the areas of computer and information sciences. It will advance the student s generic research skills necessary for achieving research results, their presentation and publication. It will train students in refereeing and interacting with reviewers and choosing the media and means for publication. Writing styles specific to area publications will be discussed. The students will have to prepare a paper, submit it to their peers' review and discussions, and deliver a presentation based on the paper. The students must actively participate in the reviews and in class and on-line discussions. **Credit 4**

4040-820 Discovery
This course provides the necessary foundation in the theory and practice of discovering information from large data sets. Managing and interpreting the increasing quantities of scientific and business data to generate useful knowledge is a major challenge. Computing and information sciences professionals need to be able to combine data from multiple data sources, extract relevant information, and present it so that domain experts can develop knowledge and understanding. Topics include informatics, knowledge discovery, data visualization, information sharing and presentation, and, ethical issues underlying access and interpretation of large data sets. Computing projects are required. (4002-784 or permission of instructor) **Credit 4**

4040-830 Connectivity
This course draws attention to commonalities underlying social networks, biological networks, and communications networks. This will give the students a deeper understanding of the issues, a broader set of models and metaphors for designing new communication systems, and will better prepare them for development of connectivity solutions that meet the needs of users and communities they serve. Topics include fundamental and emerging concepts in networking, and the analytical and heuristic tools that people use to develop and analyze networks. Computing exercises will be required to provide hands-on experience with selected tools and technologies. (4005-740 or permission of the instructor) **Credit 4**

4040-840 Security and Trust
This course studies general security issues in a computing environment. This includes theoretical, practical, social, policy and procedural, human factors, and technological aspects. Students will learn to evaluate the security attributes in a computing-based environment. Topics are: cryptography, network security, policies and procedures, access control, secure software engineering, and human factors of security. Computing exercises will be required. (4040-820 or permission of the instructor) **Credit 4**

4040-849 Ph.D. Seminar
Current advances in computing and information sciences. (Prerequisite courses set by instructor) **Credit 1–4**

4040-850 Design
This course focuses on problem-solving and design approaches integrating the areas of interaction, informatics, and infrastructure into application domains. A primary goal is to give students a project-oriented experience in system-level design for creating and building multidisciplinary systems too complex to be treated by engineering analysis alone, and in the context of use inspired basic research. A second goal is to introduce students to existing design representations and methodologies, and to the concepts and terminology of domain-specific product line engineering. Topics include various types of systems and their lifecycles and process frameworks; effective system design representations and development methods; usability heuristics testing and assessment methods, product line domain engineering concepts; project planning and oversight tools. (4002-725, 4010-0361, 0306-661, or permission of instructor) **Credit 4**

4040-890 Dissertation and Research
Students will perform use-inspired original research in the interaction, informatics, and infrastructure areas of computing and information sciences applied to specific domain(s). Students will receive guidance from their adviser(s) in choosing an appropriate topic. (Permission of the Ph.D. program director) **Credit 0–32**

4040-896 Cyberinfrastructure Colloquium
Best practices in collaborative cross-disciplinary research and in communication will be developed and exemplified in a cyberinfrastructure colloquium which will be open to all students and faculty. **Credit 0**

4040-899 Independent Study
Ph.D. students will work with supervising faculty on a project or research study of mutual interest. The design and evaluation will be determined through discussion with the supervising faculty and documented through completion of an independent study form. The independent study must be approved by the Ph.D. program director. **Credit 1–6**

Networking, Security and Systems Administration

4055-721 Perl for System Administration
This course is structured for students that have a foundation in scripting in Perl and will provide them with an additional experiencee in the use of the Perl programming language, with examples and problems drawn from the system administration arena. Students will build on their essential skills in the language and will be taught how to locate and install Perl Modules for use on a computing system. OOPerl (Object Oriented Perl) will be introduced, as an extension to the Perl Modules. Application areas discussed will include programs for walking the files system, user account creation and manipulation, and the processing of log files. (Completion of a two course object oriented programming sequence) **Class 4, Credit 4**

4055-726 Research Methods in NSSA
This seminar introduces students to the MS in Networking, and System Administration, or the MS in Computer Security and Information Assurance, by providing an opportunity to meet the faculty involved in the program and their fellow students. Students will learn about current areas of research in networking, security, and system administration and the areas of research interests of the faculty. To encourage students to begin thinking about their final project or thesis, students will develop a research proposal that may serve as the basis for their later project/thesis proposal. In addition, this course provides an overview of the academic research methodologies used in graduate level work. Topics include: experimental research, correlation, experiment observation, surveys, and case studies. Also included will be document structure, validation, and the process for submission and review to conferences and journals. **Class 4, Credit 4**

4055-744 *Nix Fundamentals for Application Domains
Students will use a Unix-like operating system as it pertains to the support of web, application and database systems. This course allows students to explore design requirements for production servers as applied to domain areas such as web servers, web services, database applications and multimedia content distribution. Topics will include: file system organization and permissions, user interfaces, package management, and services. **Class 4, Credit 4**

4055-746 Telecommunications Network Protocols
Network topologies are discussed, with coverage of layers, 1, 2, 3, and 4. Access control, framing, network protocols, (IP) transport protocols (TCP and UDP), session initiation protocols (SIP), subnetting, port numbers, hubs, switches, routers, and other topics are covered. **Class 4, Credit 4**

4055-755 Secure Wireless Networks
Providing security in today's complex networks is a complicated subject and requires network managers to be well versed in the many aspects comprising network security. In order to accommodate the rapid expansion of networks and the alarming rate in which network security is breached, there is a need for more professionals who understand the basics of security in a networked world. This course is designed to provide students with the foundation needed to understand the problems of network security, perform a risk analysis to ascertain the threats and cost of an attack, and design and implement security strategies to effectively build a defense to minimize the effects of these attacks. (4055-746 or equivalent knowledge) **Class 4, Credit 4**

4055-760 Computer Viruses and Malicious Software
This course involves the study of malicious software (malware) including computer viruses, worms, and Trojan horses. Topics include the various mechanisms used in the construction of malicious software; existing commercial anti-virus software; preventative and reactive means for dealing with malicious software on workstations, servers and in networks; training and education of users; and reliable sources to monitor for alerts as well as the prevention of hoaxes. (4002-716, C++ for Programmers or equivalent) **Class 3, Lab 2, Credit 4**

4055-761 Principles of System Administration
Students are introduced to fundamental system administration topics and technologies that serve as the basis for later course work in system administration. Topics covered include; ethics and system administration, the law and system administration, and the role of the system administrator in organizations. Technologies covered include: computing resource management, the TCP/IP protocol suite, the Domain name Service (DNS), the Dynamic Host Configuration Protocol (DHCP), and the Lightweight Directory Access Protocol (LDAP). (4050-350 and 4050-351 or 4055-746) **Class 4, Credit 4**

4055-780 Computer System Security
This course provides an introduction to computer network security. The areas covered will include the liability, exposure, opportunity, and ability to exploit various weaknesses in a networked computer environment. The forms of the attacks and the detection and defense of the attacks will be discussed. The issues and facilities available to both the intruder and administrator will be examined and evaluated with illustrative laboratory exercises. (4055-761 or equivalent, corequisite: 4055-780 lab) **Class 3, Lab 2, Credit 4**

4055-782 Wireless Adhoc/sensor Networks
This course will introduce students to the diverse literature on ad hoc/sensor networks, and expose them to the fundamental issues in designing and analyzing ad-hoc/sensor network systems. Students will study related technologies and standards ranging from networking, OS support and algorithms, to security. Of primary concern will be protocol design, communication and computational challenges posed by these systems. Activities will include constructing ad-hoc/sensor networks, programming on the sensor hardware, and studying the performance of various protocols. (Prerequisites: 4055-746 and a two course sequence in object-oriented programming) **Class 3, Lab 2, Credit 4**

4055-815 **Introduction to Routing and Switching**
This course is a laboratory-based course that focuses on the standard used to establish internetwork structures that will support a TCP/IP data stream for higher level services to operate over. It is primarily concerned with the network layer and below. Although the course focuses on the TCP/IP protocol suite and the Ethernet LAN protocol, other protocols may be studied. Students will use their knowledge of how to connect computers (PC) in a LAN and learn how to connect separate networks together to form an internetwork. Bridging and switching concepts are investigated (such as the resolution of bridging loops through the appropriate algorithms). Routed and routing protocols and algorithms are studied and implemented. (4050-351) **Class 3, Lab 2, Credit 4**

4055-817 **Emerging Network Technologies**
The Internet has experienced profound growing pains in the last several years that have called into question the adequacy of some of the underlying technologies upon which it has been based. In response to this there are a substantial number of emerging network technologies that if widely adopted may allow the Internet to continue to grow and develop. This course is designed to provide students with an overview of several of these emerging network technologies. The course will consist of a combination of lectures, independent labs and simulation and modeling exercises. **Class 4, Credit 4**

4055-818 **Network Management**
This course will introduce students to the advanced concepts related to the development and implementation of network management tools utilizing a scripting language and the simple network management protocol (SNMP). Theoretical concepts related to network management and tool development will be discussed as well as the requirements of tool use in an enterprise scale network environment. Scripting/programming projects required. (4055-817, 4050-721, 4002-716 or equivalent) **Class 3, Lab 2, Credit 4**

4055-841 **Advanced Computer Forensics**
This course provides students with knowledge and understanding of computer forensics. It will also provide a theoretical foundation for the techniques and methods needed for the extraction of information from digital devices. Students will gain exposure to the spectrum of available computer forensics tools along with developing their own tools for "special needs" situations. The core forensics procedures necessary for ensuring the admissibility of evidence in court, as well as the legal and ethical implications of the process, will be covered on both Unix and Windows under multiple file systems. (4002-716 or equivalent and 4055-761 or equivalent) **Class 4, Credit 4**

4055-850 **Network Design and Performance**
This course will examine the design and performance of networks. Students will learn to design networks based on identified needs, analyze the performance of that network. The designs include site, campus, and enterprise. WAN technologies will be combined with LAN technologies in the design of enterprise networks. Students will learn to assess the business goals and their application to the network goals. Students will learn to evaluate the security goals of the network and to integrate these goals in the design. (4002-455, 4055-746, 4055-761) **Class 4, Credit 4**

4055-862 **Advanced Routing Protocols**
Managing complex network environments requires an understanding of the sophisticated routing protocols necessary for controlling information flow. This course will examine the routing protocols in standard use and their application in typical enterprise and large internet service provider (ISP) environments. The advantages and disadvantages of each protocol will be investigated. In addition, emerging networking technologies and the protocols needed to facilitate their implementation will also be discussed. (4055-746 or equivalent) **Class 4, Credit 4**

4055-863 **Protocol Design and Implementation**
Students will use a package that provides them access to the lowest layers of the OSI model available to software. Employing this package, students will write programs to interact with established protocols, and to implement their own protocols. What a protocol is will be discussed and what makes a protocol good or bad will also be explored. (4055-746 and 4002-716 or equivalent) **Class 5, Credit 4**

4055-882 **Enterprise Security**
This course is designed to provide students with the advanced concepts needed to establish network security strategies to ensure adequate protection for the corporate environment and yet provide accessibility for the corporate community. (4055-761 or 4055-746) **Class 4, Credit 4**

4055-883 **Enterprise Networking**
This course will provide students with the knowledge and understanding to apply modeling and simulation techniques to predict throughput in large-scale enterprise networks. Theoretical concepts of large-scale networks will be discussed and students will create software models based on this theory. This course will provide students with the knowledge needed to apply available tools for modeling network functionality to determine the impact of network infrastructure modification, device reconfiguration, and the impact of new application rollout. Modeling/simulation projects required. (4055-850, Network Design and Performance) **Class 4, Credit 4**

4055-884 **Enterprise Service Provisioning**
Advances in server software and hardware have made it possible for large organizations to consolidate software services onto fewer, higher powered servers while at the same time enhancing reliability and availability. This course will explore available technologies such as cluster computing and server virtualization as they can be used to deploy software services in enterprise environments. (4055-761 or equivalent, 4055-817) **Class 4, Credit 4**

4055-886 **Security Audits of Web Servers and Applications**
This course will provide students with an introduction to processes and procedures for performing a technical security auditing of web servers and web based applications. Students will not only explore the existing XML/WebServices threats, but also learn to apply appropriate auditing tools to identify new vulnerabilities existing in or stemming from web servers and applications. Students will write and present their audit reports on web servers and applications' vulnerabilities. (4055-780 or equivalent) **Class 4, Credit 4**

4055-890 **Graduate Seminar in NSSA**
This is the NSSA seminar course to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given special-topics offering. (As appropriate for topic proposed) **Credit 2–8**

4055-896 **Proposal Development**
Capstone experience for the Master of Science in Applied Networking and Systems Administration. Students will submit an accepted proposal as a prerequisite for the formal thesis. (Permission of the NSSA graduate studies committee) **Class 2, Credit 1**

4055-897 **MS NSSA Thesis**
This is a capstone experience for graduate students in the Master of Science in Networking and System Administration and the Master of Science in Computing Security and Information Assurance. This course will provide an opportunity for students to carry out an individual piece of research on a specified topic area in the NSSA domain. This research should make an original contribution to the body of knowledge in the area of study. Students must submit an accepted thesis proposal in order to enroll. (4055-896 or permission of instructor) **Credit 8**

4055-899 **Graduate Independent Study in NSSA**
Graduate students will work with a supervising faculty member on a project of mutual interest. Project design and evaluation will be determined through discussion with the supervising faculty member and documented through completion of an independent study form to be filed with the Department of NSSA. **Credit 1–6**

4055-999 **Grad Coop in NSSA**
Students will gain experience and a better understanding of the application of technologies discussed in classes by working in the field of networking, security, or system administration. Students will be evaluated by their employer. (Good standing; completion of Bridge and 16 graduate credits)

Interactive Games and Media

4085-715 **Programming for Designers**
This course is an introduction to programming for students with a background in design. Students will write programs to construct and control interactive, media-rich experiences. Students will employ fundamental concepts of object-oriented computer programming such as classes, variables, control structures, functions, and parameters in their code. Students will develop their problem solving skills and begin building a "logical toolkit" of algorithms and program design strategies. Students will extend existing software objects provided by the instructor, as well as create new objects of their own design. Programming projects will be required. (2014-786) **Class 4, Credit 4 (W)**

4085-727 Introduction to Digital Audio Production
Technologies and techniques for producing and manipulating digital audio are explored. Topics include digital representations of sound, digital audio recording and production, MIDI, effects, synthesis techniques, real-time performance issues, and the application of digital audio to multimedia and Web production. (Permission of the instructor) **Class 4, Credit 4 (W)**

4085-728 Interactive Narrative
This course will examine elements of narrative and storytelling within computer games. Students will learn how narrative works within these environments and how it differs from standard narrative, whether the digital creation is original or derived from a traditional narrative source. Students will learn to apply different theories of Ludology (theory and critical analysis of computer games) to analysis and critique of computer games. Students will write treatments, flowcharts, storyboards and scripts for their own games and then implement prototypes based on those documents. Students will complete written assignments. (Permission of the instructor) **Class 4, Credit 4 (F)**

4085-732 Game Design
In this course, students will examine technical requirements for the creation of computer games based on previously developed design artifacts. They will create a design document consistent with current industry practices, building upon a written script, related materials and prototype and will present the draft design documents for critique. (4085-728) **Class 4, Credit 4 (W)**

4085-735 Interactive Game and Audio
This course provides the students with exposure to the design, creation and production of audio in interactive applications and computer games. Students will become familiar with the use of sound libraries, recording sounds in the studio and in the field, generating sound with synthesizers, and effects processing. Students will create sound designs for interactive media, integrating music, dialog, ambient sound, sound effects and interface sounds within interactive programs. (4085-727 or permission of instructor) **Class 4, Credit 4 (S)**

4085-738 Multi-user Media Spaces
This course will focus on the development of interactive applications that use network connectivity to allow multiple users to interact with each other in real time and in a persistent virtual community. The course will integrate multiple technologies dealing with connectivity, database access, server-side logic and object-oriented programming environments. Important human-computer interaction issues will be raised around the design and processing of messages and the traffic patterns generated by multi-user messaging. (4085-746) **Class 4, Credit 4 (F, W)**

4085-742 Interactive Media Development
The development of interactive media requires principles garnered from a variety of disciplines. Through readings, critiques, exercises and discussions, students will explore what makes an interactive media application (or component of an application) successful and what types of applications are best suited to interactive media. This course provides an introduction to the design and development of interactive media for student with technical skills developed for making other types of interactive software. (Permission of instructor) **Class 4, Credit 4 (W)**

4085-743 Interactive Media Project
This advanced graduate course will allow students to work as domain specialists on teams competing one or more large projects over the course of the quarter. The projects will have a Game Design and Development and/or New Media core, but will require expertise in a variety of sub-domains; including web design and development, social computing, computer game development, multi-user media, human computer interaction and streaming media. Students will learn to apply concepts of project management and scheduling, production roles and responsibilities, and their domain skill sets to multidisciplinary projects. Students will complete design documents, progress reports and final assessments of themselves and their teammates in addition to completing their assigned responsibilities on the main projects. (Permission of instructor) **Class 4, Credit 4 (S)**

4085-744 Building Online Communities
In this graduate seminar students design and then work in teams to implement fully-functional on-line communities and/or social software tools to support on-line communities. They are also responsible for attracting members, and promoting their communities. Students will also evaluate the performance of their designs, interaction of their online communities, and their own management skills. (4085-794 or 4004-737) **Class 4, Credit 4 (S)**

4085-746 Programming for Interactive Multimedia
In this course, students will create object-oriented interactive applications in domains such as simulation, games, education and artificial life. They will build data structures and classes to create virtual worlds in 2 and 3 dimensions, populated by autonomous agents. Programs will often extend modules created by previous classes or the instructors. Some projects may require working in groups. (4004-730) **Class 4, Credit 4 (F, W, S)**

4085-757 Graphical Elements of the User Experience
This course provides a theoretical framework covering principles of GUI and its effect upon the user experience. Emphasis will be upon principles that guide the user toward certain behaviors and elicit a sense of identity. This course is designed to articulate methods used to manipulate visual perceptions of space and surface. Students will apply these methods to create user interfaces that reflect the utility and character appropriate for specific projects. (4085-742 or equivalent) **Class 4, Credit 4 (S)**

4085-790 Emerging Themes in Entertainment Technology
This course examines current technologies as well as future trends that will impact the direction of technology development within the video games industry. Topics of study may include, but are not limited to: graphics hardware, graphics algorithms, content creation tools, content organization tools, artificial intelligence techniques, machine learning techniques, game play networking, audio and video hardware and algorithms, user interface development, control and feedback systems, simulation systems, console game systems, experimental gameplay, as well as game engine technology and corresponding development APIs. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (S)**

4085-791 History and Critical Analysis of Computer Games and Interactive Entertainment
This course provides a historical perspective on the evolution of computer and video game design, development and production. Related interactive digital entertainment will also be investigated to provide an understanding of historical issues related to games, computer games, and interactive media. Topics include analysis and critique of analog and interactive television technology, the application of computing and technology to the arts and literature, the business of computer games and cultural responses to computer games. Students will critique computer games and other interactive entertainment products in the context of these topics, the trade press, and personal experience. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (F)**

4085-792 Development Process in the Game Industry
This course examines the individual and group roles of the development process model within the game design and development industry. Students will transform design document specifications into software and hardware needs for developers, testers, and end users. Students will examine team dynamics and processes for programming, content development, testing, deployment, and maintenance. Students will explore design process through the deconstruction of the game industry's software lifecycle model. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (F)**

4085-793 Business and Legal Aspects of Game Development
This course will provide students with a practical background in business and legal practices specific to the video games industry. Students will be introduced to entrepreneurship in the video games industry, confidentiality rules, game developer rights and responsibilities, the developer/publisher/retailer relationship, contract development, intellectual property rules and regulations, royalties, licensing, and legal responsibilities for content and consumer impact. Projects may include individual and group research, examination of case studies, and written and oral reports on current industry practice. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (W)**

4085-794 Online Identity, Social, and Community Behavior
This course introduces students to the expanding body of research and popular writing on online identity, social and community behavior and its application to the development of new on-line communities and social software tools. Students will create their own prototypes for on-line communities and/or software tools and will participate in and evaluate existing online environments. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (W)**

4085-802 **Perspectives on Computer Mediation**
This course examines the design and implementation of software for computer mediation from several perspectives: the computer support for cooperative work (CSCW) perspective addresses activity and organization management, the computer-mediated collaboration (CMC) perspective addresses social systems for computing, and the computer supported collaborative learning (CSCL) perspective addresses collaborative and constructivist learning systems. Students will investigate the design and implementation of computer mediated experiences across several domains, including, but not limited to: social computing, pervasive and ubiquitous computing, computer-based learning environments, entertainment and game systems, as well as visualization and simulation systems. Students will be required to work in teams to design a large-scale computer mediated project. (4085-757 or 4004-745) **Class 4, Credit 4 (S)**

4085-804 **Building Tools for Creative Practice**
Students will be introduced to many of the patterns defining modern computer interfaces and will use them to implement a novel interface of their own design. Students will develop implementation skills for prototyping traditional and experimental interfaces for computing devices. Design patterns and classes will be used to implement components of a typical graphical user interface. Students will then apply these programming strategies to build a toolkit for a new, less conventional interaction style of their own design. Programming projects will be required. (4004-730 and 4004-745) **Class 4, Credit 4 (W)**

4085-834 **2D Graphics Programming**
Students explore the use of an advanced graphics API to access hardware accelerated graphics. Course discussion will include the use of scene graphs, optimizations, and integration with the API object structure. Students will explore advanced use of the API calls in production code, to construct environments capable of real-time performance. (Graduate standing in Game Design and Development) **Class 4, Credit 4 (S)**

4085-835 **3D Graphics Programming**
Students will explore the use of an advanced graphics API to access hardware accelerated graphics. This course will include discussion of scene graphs, optimizations, and integration with the API object structure. Students will explore advanced use of the API calls in production code, to construct environments capable of real-time performance. (4085-834) **Class 4, Credit 4 (F)**

4085-836 **Game Engine Design and Development**
This course will provide students with theory and practical skills in game engine design topic areas such as understanding the graphics pipeline as it influences engine design, hardware principles and the relationship to game engine construction, mathematical principles, scene graph construction and maintenance, advanced scene graph manipulation, textures, materials, and lighting, collision systems, physics, particle systems, and control systems. Furthermore, this course will examine software and toolsets that assist game engine designers in their tasks. Students will be expected to design and implement a game engine in teams as well as properly document their design and development strategy. (4085-835) **Class 4, Credit 4 (W)**

4085-887 **Capstone Design in MS GD&D**
This course allows students within the game design and development program to develop a capstone proposal and design document. The capstone design document specifies the scope and depth of the capstone project. In addition, it defines the group and individual responsibilities for the cohort capstone project experience. (Permission of MS Game Design and Development faculty adviser) **Class variable, Credit 0–4 (W)**

4085-888 **Capstone Development in MS GD&D**
This course provides Master of Science in Game Design and Development students with capstone project experiences. Students are expected to work in cohorts towards the implementation of a game system that properly illustrates proficiency in the application of theory and practice towards a large-scale project. For each student, individual responsibilities for the group project will be defined in consultation with both the group and the faculty. Students must successfully complete the Capstone Design course and present a satisfactory capstone project proposal to the faculty before enrolling in this course. (4085-887 and permission of MS Game Design and Development faculty adviser) **Class variable, Credit 0–4 (S)**

4085-890 **Graduate Seminar in Interactive Games and Media**
This is intended to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given special-topics offering. (as appropriate for topic proposed) **Class 4, Credit 2–8 (F, W, S)**

4085-891 **Advanced AI: Evolutionary Computing**
This course will provide students with theory and practical skills in Evolutionary Computing. Topic areas include the history and evolution of artificial life, evolutionary computing, and biologically inspired AI applied to the domain of video game AI. Students will be expected to design and implement a game in teams as well as properly document their design and development strategy. (4005-750) **Class 4, Credit 4 (W)**

4085-899 **Independent Study**
The student will work independently under the supervision of a faculty adviser on a topic not covered in other courses. (Proposal signed by a faculty member) **Class variable, Credit 1–8 (F, W, S)**

4085-999 **Graduate Co-op Education**
An optional cooperative educational experience is available to graduate students to add practical employment experience to their studies to support their career objectives and personal goals. (Permission of associate director) **Class 0 Credit 0 (F, W, S)**

Semester Courses

Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Information Sciences and Technologies

ISTE-600 **Analytical Thinking**
There is mounting evidence of a need to improve the ability of individuals and groups to think thoughtfully and analytically in order to develop appropriate and useful solutions to complex problems. Sources of complexity include human cognitive limitations, uncertainty, system dynamics, and reasoning errors. This course will provide students with frameworks, techniques, methods, and tools to improve analytical and critical thinking and presentation skills. Students will work individually and in groups on assignments and case study analyses. (One year of programming in an high level language, one statistics course) **Class 3, Lab 0, Credit 3 (F)**

ISTE-605 **Scholarship in Information Sciences and Technologies**
IT graduate students are expected to make a significant scholarly contribution as a requirement for the MS degree. The Scholarship in Information Sciences and Technologies course provides students with the fundamental skills needed to conduct a program of investigation related to participating in the degree capstone course, or in developing a capstone or thesis project. The course focuses on skills such as identifying interesting and important topics and problems, developing and articulating research questions and proposals, critical thinking, and effective oral and written communication and presentation of scholarship. **Class 3, Lab 0, Credit 3 (F)**

ISTE- 608 **Database Design and Implementation**
An introduction to the theory and practice of designing and implementing database systems. Current software environments are used to explore effective database design and implementation concepts and strategies. Topics include conceptual data modeling, methodologies, logical/physical database design, normalization, relational algebra, schema creation and data manipulation, and transaction design. Database design and implementation projects are required. (One year of programming in an object-oriented language) **Class 4, Credit 3 (F, S)**

ISTE-610 **Knowledge Representation Technologies**
This is the first course in a 2-course sequence that provides students with exposure to foundational information sciences and technologies. Topics include an overview of data types, structuring and processing data and knowledge, data transformation, and data storage and warehousing. Students will learn computational methods to manage large datasets in the context of specific problem scenarios. (One year of programming in an object-oriented language, ISTE-608 Database Design and Implement or equivalent, one web course). **Class 3, Lab 0, Credit 3 (F)**

ISTE-612 **Knowledge Processing Technologies**
This is the second course in a 2-course sequence that provides students with exposure to foundational information sciences and technologies. Topics include internet middleware technologies, data and text analytics, and information visualization. (One year of programming in an object-oriented language, ISTE-608 Database Design and Implement or equivalent, one web course, one statistics course) **Class 3, Lab 0, Credit 3 (F, S)**

ISTE-645 **Foundations of Web Technologies I**
This class provides an introduction to Internet and web technologies. Topics include an introduction to the Internet and basic Internet technologies (including, but not limited to: SSH, SFTP, UNIX, XHTML, CSS, Client-Side programming, and web site publishing). (ISTE-121 Comp Prob Solve Info Domain II or equivalent) **Class 3, Lab 0, Credits 3 (S)**

ISTE-646 **Foundations of Web Technologies II**
This course builds on the basic aspects of web page development that are presented in the first course and extends that knowledge to focus on issues and technologies related to the design and development of web sites. Topics include advanced Internet technologies (including, but not limited to: AJAX, server-side programming, database use and access, client libraries, server frameworks, and creating and consuming information services). (ISTE-645 Found Web Technologies I) **Class 3, Lab 0, Credits 3 (F)**

ISTE-699 **Graduate Co-op**
An optional cooperative educational experience is available to graduate students to add practical employment experience to their studies to support their career objectives and personal goals. Permission of Graduate Coordinator is required. (Graduate standing with the IST department, and prerequisites plus at least 18 credits completed with a 3.0 GPA or better) **Credit 0 (F, S, Su)**

ISTE-721 **Information Assurance Fundamentals**
This course provides an introduction to the topic of information assurance as it pertains to an awareness of the risks inherent in protecting digital content in today's networked computing environments. Topics in secure data and information access will be explored from the perspectives of software development, software implementation, data storage, and system administration and network communications. Current software exploitation issues and techniques for information assurance will be investigated. (Graduate standing in GCCIS) **Class 3, Lab 0, Credit 3 (S)**

ISTE-722 **Database Connectivity and Access**
In this course, students will build applications that interact with databases. Through programming exercises, students will work with multiple databases and programmatically invoke the advanced database processing operations that are integral to contemporary computing applications. Students will examine and evaluate alternative approaches for each of these operations. Topics include the database drivers, the data layer, connectivity operations, security and integrity, and controlling database access. (ISTE- 608 or equivalent) **Class 3, Lab 0, Credit 3 (F, S)**

ISTE-724 **Data Warehousing**
This course covers the purpose, scope, capabilities, and processes used in data warehousing technologies for the management and analysis of data. Students will be introduced to the theory of data warehousing, dimensional data modeling, the extract/transform/load process, warehouse implementation, dimensional data analysis, and summary data management. The basics of data mining and importance of data security will also be discussed. Hands-on exercises include implementing a data warehouse. (ISTE- 608 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISTE-726 **Database Management and Access**
Students will be introduced to issues in client/server database implementation and administration. Students will configure, test, and establish client-server communication and server-server communication with single and multiple database servers. Topics such as schema implementation, storage allocation and management, user creation and access security, backup and recovery, and performance measurement and enhancement will be presented in lecture and experienced in a laboratory environment. Students will configure and demonstrate successful communication between a database file server and multiple clients. (ISTE- 608 or equivalent) **Class 4, Lab 0, Credit 3 (F, S)**

ISTE-728 **Database Performance and Tuning**
Students will explore the theory and application of performance monitoring and tuning techniques as they relate to database systems. Standard topics in DBMS performance will be discussed including: physical and logical design issues, the hardware and software environment, SQL statement execution, and front-end application issues. Techniques in performance monitoring and tuning will be investigated. (ISTE-726 Data Management and Access) **Class 4, Lab 0, Credit 3 (S)**

ISTE-740 **Geographic Information Science and Technology**
This course provides a survey of the theory, concepts, and technologies related to representation and understanding of the earth - a scientific domain known as Geographic Information Science and Technology (GIS and T). Students will gain hands-on experience with technologies such as Global Positioning Systems (GPSs), Geographic Information Systems (GISs), remote sensing, Virtual Globes (Google Earth), and web mapping mashups. Furthermore, students will learn relevant GIS and T theory, concepts, and research trends such as spatial reasoning, spatiotemporal data representation, and spatial analysis. **Class 3, Lab 0, Credit 3 (F)**

ISTE-742 **Introduction to Geographic Information Systems**
This course introduces students to the world of Geographic Information Systems (GIS). Course lectures, reading assignments, and practical lab experiences will cover a mix of conceptual, practical and technical GIS topics. Topics include GIS data models, basic cartography, geodatabases, spatial analysis, GIS software, and theory and concepts from the Geographic Information Science and Technology domain. (ISTE-740 Geographic Information Science and Technology, or permission of instructor.) **Class 3, Credit 3 (S)**

ISTE-744 **Thematic Cartography and Geographic Visualization**
This course examines concepts and techniques associated with dynamic map construction, usage, and assessment. Specific topics include thematic cartography, geographic information visualization, sources of dynamic geographic information, developing animated and interactive maps, mapping mashup development, using maps as a means to support group work, usability of dynamic maps, and current geovisualization research areas. Development of a visualization prototype and an associated scholarly paper in an area related to thematic cartography and geographic visualization are required. (one course in a high level programming language). **Class 3, Credit 3 (S)**

ISTE-750 **Internet Middleware Design and Implementation**
This course provides students with an introduction to the design and implementation of Internet middleware application programming Interfaces (API's) and services. Topics include the blending of Interactive and dynamic content from multiple servers and services utilizing data from heterogeneous sources, with a strong design focus on the needs of client software and human users which will utilize those services. Provides a practical and theoretical basis for the design and implementation of API's & middleware, and for the design and development of custom servers and services built on top of existing frameworks (such as Apache/PHP). Emphasis is placed on fundamentals, concepts and standards. Exercises, programming, and projects are required. (ISTE-612) **Class 3, Lab 0, Credit 3 (S)**

ITSE-754 **Client Design and Development**
This course will explore the analysis, design, development, and implementation of client-side programming in the context of Internet technologies, mobile devices, and Web-based client systems. Students will learn to design and build usable and effective interactive systems, clients, and interfaces. Key features addressed will include browser and platform compatibility, object reusability, bandwidth and communications issues, development environments, privacy and security, and related technologies and APIs. Programming is required. (ISTE-750 Internet Middleware Design and Implementation) **Class 3, Lab 0, Credit 3 (F)**

ISTE-756 **Server Design and Development**
This course provides students with advanced work in the design and implementation of highly-scalable Internet servers, and application programming interfaces (APIs). Topics include the effects of client requirements upon design, creating and blending heterogeneous data for analysis and visualization, and approaches to building highly-scalable services. Students will develop dynamic, data centric web systems, as well as building information services systems that are independent of the technologies that use them. Students will implement their own servers and services using programming languages. Exercises, programming, and projects are required. (ISTE-750 Internet Middleware Design and Implementation) **Class 3, Lab 0, Credit 3 (S)**

ISTE-758 **Semantic Web Technologies**
This course provides students with an in-depth introduction to Semantic Web technologies, utilizing ontologies and relationship metadata. Topics include the creation of data linkage through metadata, practical approaches to the design and implementation of ontologies, server- and client-side parsing and transformation of data and ontologies, and machine interpretation of relationships. Emphasis is placed on fundamentals, concepts and standards. Exercises, programming, and projects are required. (ISTE-610 Information Technologies I, ISTE-612 Information Technologies II) **Class 3, Lab 0, Credit 3 (F)**

ISTE-760 **Design, Development, and Deployment of Applications**
This course will introduce students to software development tools, methods and practices that contribute to making applications production-ready. Topics include designing for maintenance, version control, error handling, application testing, help systems, installation routines, and support. Programming will be required. (1 year programming in a high-level language) **Class 3, Credit 3 (S)**

ISTE- 762 **Software Economics**
In addition to developing software using an organization's own software development staff, new approaches for the acquisition of software systems continue to emerge and to be adopted. This course provides students with the necessary foundational knowledge to compare, evaluate, and assess, from financial and economic perspectives, the alternatives for developing or acquiring software systems. Topics include motivations for studying software economics, basic financial and economic concepts, measurements of software development productivity and software quality, software development cost estimation models, modeling software development and deployment activities, and acquisition alternatives such as open source, purchase, lease, cloud, and outsourcing. **Class 3, Credit 3 (S)**

ISTE-764 Project Management
Information technology projects require the application of sound project management principles in order to be developed on time, on budget, and on specification. This course takes students through the nine knowledge areas of modern project management and the utilization of project management principles in both traditional and agile environments. **Class 3, Lab 0, Credit 3 (F)**

ISTE-771 XML Programming
Exchange of information between disparate programs is a significant problem in industry. Students will learn how to leverage XML to achieve interoperability between software systems. Topics covered in this hands-on course include parsing and generating XML, the service-oriented paradigm, and the development and consumption of services. Assignments and projects will be programming intensive. (One year of programming in a high-level language) **Class 3, Lab 0, Credit 3 (F)**

ISTE-772 Knowledge Discovery for Biomedical Informatics
This course will provide an in-depth exposure to advanced topics in biomedical informatics and knowledge discovery. Large datasets will be used to illustrate and explore methods in the transformation of data to information and integration of information with domain knowledge. Topics will include high-throughput technologies in genomics, descriptive and inferential statistics, machine learning, visualization, human-computer interaction. (ISTE-121 Comp Prob Solve Info Domain II, PSYC-640 Graduate Statistics) **Class 3, Lab 0, Credit 3 (S)**

ISTE-780 Data-Driven Knowledge Discovery
Rapidly expanding collections of data from all areas of society are becoming available in digital form. Computer-based methods are available to facilitate discovering new information and knowledge that is embedded in these collections of data. This course provides students with an introduction to the use of these data analytic methods within the context of the data-driven knowledge discovery process. Topics include motivations for data-driven discovery, sources of discoverable knowledge (e.g., data, text, the Web, maps), data selection and retrieval, data transformation, computer-based methods for data-driven discovery, and interpretation of results. Emphasis is placed on the application of knowledge discovery methods to specific domains. (ISTE-600 Analytical Thinking, PSYC-640 Graduate Statistics) **Class 3, Lab 0, Credit 3 (F)**

ISTE-782 Visual Analytics
This course introduces students to Visual Analytics, or the science of analytical reasoning facilitated by interactive visual interfaces. Course lectures, reading assignments, and practical lab experiences will cover a mix of theoretical and technical Visual Analytics topics. Topics include analytical reasoning, human cognition and perception of visual information, visual representation and interaction technologies, data representation and transformation, production, presentation, and dissemination of analytic process results, and Visual Analytic case studies and applications. Furthermore, students will learn relevant Visual Analytics research trends such as Space, Time, and Multivariate Analytics and Extreme Scale Visual Analytics. (PSYC-640 Graduate Statistics). **Class 3, Lab 0, Credit 3 (F)**

ISTE-790 Thesis in Information Sciences and Technologies
The thesis capstone experience for the Master of Science in Information Sciences and Technologies program. Students must submit an approved capstone proposal in order to enroll. (Permission of capstone committee and graduate coordinator) **Class 0, Lab 0, Credit 3 (F, S, Su)**

ISTE-791 Project in Information Sciences and Technologies
The project-based culminating experience for the Master of Science in Information Sciences and Technologies program. A MS project will typically include a software system development component requiring a substantial and sustained level of effort. Students must submit an approved project proposal in order to enroll. (Permission of project committee and graduate program director) **Class 0, Lab 0, Credit 3 (F, S, Su)**

ISTE-795 Capstone in Information Technology
This is the project-based capstone course for the Master of Science in Information Sciences and Technologies program. Students work in teams to complete a substantial, integrative system development project that included a large dataset(s). Submission of a project proposal, a formal set of development artifacts, a final project report, and a public defense with system demonstration are required. (Completion of or in the final semester of graduate coursework; or permission of graduate program director/coordinator) **Class 0, Lab 0, Credit 3 (F, S, Su)**

ISTE-798 Graduate Seminar in Information Sciences and Technologies
This IST seminar course provides an opportunity for special one-time offerings of graduate topics or allows faculty to pilot possible new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given seminar offering. (Graduate standing with topic-specific prerequisites as appropriate) **Class 3, Credit 3 (F, S, Su)**

ISTE-799 Independent Study
The student will work independently, under the supervision of one or more faculty advisers, on a topic of mutual interest that is beyond the depth of or not covered in other courses. (Permission of instructor and department) **Credit 1–3 (F, S, Su)**

HCIN-600 Research Methods
This course provides students with an introduction to the practical application of various research methods that can be used in human computer interaction. The course provides an overview of the research process and the literature review, and provides initial study in survey research and experimental research methods. Students will analyze several existing research studies and design and conduct studies. (PSYC-640) **Class 3, Lab 0, Credit 3** (F)

HCIN-610 Foundations of Human-Computer Interaction
Human-computer interaction (HCI) is a field of study concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. This course surveys the scope of issues and foundations of the HCI field: cognitive psychology, human factors, interaction styles, user analysis, task analysis, interaction design methods and techniques, and evaluation. This course will focus on the users and their tasks. **Class 3, Lab 0, Credit 3 (F, Su)**

HCIN-620 Information and Interaction Design
Designing meaningful relationships between people and the products they use is both an art and a science. This course will focus on the unique design practice of: representing and organizing information in such a way as to facilitate perception and understanding (information architecture); and, specifying the appropriate mechanisms for accessing and manipulating task information (interaction design). This course will also explore the various design patterns (design solutions to particular problems) that are appropriate for the HCI professional. (HCIN-636; corequisite: HCIN-610) **Class 3, Lab 0, Credit 3 (F, S)**

HCIN-630 Usability Testing
This project-based course will focus on the formal evaluation of products. Topics include: usability test goal setting, recruitment of appropriate users, design of test tasks, design of the test environment, test plan development and implementation, analysis and interpretation of the results, and documentation and presentation of results and recommendations. (HCIN-600, HCIN-610) **Class 3, Lab 0, Credit 3 (S)**

HCIN-636 Interactive Programming
This course teaches students how to program interactive components to create user interfaces and information visualization systems. Students will work with data, information, animation, and digital media to create interactive applications. Students will be introduced to visual layout and design concepts. Programming is required. (ISTE-121 Computational Problem Solving in the Information Domain II) **Class 3, Credit 3 (F)**

HCIN-660 Fundamentals of Instructional Technology
Instructional Technology encompasses the basic processes for developing and delivering instruction. Instructional Systems Design (ISD) is a well-established methodology for describing knowledge and skills and developing instructional systems to effectively conveying knowledge. This course enables the student to be able to plan, organize, and systematically develop instructional materials. The course uses an ISD model to analyze, design, deliver, and evaluate instruction. **Class 3, Lab 0, Credit 3 (F)**

HCIN-661 Interactive Courseware
Computer software that teaches is referred to as courseware. This course is a continuation of HCIN-660 that transitions from “general” Instructional Design into the actual application of these principles in a computer-based environment. Although the basic principles of instructional design hold true in all media environments, using these teaching and learning principles is somewhat different when developing instruction that will be delivered by computer. This course teaches procedures that have already been successful in the design and development of courseware. (HCIN-660, ISTE-121 or ISTE-331) **Class 3, Lab 0, Credit 3 (S)**

HCIN-700 Current Topics in HCI
Human Computer Interaction (HCI) is an evolving field. This course is designed to study the current themes and advanced issues of HCI. Topics will vary depending upon current research and developments in the field. (HCIN-610) **Class 3, Lab 0, Credit 3 (S)**

HCIN-705 Topics in HCI for Biomedical Informatics
This course will provide a theoretical and case-based study of several areas of HCI, all considered within the application domain of biomedical informatics. Course topics include: A Scientific Approach to UI design (Usability Engineering), Domain-Specific User Analysis and User Profiles, Social and Cultural Influences, General and Domain-Specific Design Issues, Information Visualization, Data Integration, Mobile Devices, Security, Privacy and Ethics. (HCIN-610 Foundations of Human-Computer Interaction) **Class 3, Credit 3 (S)**

HCIN-715 Agent-Based and Cognitive Modeling
This course is intended as an introduction to the emerging areas of Agent-Based Modeling and Cognitive Modeling. Both modeling approaches are at the intersection of research (theory development and confirmation) and computational simulation. This course will be an introduction to these topics, focusing on the research aspects of agent-based modeling and the development and testing of cognitive models. The role of visualization in modeling development and analysis is presented. Students will analyze the social science literature for current models and theories and will develop computational models incorporating these theories. (HCIN-600, ISTE-340 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

HCIN-720 Designing User Experiences for Internet-enabled Devices
With the emergence of devices like touch-screens, smartphones, tablet/slate computers, and Internet-connected appliances like large-screen televisions, a new set of skills and knowledge in designing user experiences is required. Applications and Apps which target users on smartphones and tablets cannot just be based on miniaturizing the desktop experience; they require re-thinking the design patterns and best practices applied to devices. Students will learn to design, prototype, and develop user experiences aimed at use of these new classes of devices. (HCIN-620) **Class 3, Lab 0, Credit 3 (S)**

HCIN-722 Human Computer Interaction with Mobile Devices
With the emergence of mobile devices such as smartphones and tablet/slate computers as well as software technologies such as gesture-based interfaces and augmented reality, new possibilities for human computer interaction have emerged and new skills and knowledge in designing human computer interactions is required. Students will learn to design and implement human computer interactions utilizing these devices and their unique capabilities. (HCIN-720) **Class 3, Lab 0, Credit 3 (S)**

HCIN-730 User-centered Design Methods
This course will focus on the major user centered design methodologies used in the development of applications and environments. Topics include: evolution of software design methods, emergence of user-centered design, and key concepts, attributes and process of the major design methodologies. Software design projects will be required. (HCIN-610) **Class 3, Lab 0, Credit 3 (S)**

HCIN-735 Collaboration, Technology, and the Human Experience
Students will examine the role of technology and group collaboration in organizations. An overview of relevant theory, current and emergent technologies, and trends in collaborative science will provide the context for strategic implementation and development of collaborative environments. Group projects using collaborative technologies will be required. (HCIN-600, HCIN-610) **Class 3, Lab 0, Credit 3 (S)**

HCIN-795 MS HCI Project
In this course, students will apply the theories and methodologies to a problem in the HCI domain. Students working individually or in teams, through the guidance of the instructor, will investigate a problem space, perform a literature review, develop the problem statement, design and implement a solution, and communicate the results. (Permission of HCI program director) **Class 3, Lab 0, Credit 3 (S)**

HCIN-796 MS HCI Thesis
Students electing a research experience will work closely with an adviser on a current research project or one developed and guided by the adviser. (Permission of the HCI program director and faculty adviser) **Credit 1–6 (F, S, Su)**

MEDI-701 Introduction to Medical Informatics
This course provides a rigorous introduction to the principles of medical informatics. The focus of this course is on the study of the nature of medical information and its use in clinical practice and clinical quality improvement. Key topics include: the electronic medical record (EMR) and its impact on health care delivery, the Internet and mobile computing as sources of medical information, Healthcare Information Systems, the software development lifecycle, the importance of the informatics specialists in medicine and the various roles they can play, and government economic incentives and policy issues in healthcare such as privacy, confidentiality, including health care regulatory and accreditation issues and the Health Insurance Portability and Accountability Act (HIPAA). Students will participate in online discussion of medical informatics. They will also investigate several topics of interest in the field and provide presentations. **Class 3, Lab 0, Credit 3 (F)**

MEDI-702 Perspectives of Health Informatics
The health care industry is composed of many different disciplines, specialties, and professions. Designing and developing informatics solutions requires an understanding of the roles, approaches and information needs of the many diverse user groups in delivering health care services for patients and health populations. This course will focus on the overlapping and divergent requirements of a comprehensive electronic health record from the perspectives of patients, health care providers (physicians, nurses, pharmacists, etc.), health care payers, public health structures, biotechnology firms and researchers. Group projects will be required. (MEDI-701) **Class 3, Lab 0, Credit 3 (F)**

MEDI-704 Practice of Health Care
This ten-week course is an introduction to clinical practice for graduate students in Medical Informatics. It consists of the study of six medical specialties including shadowing of clinicians in these areas. Students in this course will be part of a team of health care professionals in the selected specialties. They will round with providers, assist with information gathering and dissemination, and observe specialty specific disease process, diagnosis and treatment. They will observe and note clinical workflow and technology usage. They will interact with team members and assist with the acquisition of reference knowledge as appropriate. They will keep a log of cases during the rotation and use this as the basis for their research project and case presentation. (MEDI-701) **Class 3, Lab 0, Credit 3 (S)**

MEDI-705 Medical Knowledge Structures
This course presents concepts related to organization and retrieval of knowledge-based information in the health sciences. It includes a study of classification schemes, controlled vocabularies and thesauri, metadata, and ontologies. Major schemes and systems examined, for example, include MeSH, UMLS, and PubMed. Also covered are the topics of knowledge retrieval at the point of care, and knowledge discovery. (MEDI-701) **Class 3, Lab 0, Credit 3 (S)**

MEDI-707 Clinical Decision Support
This course provides a rigorous introduction to the principles of modeling and implementing decision support systems. It begins with an overview of how to frame a clinical or health care management question, develop a decision support model, and find appropriate evidence for model calibration. The major decision categories covered in the course for clinical practice include those regarding treatment, diagnosis, harm (etiology), and prognosis. The major decision categories covered in the course for health care management include service provision, resource allocation, and cost-effectiveness. The course will identify the best types of evidence to answer questions, and how to find and apply that evidence. The decision support modeling techniques include game theory, Bayesian theory, decision trees, planning models, systems dynamics models, and queuing models. The course concludes with a section on summarizing evidence (e.g., through systematic reviews and meta-analysis), putting evidence into practice (e.g., implementing clinical practice guidelines), and the limitations of the approaches covered in the course. Students will apply decision support techniques in addressing real world problems using appropriate software and participate in online discussion of decision analysis in the medical literature. (MEDI-701) **Class 3, Lab 0, Credit 3 (S)**

MEDI-730 Medical Application Integration
A typical hospital information system architecture contains a variety of best of breed applications running on different hardware and software platforms. Exchange of information between these applications can be a significant problem. In this course, students will learn how to leverage the loose coupling of service-oriented architectures and message oriented middleware to address the issues of data integration between these types of computer programs when executing across domains. Programming projects will be required. (MEDI-701, ISTE-608, Java Programming) **Class 3, Lab 0, Credit 3 (F)**

MEDI-735 Clinical Information Systems
A study of the component approach to clinical information systems. Students will learn about the evolution of Health Information Systems, and the variety of systems offered by vendors at the present time. The importance of the Electronic Health Record (EHR), the Computerized Physician Order Entry (CPOE) and Clinical Decision Support will be stressed as they become the focal points in clinical information systems. The following components will be studied in detail: patient, activity, health record, knowledge, and security components. The role of imaging management and integration will also be reviewed. (MEDI-701) **Class 3, Lab 0, Credit 3 (S)**

MEDI-766 Building the Electronic Health Record
This course explores the acquisition, storage, and use of information in the electronic health record (EHR) through hands-on development and programming. Students will learn about the types of information used in clinical care: text, structured data, images, and sounds. Other topics covered include: clinical vocabularies (existing schemes and their limitations); how clinical information is generated and utilized; methods of information storage and retrieval; departmental systems (laboratory, radiology, and hospital information systems); organizational systems (including scheduling, registration and financial systems); and the legal, social and regulatory problems of EHRs including security and confidentiality. (MEDI-701, MEDI-705, HCIN-610) **Class 3, Lab 0, Credit 3 (F)**

MEDI-788 Capstone in Medical Informatics
This team-based course provides students with the opportunity to apply the knowledge and skills learned in coursework to design, develop, and implement a solution to a real problem in the medical informatics domain. Project teams also will be responsible for submitting a final project report, and for making a final presentation to project stakeholders. (Completion of first year courses) **Class 3, Lab 0, Credit 3 (F)**

Computer Science

CSCI-603 — Advanced C++ and Program Design
The course covers design techniques and advanced programming. Topics include the software development life cycle; analysis and design using the Unified Modeling Language (UML); advanced programming in the C++ programming language will be used; and implementation strategies for external data structures. Individual and group programming projects will be required. Homework assignments are an integral part of the course. (Previous programming experience) **Class 3, Credit 3 (F)**

CSCI-605 — Advanced Java Programming
The goal of the course is to introduce the programming language Java. Topics include class design and implementation, inheritance, exceptions, I/O, threads, swing, network programming, and remote method invocation. Object-oriented technology will be used to design and implement software solutions. This course serves as a bridge course for MS graduate students and can not be taken by CS undergraduate students without the permission of the undergraduate coordinator. Programming assignments are an integral part of the course. (Previous programming experience) **Class 3, Credit 3 (F, S)**

CSCI-610 — Foundations of Computer Graphics
Foundations of Computer Graphics is a study of the hardware and software principles of interactive raster graphics. Topics include an introduction to the basic concepts, 2-D and 3-D modeling and transformations, viewing transformations, projections, rendering techniques, graphical software packages and graphics systems. The course will focus on rasterization techniques and emphasize the hardware rasterization pipeline including the use of hardware shaders. Students will use a standard computer graphics API to reinforce concepts and study fundamental computer graphics algorithms. Programming projects and a survey of the current graphics literature will be required. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or equivalent or permission of instructor; students who complete CSCI-510 may not take CSCI-610 for credit) **Class 3, Credit 3 (F, S)**

CSCI-620 — Data Exploration and Management
This course provides a broad introduction to the exploration and management of large datasets being generated and used in the modern world. First, practical techniques used in exploratory data analysis and mining are introduced; topics include data preparation, visualization, statistics for understanding data, and grouping and prediction techniques. Second, approaches used to store, retrieve, and manage data in the real world are presented; topics include traditional database systems, query languages, and data integrity and quality. Case studies will examine issues in data capture, organization, storage, retrieval, visualization, and analysis in diverse settings such as urban crime, drug research, census data, social networking, and space exploration. Data exploration and management projects, a term paper and a presentation are required. (STAT-145 Introduction to Statistics I or equivalent, or permission of instructor) **Class 3, Credit 3 (F, S)**

CSCI-621 — Database System Implementation
This course provides a broad introduction to database management systems including data modeling, the relational model, and SQL. Database system implementation issues are covered next, where the focus is on data structures and algorithms used to implement database management systems. Topics include physical data organizations, indexing and hashing, query processing and optimization, database recovery techniques, transaction management, concurrency control, and database performance evaluation. Current research topics in database system implementation are also explored. Programming projects, a term paper, and presentations will be required. (CSCI-620 Data Exploration and Management, or CSCI-320 Principles of Data Management and CSCI-420 Principles of Data Mining, or permission of instructor) **Class 3, Credit 3 (F, S)**

CSCI-622 — Secure Data Management
This course examines policies, methods and mechanisms for protecting enterprise data. Topics include data integrity and confidentiality; access control models; secure database architectures; secure transaction processing; information flow, aggregation, and inference controls; auditing; secure relational and non-relational (object-oriented and XML) data management; privacy preserving techniques; and data security support in modern database servers. Programming projects are required. (CSCI-620 Data Exploration and Management, or CSCI-320 Principles of Data Management and CSCI-420 Principles of Data Mining, or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-630 — Foundations of Intelligent Systems
An introduction to the theories and algorithms used to create intelligent systems. Topics include search algorithms (e.g. A*, iterative deepening), logic, planning, knowledge representation, machine learning, and applications from areas such as computer vision, robotics, natural language processing, and expert systems. Programming assignments and oral/written summaries of research papers are required. (CSCI-603 Advanced C++ and Program Design, CSCI-605 Advanced Java Programming, and CSCI-661 Foundations of Computer Science Theory, with B or better in all courses or equivalent or permission of instructor. Students who complete CSCI-331 may not take CSCI-630 for credit) **Class 3, Credit 3 (F, S)**

CSCI-631 — Foundations of Computer Vision
An introduction to the underlying concepts of computer vision and image understanding. The course will consider fundamental topics, including image formation, edge detection, texture analysis, color, segmentation, shape analysis, detection of objects in images and high level image representation. Depending on the interest of the class, more advanced topics will be covered, such as image database retrieval or robotic vision. Programming assignments are an integral part of the course. (CSCI-603 Advanced C++ and Program Design, CSCI-605 Advanced Java Programming, and CSCI-661 Foundations of Computer Science Theory, with B or better in all courses or equivalent or permission of instructor (students who complete CSCI-431 may not take CSCI-631 for credit)) **Class 3, Credit 3 (F, S)**

CSCI-632 — Mobile Robot Programming
This course covers standard and novel techniques for mobile robot programming, including software architectures, reactive motion control, map building, localization and path planning. Other topics may include multiple robot systems, robot vision and non-traditional and dynamic robots. Students will implement various algorithms in simulation as well as on a real robot, and investigate and report on current research in the area. (CSCI-331 Introduction to Intelligent Systems or CSCI-630 Foundations of Intelligent Systems or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-633 — Biologically Inspired Intelligent Systems
There have been significant advances in recent years in the areas of neuroscience, cognitive science and physiology related to how humans process information. In this course students will focus on developing computational models that are biologically inspired to solve complex problems. A research paper and programming project on a relevant topic will be required. A background in biology is not required. (CSCI-603 Advanced C++ and Program Design, CSCI-605 Advanced Java Programming, and CSCI-661 Foundations of Computer Science Theory, with B or better in all courses or equivalent or permission of instructor) **Class 3, Credit 3 (F)**

CSCI-641 — Advanced Programming Skills
The goal of this course is to introduce the students to a programming paradigm and an appropriate programming language chosen from those that are currently important or that show high promise of becoming important. A significant portion of the learning curve occurs through programming assignments with exemplary solutions discussed later in class. The instructor will post specifics prior to registration. With the approval of the program coordinator, the course can be taken for credit more than once, provided each instance deals with a different paradigm and language. A term project involving independent investigation is also required. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or CSCI-141 Computer Science I, CSCI-142 Computer Science II, and CSCI-243 The Mechanics of Programming or equivalent or permission of instructor (students who complete CSCI-541 may not take CSCI-641 for credit)) **Class 3, Credit 3 (F, S)**

CSCI-642 — Secure Coding
This course provides an introduction to secure coding including topics such as principles of secure coding, security architectures and design, operational practices and testing, programmatic use of cryptography, and defenses against software exploitation. Other topics include software based fault isolation, type-safe languages, certifying compilers; proof-carrying code, and automated program analysis and program rewriting. Programming projects, presentations, and a term paper will be required. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or CSCI-141 Computer Science I, CSCI-142 Computer Science II, and CSCI-243 The Mechanics of Programming or equivalent or permission of instructor) **Class 3, Credit 3 (F)**

CSCI-651 — Foundations of Computer Networks
This course is an introduction to the concepts and principles of computer networks. Students will design and implement projects using application protocols, and will study transport, network, and data link protocols and algorithms. The course also includes an introduction to local area networks, data transmission fundamentals, and network security. Programming projects and reading research papers will be required. (MATH-251 Probability and Statistics I or equivalent and CSCI-605 Advanced Java Programming, with B or better or equivalent or permission of instructor) **Class 3, Credit 3 (F)**

CSCI-652 Distributed Systems
An introduction to the study of distributed systems. The course covers distributed system architectures such as client-server and peer-to-peer, distributed system design issues such as communication, fault tolerance, coordination, and deadlock, distributed system middleware such as remote method invocation (RMI) and tuple space, and the theory of distributed algorithms such as logical clocks and leader election. Programming projects are required. (CSCI-352 Operating Systems or equivalent and CSCI-603 Advanced C++ and Program Design or equivalent) **Class 3, Credit 3 (F, S)**

CSCI-654 Foundations of Parallel Computing
This course is a study of the hardware and software issues in parallel computing. Topics include an introduction to the basic concepts, parallel architectures and network topologies, parallel algorithms, parallel metrics, parallel languages, granularity, applications, parallel programming design and debugging. Students will become familiar with various types of parallel architectures and programming environments. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming and CSCI-661 Foundations of Computer Science Theory, with B or better in all courses or equivalent or permission of instructor. Students who complete CSCI-454 may not take CSCI-654 for credit.) **Class 3, Credit 3 (F)**

CSCI-661 Foundations of Computer Science Theory
This course provides an introduction to the theory of computation, including formal languages, grammars, automata theory, computability, and complexity. CS undergraduate students can not take this course for undergraduate credit. (MATH-190 Discrete Mathematics for Computing or equivalent and some programming experience (students who complete CSCI-262 or CSCI-263 may not take CSCI-661 for credit)) **Class 3, Credit 3 (F, S)**

CSCI-662 Foundations of Cryptography
This course provides an introduction to cryptography, its mathematical foundations, and its relation to security. It covers classical cryptosystems, private-key cryptosystems (including DES and AES), hashing and public-key cryptosystems (including RSA). The course also provides an introduction to data integrity and authentication. (CSCI-661 Foundations of Computer Science Theory and CSCI-603 Advanced C++ and Program Design or CSCI-605 Advanced Java Programming, with B or better in all courses or equivalent or permission of instructor (students who complete CSCI-462 may not take CSCI-662 for credit)) **Class 3, Credit 3 (F, S)**

CSCI-663 Computability
The course is devoted to the review of basic concepts and results in classical mathematical computability theory, which tries to answer the question: what are the fundamental capabilities and limitations of computers? Computability theory deals with these limitations from above by analyzing and classifying unsolvable problems, in contrast to complexity theory which classifies problems according to the efficiency of algorithms solving them. The computability frontier is where these two theories meet. (CSCI-661 Foundations of Computing Theory or CSCI-262 Introduction to Computer Science Theory or CSCI-263 Honors Introduction to Computer Science Theory) **Class 3, Credit 3 (F)**

CSCI-664 Computational Complexity
This course provides an introduction to computational complexity theory. It covers the P=NP problem, time and space complexity, randomization, approximability, and relativization. (CSCI foundations of Computing Theory or CSCI-262 Introduction to Computer Science Theory or CSCI-263 Honors Introduction to Computer Science Theory, and either CSCI-665 Foundations of Algorithms or CSCI-261 Analysis of Algorithms) **Class 3, Credit 3 (S)**

CSCI-665 Foundations of Algorithms
This course provides an introduction to the design and analysis of algorithms. It covers a variety of classical algorithms and their complexity and will equip students with the intellectual tools to design, analyze, implement, and evaluate their own algorithms. (CSCI-603 Advanced C++ and Program Design, CSCI-605 Advanced Java Programming, and CSCI-661 Foundations of Computer Science Theory, with B or better in all courses or equivalent or permission of instructor (students who take CSCI-261 may not take CSCI-665 for credit)) **Class 3, Credit 3 (F, S)**

CSCI-686 Graduate Professional Seminar
This course provides students with skills required to succeed as Computer Science professionals, balancing the divergent needs of computing technology, employee, employer, and societal needs. Topics covered include skills in professional communication; skills to determine and effectively address needs of diverse audiences; research skills such as the ability to perform a literature review, design and conduct studies; team participation and management skills; conflict management; and skills to handle legal, ethical and societal challenges faced by CS professionals. **Class 3, Credit 3 (F, S)**

CSCI-687 Graduate Research Seminar
This course provides students with the theoretical background and practical application of various research methods that can be used in computing and information sciences. The course provides an overview of the research process and literature review, and provides initial study in correlation and experimental research methods and design. Students will analyze several existing research studies and design and conduct studies. **Class 3, Credit 3 (F, S)**

CSCI-699 Computer Science Graduate Co-op
Students perform professional work related to computer science for which they are paid. Students work full time during the term for which they are registered. Students must complete a student co-op work report for each term for which they are registered; students are also evaluated each term by their employer. A satisfactory grade is given for co-op when both a completed student co-op work report and a completed, corresponding employer evaluation are received and when both documents are generally consistent. Co-op is an optional part of the MS in computer science degree. Graduate students are eligible to do a maximum of 364 days of co-op and students must register for co-op by the end of add/drop period for the appropriate term. See the CS graduate program coordinator or RIT's Office of Cooperative Education and Career Services for further details. (Students must complete the assigned bridge course(s) and at least 12 semester hours of their MS program of study with a GPA greater than or equal to 3.0) **Credit 0** (**F, S, Su, Winter Intersession)**

CSCI-711 Global Illumination
This course will investigate the theory of global illumination (GI) in computer image synthesis. Seminal computer graphics papers will be used to explore the various components of the GI pipeline and explain how the path of light in a virtual scene can be simulated and used to create photorealistic imagery. The course will emphasize the theory behind various GI rendering tools and libraries available for image synthesis. The student will put theory into practice via a set of programming assignments and a capstone project. Topics will include light and color, three-dimensional scene specification, camera models, surface materials and textures, GI rendering methods, procedural shading, tone reproduction, and advanced rendering techniques. Readings and summaries of computer graphics literature will be required. (CSCI-510 Introduction to Computer Graphics or CSCI-610 Foundations of Computer Graphics or permission of instructor) **Class 3, Credit 3 (F, S)**

CSCI-712 Computer Animation: Algorithms and Techniques
This course takes a look at computer animation from a programmer's perspective. It will investigate the theory, algorithms and techniques for describing and programming motion for virtual 3D worlds. Approaches that will be explored include keyframing systems; kinematics, motion of articulated figures, procedural and behavioral systems, and the use of motion capture data. This course is a programming-oriented course with major deliverables including the implementation of techniques presented in lecture as well as a final project concentrating on an area of a student's choice. Students enrolling in this course are expected to have proficiency in the use of at least one 3D API (e.g. OpenGL, DirectX, Java3D). Readings and summaries of computer graphics literature will be required. (CSCI-510 Introduction to Computer Graphics or CSCI-610 Foundations of Computer Graphics or permission of instructor) **Class 3, Credit 3 (F, offered every other year)**

CSCI-713 Applied Perception in Graphics and Visualization
The goal of this course is to introduce students to the field of applied perception in graphics and visualization and demonstrate how it has contributed to the development of better display systems and computer graphics rendering techniques. The delivery of the course material will be done primarily through lectures with biweekly programming assignments based upon the techniques presented in class. Students will also be exposed to a wide range of technical papers and be expected to make classroom presentations on selected topics in the field of applied perception in graphics and visualization. (CSCI-510 Introduction to Computer Graphics or CSCI-610 Foundations of Computer Graphics or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-714 Scientific Visualization
Visualizations of scientific data are helpful in order to understand complex, n-dimensional behavior of simulations. This course covers techniques that are needed to visualize n-dimensional data sets produced by real scientific simulations. Topics include: Visualization design, discrete visualization techniques, scalar and volume visualization techniques and perception of visualizations. Additionally topics such as distributed file systems, specialized file systems and distributed computing needed in order to create the visualizations will be covered. A team project and presentations are required. (CSCI-510 Introduction to Computer Graphics or CSCI-610 Foundations of Computer Graphics or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-715 Applications in Virtual Reality
This course will investigate the application of virtual reality software and technology within a given domain. Working in sets of technical teams, students will collectively investigate and solve a large-scale visualization task within that problem domain. Focus of individual student teams may include (but is not limited to) distributed VR framework, viewing applications, interaction with VR devices / displays, and audio in virtual environments. Students will be required to read and summarize selected articles from VR literature, as well as papers specific to the problem domain being investigated, to assist in making design decisions. A report or survey of one aspect of using a virtual reality system within the given domain is also required. Students should have a strong programming background and a proficiency in a 3D API (OpenGL, DirectX, or Java3D). Students with expertise in distributed systems and an interest in graphics or virtual reality are also encouraged to register. (CSCI-510 Introduction to Computer Graphics or CSCI-610 Foundations of Computer Graphics or permission of instructor) **Class 3, Credit 3 (F, offered every other year)**

CSCI-719 Topics in Computer Graphics
This course examines current topics in computer graphics. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances presented will be identified as belonging to the computer graphics and visualization cluster. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-720 Data Mining
This course provides a graduate-level introduction to the concepts and techniques used in data mining. Topics include the knowledge discovery process; prototype development and building data mining models; current issues and application domains for data mining; and legal and ethical issues involved in collecting and mining data. Both algorithmic and application issues are emphasized to permit students to gain the knowledge needed to conduct research in data mining and apply data mining techniques in practical applications. Data mining projects, a term paper, and presentations are required. (CSCI-620 Data Exploration and Management, or CSCI-320 Principles of Data Management and CSCI-420 Principles of Data Mining, or permission of instructor) **Class 3, Credit 3 (F, S)**

CSCI-721 Data Cleaning and Preparation
This course provides an introduction to the concepts and techniques used in preparing data for subsequent data mining. Topics include the knowledge discovery process; data exploration and its role; data extraction, cleaning, integration and transformation; handling numeric, unstructured, text, web, and other forms of data; and ethical issues underlying data preparation and mining. Data cleaning projects, a term paper, and presentations are required. (CSCI-620 Data Exploration and Management, or CSCI-320 Principles of Data Management and CSCI-420 Principles of Data Mining, or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-729 Topics in Data Management
This course examines current topics in data management. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances will be identified as belonging to the Data Management cluster, the Security cluster, or both clusters. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-731 Advanced Computer Vision
This course examines advanced topics in computer vision including motion analysis, video processing and model based object recognition. The topics will be studied with reference to specific applications, for example video interpretation, robot control, road traffic monitoring, and industrial inspection. A research paper, an advanced programming project, and a presentation will be required. (CSCI-631 Foundations of Computer Vision or CSCI-431 Introduction to Computer Vision or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-732 Image Understanding
This course explores the theory and methodologies used to interpret images in terms of semantic content. Techniques from image processing and pattern recognition are extended for the purpose of scene understanding using both a bottom-up and a top-down approach. Topics include human visual perception, knowledge representation, object recognition, contextual classification, scene labeling, constraint propagation, interpretation trees, semantic image segmentation, 3D models and matching, active vision, and reasoning about images. Programming projects are required. (CSCI-631 Foundations of Computer Vision or CSCI-431 Introduction to Computer Vision or permission of instructor) **Class 3, Credit 3 (S, offered every other year)**

CSCI-734 Foundations of Security Measurement and Evaluation
The course will introduce students into the algorithmic foundations and modern methods used for security evaluation. It will combine a theoretical revision of the methods and models currently applied for computer security evaluation and an investigation of computer security through study of user's practice. The students will be required to complete a few home assignments, to deliver a class presentation, to implement a team project, to lead the team's work and to undertake research on the topic assigned. (CSCI-651 Foundations of Computer Networks or permission of instructor) **Class 3, Credit 3 (F)**

CSCI-735 Foundations of Intelligent Security Systems
The course will introduce students to the application of intelligent methodologies applications in computer security and information assurance system design. It will review different application areas such as intrusion detection and monitoring systems, access control and biological authentication, firewall structure and design. The students will be required to implement a course project on design of a particular security tool with an application of an artificial intelligence methodology and to undertake research and analysis of artificial intelligence applications in computer security. (CSCI-630 Foundations of Intelligent Systems or CSCI-331 Introduction to Intelligent Systems or CSCI-651 Foundations of Computer Networks or permission of instructor) **Class 3, Credit 3 (F, S)**

CSCI -736 Neural Networks and Machine Learning
The course will introduce students into the current state of artificial neural networks. It will review different application areas such as intrusion detection and monitoring systems, pattern recognition, access control and biological authentication, and their design. The students will be required to conduct research and analysis of existing applications and tools as well as to implement a course programming project on design of a specified application based on neural networks and/or fuzzy rules systems. (CSCI-630 Foundations of Intelligent Systems or CSCI-331 Introduction to Intelligent Systems or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-737 Pattern Recognition
An introduction to pattern classification and structural pattern recognition. Topics include Bayesian decision theory, evaluation, clustering, feature selection, classification methods (including linear classifiers, nearest-neighbor rules, support vector machines, and neural networks), classifier combination, and recognizing structures (e.g. using HMMs and SCFGs). Students will present current research papers and complete programming projects such as optical character recognizers. (CSCI-630 Foundations of Intelligent Systems or CSCI-331 Introduction to Intelligent Systems or permission of instructor) **Class 3, Credit 3 (F, offered every other year)**

CSCI-739 Topics in Intelligent Systems
This course examines current topics in intelligent systems. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances will be identified as belonging to the intelligent systems cluster, the computational vision and acoustics cluster, the security cluster, or some combination of these three clusters. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-740 Programming Language Theory
This course is an introduction to the formal study of programming languages, demonstrating important intellectual tools for the precise description of programming languages and investigating the essential features of programming languages using these tools. Topics include: dynamic semantics (such as operational semantics); static semantics (such as type systems); proofs by induction on structures and derivations; formal treatment of essential programming-language features (such as assignment, scope, functions, objects, and threads). Both written and programming assignments will be required. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or CSCI-141 Computer Science I, CSCI-142 Computer Science II, and CSCI-243 The Mechanics of Programming and CSCI-661 Foundations of Computer Science Theory or equivalent or permission of instructor) **Class 3, Credit 3 (F)**

CSCI-742 Compiler Construction
This course discusses design and implementation of language processors and translators. Topics include lexical, syntactic, and semantic descriptions, algorithms for analysis tools, and programming techniques, as well as interpreters and code generation for typical computer architectures. Teams of students will be required to design and implement a programming language with nested block structure and data aggregates. (CSCI-603 Advanced C++ and Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or CSCI-141 Computer Science I, CSCI-142 Computer Science II, and CSCI-243 The Mechanics of Programming and CSCI-661 Foundations of Computer Science Theory or equivalent or permission of instructor (students who take CSCI-442 may not take CSCI-742 for credit)) **Class 3, Credit 3 (S)**

CSCI-746 Software Development Tools
This course investigates and evaluates various software tools used in the development of software. Topics include simple dependency-based tools such as make and ant as well as full-featured integrated development environments. Working with and proposing modeling languages for such tools is an important part of the course. Programming projects will be required.(CSCI-603 Advanced C++ Program Design and CSCI-605 Advanced Java Programming, with B or better in both courses or CSCI-141 Computer Science I, CSCI-142 Computer Science II, and CSCI-243 The Mechanics of Programming and CSCI-661 Foundations of Computer Science Theory or equivalent or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-749 Topics in Languages and Tools
This course examines current topics in languages and tools. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances will be identified as belonging to the languages and tools cluster, the security cluster, or both clusters. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-753 Advanced Computer Networks
This course explores state-of-the-art techniques and open research problems in computer and wireless mobile networks. Topics include internet architecture design, peer-to-peer overlay networks, network security, routing protocols for wireless ad hoc networks, energy efficient issues in wireless networks, wireless sensor networks, routing protocols, and congestion control mechanisms. Reading research papers, presenting recent research results, conducting a team project, and writing term papers are required. (CSCI-651 Foundations of Computer Networks, CSCI-603 Advanced C++ and Program Design, CSCI-605 Advanced Java Programming or equivalents or permission of instructor) **Class 3, Credit 3 (S)**

CSCI-759 Topics in Systems
This course examines current topics in systems. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances will be identified as belonging to the distributed systems cluster, the architecture and operating systems cluster, the security cluster, or some combination of these three clusters. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-761 Topics in Advanced Algorithms
This course focuses on advanced algorithms and data structures in a specialized area of computer science or in a specific scientific domain. Both practical and theoretical aspects of algorithms will be explored to provide coverage of the state of the art and shortcomings of computing in the specialized area. This includes proofs of correctness and complexity analysis of the algorithms. Students will write a term paper that explores the current state of research in the area or reports on the student's implementation and experiments with algorithms for a chosen problem. Students will also be required to make presentations. The instructor will post the specifics of each course offering before the registration. With the approval of the program coordinator, this course can be taken for credit more than once, provided each instance concerns a different specialized area or domain. (CSCI-665 Foundations of Algorithms or CSCI-261 Analysis of Algorithms) **Class 3, Credit 3 (F, S)**

CSCI-762 Advanced Cryptography
This course investigates advanced topics in cryptography. It begins with an overview of necessary background in algebra and number theory, private- and public-key cryptosystems, and basic signature schemes. The course will cover number theory and basic theory of Galois fields used in cryptography; history of primality algorithms and the polynomial-time test of primality; discrete logarithm based cryptosystems including those based on elliptic curves; interactive protocols including the role of zero-knowledge proofs in authentication; construction of untraceable electronic cash on the net; and quantum cryptography, and one or more of digital watermarking, fingerprinting and steganography. Programming will be required. (CSCI-662 Foundations of Cryptography or CSCI-462 Introduction to Cryptography or equivalent and permission of instructor) **Class 3, Credit 3 (S)**

CSCI-769 Topics in Theory
This course examines current topics in theory. This is intended to allow faculty to pilot potential new graduate offerings. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. Specific course instances will be identified as belonging to the theory cluster, the security cluster, or both clusters. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-788 Computer Science MS Project
Project capstone of the master's degree program. Student must submit an acceptable project proposal in order to enroll. (Permission of project committee and graduate coordinator) **Credit 3 (F, S, Su, Winter Intersession)**

CSCI-790 Computer Science MS Thesis
Thesis capstone of the master's degree program. Student must submit an acceptable thesis proposal in order to enroll. It is expected that the work would lead to a paper of the caliber of those generally acceptable to a national conference. (Permission of thesis committee and graduate coordinator) **Credit 6 (F, S, Su, Winter Intersession)**

CSCI-799 Computer Science Graduate Independent Study
Students work with a supervising faculty member on topics of mutual interest. A student works with a potential faculty sponsor to draft a proposal that describes what a student plans to do, what deliverables are expected, how the student's work will be evaluated, and how much credit will be assigned for successful completion of the work. The faculty sponsor proposes the grade, but before the grade is officially recorded, the student must submit a final report that summarizes what was actually accomplished. (Permission of i

Software Engineering

SWEN-610 Foundations of Software Engineering
An overview course in software engineering emphasizing software design and software development projects. The course will focus on object-oriented (OO) analysis, design principles and techniques. Students will be introduced to OO modeling, design patterns and design/code refactoring techniques. While there is a significant emphasis on product development, students will be required to use a rigorous process in a team-based product development project. Major topics include analysis and specification of software, subsystem modeling using patterns, and software testing. A term-long, team-based project done in a studio format is used to reinforce concepts presented in class. (Graduate standing in Software Engineering, Introductory programming sequence equivalent to the undergraduate first-year computer science programming sequence.) **Class 3, Lab 0, Credit 3 (F)**

SWEN-640 Research Methods
Overview of the academic research methodologies used in graduate level work. Topics include: writing style, audience analysis, research planning, experimental design, document structure, research validation, and the process for submission and review to conferences and journals. This course provides the student with an opportunity to identify and develop a detailed thesis or capstone proposal that will be continued in a subsequent course. An in-depth study of a software engineering topic will be research focused. The student selects a research problem, conducts background research, and selects appropriate technology and methodologies needed to fully conduct the project. The topic is selected by the student and is in agreement with the student's adviser and committee. The proposal is presented in a scholarly format for approval by the adviser and committee. (Department approval) **Class 3, Lab 0, Credit 3 (F)**

SWEN-660 Graduate Affinity Research Group
This course is a project-based, research-focused course that supports teamwork, collaboration, and both professional and technical skill building. Students will work in teams that consist of both students and professor. Topics include: research methods, technical communication, and technical topics that are relevant to the projects. (Instructor approval) **Class 3, Lab 0, Credit 3 (F, S, Su)**

SWEN-699 Graduate Co-op Experience
One block of full-time, paid employment in Software Engineering. See the Software Engineering graduate program coordinator or RIT's Office of Cooperative Education for further details. (Department approval, completion of all bridge courses and 17 semester hours of graduate courses) **Class 0, Lab 0, Credit 0 (F, S, Su)**

SWEN-701 Practicum I
A project course where students practice what they have learned or are learning in class, through directed study. Teams work with contemporary tools, technologies, and methodologies. The practicum is an ongoing project in which students register to participate as Engineers in a specific role in accordance to individual levels of expertise and profile. (SWEN-610) **Class 2, Lab 0, Credit 2 (F, S, Su)**

SWEN-702 Practicum II
A project course where students practice what they have learned or are learning in class, through directed study. During the first week of class teams of students are assembled. The practicum is an ongoing project in which students register to participate as Senior Engineers in a specific role in accordance to individual levels of expertise and profile. (SWEN-701) **Class 2, Lab 0, Credit 2 (F, S, Su)**

SWEN-722 **Process Engineering**
In this course, students will study various lifecycle models for developing software systems. They will study the Software Process Engineering Metamodel (SPEM) standard as a tool for modeling and analyzing engineering processes. Students will use SPEM to characterize various process and organization models and patterns, and they will align these process characteristics to categories of needs for various organizations and projects. The students will study process engineering frameworks and the configuration and assembly of reusable process components into processes. Students will also study how tools and methods support the process. Students will also study software process assessment models, including the Capability Maturity Models, and learn how to identify specific recommendations for an organization to improve their processes. Students will apply their learning to engineer software engineering processes, tools, and methods appropriate for their graduate projects, course projects, and projects for organizations they have worked for. (SWEN-610) **Class 3, Lab 0, Credit 3 (F) (S)**

SWEN-745 **Software Modeling**
Modeling plays a pivotal role during the software lifecycle during the pre-construction and post-construction activities of the software lifecycle. During the pre-construction stage, models help software engineers understand, specify, and analyze software requirements and designs. During the post-construction stage, models can be used to analyze software systems while in operation. This kind of analysis includes reliability and safety issues as well as timing constraint analysis. (Graduate standing in Software Engineering) **Class 3, Lab 0, Credit 3 (F)**

SWEN-749 **Software Evolution and Reengineering**
This course explores the concepts of software evolution and reengineering and introduces approaches and support tools used to extract the information needed to assess existing software systems. Major maintenance activities are presented including estimating maintenance costs, managing change and predicting maintainability with software quality metrics. Organizational issues relative to product maintenance are discussed. Principles of software reuse and reverse engineering techniques are demonstrated through the use of class activities, team projects and case studies. (SWEN-610, SWEN-745) **Class 3, Lab 0, Credit 3 (S)**

SWEN-755 **Software Architecture and Product Lines**
A system's software architecture is the first technical artifact that illustrates a proposed solution to a stated problem. For all but the simplest system, the achievement of qualities such as flexibility, modifiability, security, and reliability is critically dependent on the components and interactions defined by the architecture. The course focuses on the definition of architectural structures, the analysis of architectures in terms of tradeoffs among conflicting constraints, the documentation of architecture for use over a product's life cycle, and the role of architecture in defining product lines based on reusable components. (SWEN-610, SWEN-745) **Class 3, Lab 0, Credit 3 (F)**

SWEN-772 **Software Quality Engineering**
This course begins with an exploration of the concepts underlying quality systems and the use of metrics. Students are encouraged to discuss the advantages as well as the limitations of systems and quantitative approaches, with a view to understanding the 40 importance of interpretation in metrics usage and of matching quality systems choices to organizational objectives and culture. They learn the use of modern metrics such as DRE, PCE, COQ/COPQ, reliability objectives and SUMI scores through exercises in analyzing and interpreting charts. This is complemented with a project where they work in teams to design an appropriate quality system for a specific project/organizational situation, and discuss the application and analysis of its evaluation experimentation as a means of improving the quality aspects of subject project/organizational situation. (SWEN-722) **Class 3, Lab 0, Credit 3 (F)**

SWEN-780 **Capstone Research Project**
This course provides the student with an opportunity to explore a project-based research experience that advances knowledge in that area. The student selects a research problem, conducts background research, develops the system, analyses the results, and builds a professional document and presentation that disseminates the project. The report must include an in-depth research report on a topic selected by the student and in agreement with the student's adviser. The report must be structured as a conference paper, and must be submitted to a conference selected by the student and his/her adviser. (Department approval, completions of core courses) **Class 3, Lab 0, Credit 3 (F, S, Su)**

SWEN-781 **Continuation of Capstone**
This course provides the student with an opportunity to complete their capstone project, if extra time if needed after enrollment in 790. The student continues to work closely with his/her adviser. (Department approval, SWEN-780) **Class 0–1, Lab 0, Credit 0–1 (F, S, Su)**

SWEN-789 **Graduate Special Topics**
This course will cover specialized topics in software engineering. Such topics are often considered emerging and advanced. Graduate Standing and specific prerequisites will be noted upon specific proposal of a course. (Graduate standing in Software Engineering) **Class 3, Lab 0, Credit 3 (F, S, Su)**

SWEN-790 **Thesis**
This course provides the student with an opportunity to execute a thesis project, analyze and document the project in thesis document form. An in-depth study of a software engineering topic will be research focused, having built upon the thesis proposal developed prior to this course. The student is advised by their primary faculty adviser and committee. The thesis and thesis defense is presented for approval by the thesis adviser and committee. (Department approval, SWEN-640) **Class 3, Lab 0, Credit 3 (F, S, Su)**

SWEN-791 **Continuation of Thesis**
This course provides the student with an opportunity to complete their thesis project once having enrolled in both thesis courses (794, 795), if extra time if needed. The student continues to work closely with his/her adviser and thesis committee. (Department approval, SWEN-790) **Class 0–1, Lab 0, Credit 0–1 (F, S, Su)**

SWEN-799 **Independent Study**
This course provides the graduate student an opportunity to explore an aspect of software engineering in depth, under the direction of an adviser. The student selects a topic, conducts background research, develops the system, analyses results, and disseminates the project work. The report explains the topic/problem, the student's approach and the results. (Instructor approval, completion of 9 semester hours) **Class 3, Lab 0, Credit 3 (F, S, Su)**

Computing and Information Sciences

CISC-807 **Teaching Skills Workshop**
Teaching is a valuable and desirable skill for Ph.D. students. This workshop course provides an introduction to the concepts and skills needed for quality teaching in higher education. Students will be provided with lecture, reading, and class activities centered on building skills in educational analysis, design, and assessment. (Limited to Ph.D. students) **Class 2, Lab 0, Credit 2 (S)**

CISC-810 **Research Foundations**
This course provides students with the theoretical background and practical experience with a variety of research techniques and methods. The course provides an overview of the research process along with opportunities for hands-on projects. Major topics for the course include: formulating a research question, conducting a literature review, selecting methodology, sampling, analyzing statistics, using qualitative techniques, and writing a publishable paper are topics that are discussed. (MATH-251 Probability and Statistics I or equivalent) **Class 3, Lab 0, Credit 3 (F)**

CISC-820 **Quantitative Foundations**
This course provides an introduction in the fundamentals of working with quantitative information. Topics include matrix algebra (matrices, vectors, direct and indirect methods for solving linear systems, eigenvectors, singular value decomposition, least-squares systems) optimization (convex analysis, gradient descent, Newton's method, interior-point methods), statistics (random variables, p-values, hypothesis testing, confidence intervals) and data exploration (clustering, dimensionality reduction, curve fitting). (MATH-251 Probability and Statistics I, MATH-182 Project-Based Calculus I, ISTE-121 Computer Problem Solving II, or equivalents) **Class 3, Lab 0, Credit 3 (S)**

CISC-830 **Cyber Infrastructure Foundations**
Cyber Infrastructure integrates all parts of large-scale computing including a set of software, services, and tools in order to solve large-scale computing problems. This course will give an overview of the problems and solutions of large-scale computing, e.g., Large Hydron Collider. Students will design and develop new tools for cyberinfrastructure. Presentations and written reports are required. (CSCI-142 or permission of instructor) **Class 3, Lab 0, Credit 3 (S)**

CISC-849 **PhD Seminar**
Current advances in computing and information sciences. (Prerequisites set by instructor) **Class 1–3, Lab 0, Credit 1–3 (S)**

CISC-890 **Dissertation and Research**
Students will perform use-inspired original research in the interaction, informatics, and infrastructure areas of computing and information sciences applied to specific domain(s). Students will receive guidance from their adviser(s) in choosing an appropriate topic and activity. (Permission of the PhD Program Director) **Class Variable, Lab 0, Credit Variable (F, S)**

CISC-896 Colloquium in Computing and Information Sciences
This course develops the student's knowledge and understanding of various contemporary research issues, especially in the interdisciplinary areas of computing and information sciences. The student will get involved by attending a number of research presentations and discussions. The choice of topics considered may vary and will be determined by the instructor. **Class 0, Lab 0, Credit 0 (S)**

CISC-897 Research Internship
This course provides an opportunity for PhD students to complete a formal internship in a business, industry, government, educational, or research setting. The internship provides students with the opportunity to gain familiarity with practical research problems and methods. Students gain experience working in collaborative research teams with a variety of researchers, focusing on problems of multiple scales, using techniques that go beyond those available at RIT. (Completion of research potential assessment and adviser approval, or permission of the PhD program director) **Class Variable, Lab 0, Credit Variable (S)**

CISC-899 Independent Study
PhD students will work with supervising faculty on a project or research study of mutual interest. The design and evaluation will be determined through discussion with the supervising faculty and documented through completion of an independent study form. The independent study must be approved by the PhD director. (Permission of the instructor and PhD program director) **Class 1-6, Lab 0, Credit 1–6 (S)**

Networking, Security and Systems Administration

NSSA-601 Research Methods and Proposal Development
It is important that students in this graduate program be able to assess the current technological trends and foresee the essential future needs of the technologies. This course is designed to help students in this direction. Students will be encouraged to investigate the continuing networking and computing problems, problems that arise due to advances in these technologies, and those due to user demands in the area of networking and system administrations. This will provide the foundations for the student to decide on a project/thesis topic. Invited talks from faculty and members from other institution to share their research and scholarship work will seed such research thinking. Students will be encouraged to interact with faculty members to formulate their project/thesis topics and scope. Students will be expected to develop a research proposal that may serve as the basis for their later project/thesis proposal. In addition, this course provides an overview of the academic research methodologies used in graduate level work. Topics include but are not limited to: experimental research, correlation, experiment observation, surveys, and case studies. Also included will be document structure, validation, and the process for submission and review to conferences and journals. **Class 3, Credit 3 (F)**

NSSA-602 Enterprise Computing
This course explores enterprise systems (clouds, server farms, mainframes, and clusters/grids) from the environment, networking, storage, security, and system administration perspectives. Students in this course gain an understanding of the knowledge and concepts needed to manage, perform research in, and administrate those architectures. **Class 3, Credit 3 (F)**

NSSA-603 Enterprise Security and Forensics
This course is designed to provide students with the advanced concepts needed to establish network security strategies to ensure adequate protection for the corporate environment and yet provide accessibility for the corporate community. **Class 3, Credit 3**

NSSA-604 Cryptography and Authentication
In this course, students will learn in depth knowledge of cryptography and authentication. Students will explore various cryptography algorithms, authentication protocols, and their design and implementation. Students will work on a project to implement a cryptography algorithm and/or an authentication protocol. The applications of cryptography and authentications in the areas of computer networks and systems and information assurance will also be investigated. **Class 3, Credit 3 (F, S)**

NSSA-610 Advanced Wired Networking Concepts
This course will cover the principles of wired networking with a focus on algorithms, protocols and implementation of advanced wired networking concepts The course will begin with in-depth background in architecture and protocols at physical, MAC, IP, and transport layers. Also, theoretical aspects of wired network challenges are discussed with a research focus. The course also explores the realm of wired technologies such as peer-to-peer networks, future internet, real-time applications, smart grid and IPv4 and IPv6 integration and translation. Students will learn about these technologies through lectures and explore some of them though a class project. **Class 3, Credit 3 (F)**

NSSA-611 Advanced Topics in Wireless Networks and Technologies
The course is designed to provide comprehensive exposition to the challenges faced in wireless networks and technologies in the different protocol layers. Leading work conducted to address the challenges faced in the new techniques such as cross layered and integrated approaches will be covered. From the challenges perspective, case studies based on several upcoming wireless technologies and networks will be presented. in most cases, the standards efforts follow the deployment, which lags the research effort. Some of the standardization efforts and their impacts in industry deployment and the effect of research on standardization will be covered. This study will be based on case studies. (STAT-145 Introduction to Statistics I or equivalent or permission of the instructor) **Class 3, Credit 3 (S)**

NSSA-612 Network Modeling and Analysis
The course provides comprehensive exposition of the core concepts in network modeling and simulation. It will cover both graph theoretical and statistical models of complex networks such as the Internet and social networks. It also introduces different types of modeling techniques and simulation tools. The course also systematically addresses some practical and theoretical consideration for developing complex modeling. It offers real world examples to illustrate the process of modeling to address specific problems. (STAT-145 Introduction to Statistics I or equivalent) **Class 3, Credit 3 (S)**

NSSA-620 Emerging Computing and Networking Technologies
Computer networking and computer system technologies have dramatically changed the way that businesses operate and how they accomplish their organizational goals. Most of the current technologies used today have their roots in the early days of the Internet and computing. The changes that have occurred since then have been largely at the margins, rather than developed in a wholesale fashion. As our discipline moves forward there are a substantial number of emerging technologies in development to address the inadequacies of the currently deployed technologies. If widely adopted, these technologies will change how technologies support organizations and individuals creating a whole new paradigm for computing, networking, and the security of our computing environment. Students will be researching the current state of several of the most significant emerging technologies. The course will consist of a combination of lectures where technologies will be presented and explained; independent labs, modeling and simulation exercises that will reinforce the students' understanding of the technologies by allowing them to work with them in a hands-on fashion; and independent literature research do serve as a foundation for future work in this degree program. (Knowledge of networking, systems, and security technologies equivalent to the core of the NSSA BS degrees) **Class 3, Credit 3 (F)**

NSSA-621 Design and Deployment of Wireless Networks
This course will take students through large scale wireless systems. It will also cover the significant access wireless networks. Important areas of concern will be contemporary and emerging WLAN standards, cellular communication and other forms of wireless access such as wireless internet service provision. Focal points for these areas will be protocol operation, network architecture and security concerns. **Class 3, Credit 3 (S)**

NSSA-622 Carrier Networking
This course is primarily concerned with the issues associated with carrier networks in the WAN. Major protocols such as BGP, MPLS, T carriers, Metro Ethernet and SONET will form the backbone of the content. in addition to protocol architecture and operation, the course will also examine the integrated nature of these protocols as they support contemporary communication applications. **Class 3, Credit 3 (S)**

NSSA-699 NSSA Graduate Co-op
Students perform professional work related to the field of NSSA for which they are paid. Students work full-time during the term for which they are registered. Students must complete a student co-op work report for each term for which they are registered; students are also evaluated each term by their employer. A satisfactory grade is given for co-op when both the student's work report and the employer evaluation have been completed. Co-op is an optional part of the MS NSSA and MS IAF degrees. (Students must complete the assigned bridge courses and at least 12 sch of their MS program of study with a GPA of at least 3.0.) **Class 0, Lab 0, Credit 0 (F, S, Su)**

NSSA-710 Network Management
This course provides an introduction to network management concepts with hands-on laboratory sessions in developing network management applications and using it to study and analyze the performance of networks, data communications hardware and software, and use of these components in computer networks. Topics include but are not limited to introduction to network management concepts, the five basic network management functions namely fault management, configuration management, performance management, accounting management and security management, introduction to SNMP and its versions, Remote monitoring and different network management architectures. **Class 3, Credit 3 (F)**

NSSA-711 **Advanced Routing Protocols**
Managing complex network environments requires an understanding of the sophisticated routing protocols necessary for controlling information flow. This course will examine the routing protocols in standard use and their application in typical enterprise and large internet service provider (ISP) environments. The advantages and disadvantages of each protocol will be investigated. in addition, emerging wired and wireless routing protocols will also be discussed. (Knowledge of networking, systems, and security technologies equivalent to the core of the NSSA BS degrees) **Class 3, Credit 3 (F)**

NSSA-712 **Advanced Storage Technologies**
Data storage is an integral and essential component of every computer system. This course explores the spectrum of storage technologies ranging from DAS to JBODS to SANs. Media types including Ramdisk, Flash, SSD, magnetic, optical and other emerging technologies will be investigated. The issues to be faced as systems grow to enterprise scale will also be addressed. Features of local, distributed, and networked storage including SANs will be introduced as well as issues such as capacity planning, virtualization, decentralized storage, security, crash recovery and load balancing, and maintenance in support of high performance systems and maintenance. (Knowledge of networking, systems, and security technologies equivalent to the core of the NSSA BS degrees) **Class 3, Credit 3 (F)**

NSSA-713 **Enterprise Service Provisioning**
Advances in server software and hardware have made it possible for large organizations to consolidate software services onto fewer, higher powered servers while at the same time enhancing reliability and availability. This course will explore available technologies such as cluster computing and server virtualization as they can be used to deploy software services in enterprise environments. (NSSA-602 Enterprise Computing) **Class 3, Credit 3 (S)**

NSSA-714 **Advanced Large-Scale Computing**
This course explores, in depth, large-scale systems (mainframes, clouds, clusters/grids) from an advanced perspective in the environment, networking, storage, security, and system administration topics. Students in this course gain the ability needed to design and justify, perform research in, and administer those enterprise-scale systems. (NSSA-602 Enterprise Computing) **Class 3, Credit 3 (S)**

NSSA-715 **Network Design and Performance**
This course will examine the design and performance of networks. Students will learn to design networks based on identified needs and analyze the performance of that network. The designs include site, campus, and enterprise networks. WAN technologies will be combined with LAN technologies in the design of enterprise networks. Students will learn to assess the business goals and their application to the network goals. Students will learn to evaluate the security goals of the network and to integrate these goals in the design. (NSSA-602 Enterprise Computing) **Class 3, Credit 3 (S)**

NSSA-716 **Enterprise Mobile Computing**
This course will cover technologies for web-based mobile cloud computing especially for business solutions. The course covers enterprise mobile computing architecture, emerging mobile computing technologies, operating system, and security. Also, the course discusses different applications of mobile computing in mobile ad-hoc and sensor networks. (Knowledge of networking, systems, and security technologies equivalent to the core of the NSSA BS degrees) **Class 3, Credit 3 (S)**

NSSA-730 **Advanced Computer Forensics**
This course provides students with the latest techniques and methods needed for extracting, preserving and analyzing volatile and nonvolatile information from digital devices. Students will gain exposure to the spectrum of available computer forensics tools along with developing their own tools for "special need" situations. The core forensics procedures necessary for ensuring the admissibility of evidence in court, as well as the legal and ethical implications of the process, will be covered on both Unix and Windows under multiple file systems. (Knowledge of filesystems) **Class 3, Lab 0, Credit 3 (F, S)**

NSSA-731 **Web Server and Application Security Audits**
This course discusses the processes and procedures to perform a technical security auditing of web servers and web based applications. Students will not only explore the Web Servers and Applications/Services threats, but also learn to apply the latest auditing techniques to identify vulnerabilities existing in or stemming from web servers and applications. Students will write and present their findings and recommendations in audit reports on web servers and applications vulnerabilities. **Class 3, Credit 3 (F, S)**

NSSA-732 **Mobile Device Forensics**
Techniques and limitations related to the seizure and interrogation of a variety of digital devices will be explored. Various mobile phone and tablet platforms will be interrogated with the intent of gaining better access and understanding of the organization of data in the devices. The infusion of digital storage and identification devices such as MP3 players, RFID and tokens into our everyday lives requires the study of their weaknesses and forensic exploitability. As personal information is frequently gathered and stored on these devices, the loss of a device could adversely affect individuals and organizations. The examination, collection, and removal of such information will be studied. (Knowledge of networking, systems, and security technologies) **Class 3, Credit 3 (F, S)**

NSSA-733 **Information Security Risk Management**
This course will provide students with an introduction to the principle of risk management and its three key elements: risk analysis, risk assessment and vulnerability assessment. Students will also learn the differences between quantitative and qualitative risk assessment, and details of how security metrics can be modeled/monitored/controlled and how various types of qualitative risk assessment can be applied to the overall assessment process. Several industry case studies will be studied and discussed. Students will work together in sub-teams, conduct risk assessment based on selected case studies or hypothetical scenarios, finally write and present their risk assessment reports and findings. **Class 3, Credit 3 (F, S)**

NSSA-741 **Sensor and SCADA Security**
This course is designed to provide students with a knowledge of sensor network security with respect to practical implementations. In particular, secure sensor network design for Supervisor Control And Data Acquisition (SCADA) is discussed. SCADA encompasses the technologies that manage and control much of the infrastructure that we depend on everyday without realizing it. The failure or corruption of SCADA systems can not only be inconvenient but also hazardous when the resource is critical or life threatening.? Securing SCADA systems is of great strategic importance. The role of sensor networks in SCADA is discussed and sensor security protocols for SCADA applications are evaluated and studied. (Knowledge of networking and security technologies) **Class 3, Credit 3 (F, S)**

Interactive Games and Media

IGME-601 **Game Development Processes**
This course examines the individual and group roles of the development process model within the game design and development industry. Students will transform design document specifications into software and hardware needs for developers, testers, and end users. Students will examine team dynamics and processes for technical development, content development, testing, deployment, and maintenance. Students will explore the design process through the deconstruction of the game industry's software lifecycle model. (Matriculation in MS Game Design and Development) **Class 3, Credit 3 (F)**

IGME-602 **Game Design**
This course presents students with core theories of game design, informed by research results from media theory, narrative methods and models, theories of ideation, and the nature of games, play and fun. Specific emphasis is placed on the examination of historical successes and failures, along with presentation of ethical and cultural issues related to the design of interactive software. Students will engage in formal critique and analysis of media designs and their formal elements. (Matriculation in MS Game Design and Development) **Class 3, Credit 3 (F)**

IGME-603 **Gameplay and Prototyping**
This course explores the pragmatic issues of creative concept development through storyboarding, pitching, prototyping and playtesting. Students will use various tools and techniques to build game prototypes that they will evaluate through playtesting in an incremental design process informed by market research and analysis. (Matriculation in MS Game Design and Development) **Class 3, Credit 3 (F)**

IGME-609 **Programming for Designers**
This course is an introduction to programming for students with a background in design. Students will write programs to construct and control interactive, media-rich experiences. Students will employ fundamental concepts of object-oriented computer programming such as classes, variables, control structures, functions, and parameters in their code. Students will develop their problem solving skills and begin building a "logical toolkit" of algorithms and program design strategies. Students will extend existing software objects provided by the instructor, as well as create new objects of their own design. Programming projects will be required. (VCDE-709) **Class 3, Credit 3 (S)**

IGME-670 **Digital Audio Production**
Technologies and techniques for producing and manipulating digital audio are explored. Topics include digital representations of sound, digital audio recording and production, MIDI, synthesis techniques, real-time performance issues, and the application of digital audio to multimedia and Web production. (Graduate standing) **Class 3, Credit 3 (F)**

IGME-671 **Interactive Game Audio**
This course provides students with exposure to the design, creation and production of audio in interactive applications and computer games. Students will become familiar with the use of sound libraries, recording sounds in the studio and in the field, generating sound with synthesizers, and effects processing. Students will create sound designs for interactive media, integrating music, dialog, ambient sound, sound effects and interface sounds within interactive programs. (IGME-670) **Class 3, Credit 3 (S)**

IGME-680 **IGM Production Studio**
This course will allow students to work as domain specialists on teams completing one or more large projects over the course of the semester. The projects will be relevant to experiences of the Interactive Games and Media programs, but they will require expertise in a variety of sub-domains, including web design and development, social computing, computer game development, multi-user media, human-computer interaction and streaming media. Students will learn to apply concepts of project management and scheduling, production roles and responsibilities, and their domain skill sets to multidisciplinary projects. Students will complete design documents, progress reports and final assessments of themselves and their teammates in addition to completing their assigned responsibilities on the main projects. (Permission of instructor) **Class 3, Credit 3 (F, S)**

IGME-681 **Innovation and Invention**
In this course, students explore the process and products of innovation and invention. Each term we conceive and develop a different "outside the box" project in a multidisciplinary "tinkerer's lab". Readings, lectures, student presentations, and discussions deal with the interplay of technology, human nature, and a human environment in which emerging technologies and new modes of interaction are pervasive and ubiquitous. Students from multiple disciplines are guided through a series of collaborative experiences inventing, designing, implementing and studying emerging technologies and their educational and artistic potential. Presentations, projects and individual research papers are required. (Permission of instructor) **Class 3, Credit 3 (F, S)**

IGME-695 **Colloquium in Game Design and Development**
This required colloquium will introduce students to a range of emerging topics and themes in the field of game design and development. Students will attend lectures by and discussions with RIT faculty and visitors, complete related readings, and offer both oral and written responses to readings and presentations. (Matriculation in MS Game Design and Development) **Class 2, Credit 1 (F, S)**

IGME-699 **Graduate Co-op**
Cooperative education is a work experience designed to supplement the educational process. Students may select from a range of activities designated as cooperative education, including relevant industrial experience, internships, entrepreneurial activities, as well as faculty supervised research and innovation opportunities. (Permission of school director) **Class 0, Credit 0, (F, S, Su)**

IGME-720 **Social and Pervasive Game Design**
This course presents students with core theories of sociology, psychology, economics, law, and politics in the context of social and pervasive (or "alternate reality") games. Students will engage in formal critique and analysis of media designs and their formal elements. (IGME-602) **Class 3, Credit 3 (F)**

IGME-730 **Game Design and Development for Casual and Mobile Platforms**
This course explores the design and development of casual and mobile game applications. Students will begin by exploring the design practices relevant to casual and mobile games, including hardware constraints, player expectations, play experiences, mechanics for casual and mobile experiences, as well as the aesthetics and presentation of casual and mobile game elements. As students learn the theoretical concepts, they will also learn the development process for casual and mobile games. Development topics will include technology platforms, physical and logical interface control, graphics and interaction, tools and APIs, connectivity, data management, data persistence, delivery mechanisms, and systems integration with desktop and web-based platforms. (IGME-601, IGME-602, and IGME-603) **Class 3, Credit 3 (S)**

IGME-740 **Game Graphics Programming**
Students will explore the use of an advanced graphics API to access hardware-accelerated graphics in a real-time graphics engine context. The course will involve discussion of scene graphs, optimizations, and integration with the API object structure, as well as input schemes, content pipelines, and 2D and 3D rendering techniques. Students will also explore the advanced use of the API calls in production code to construct environments capable of real-time performance. Students will construct from scratch a fully functional graphics engine, with library construction for game development. Advanced topics will be explored, including real-time special effects, custom shading pipelines, and advanced deferred rendering techniques. (IGME-601 and IGME-603) **Class 3, Credit 3 (S)**

IGME-750 **Game Engine Design and Development**
This course will provide students with theory and practical skills in game engine design topic areas such as understanding the graphics pipeline as it influences engine design, hardware principles and the relationship to game engine construction, mathematical principles involved in game engine design, scene graph construction and maintenance, texture and materials management, collision systems, physics systems, particle systems, and control systems. Furthermore, this course will examine software and toolsets that assist game engine designers in their tasks. Students will be expected to design and implement a game engine in teams as well as properly document their design and development strategy. (IGME-601 and IGME-603) **Class 3, Credit 3 (F)**

IGME-760 **Artificial Intelligence for Gameplay**
This course explores artificial intelligence concepts and research through both a theoretical perspective and a practical application to game development. In particular the course focuses on AI concepts and paradigms such as search and representation, reasoning under uncertainty, intelligent agents, biologically inspired computing and machine learning to real-time situations, and applications as relevant to the field of entertainment technology and simulation. (IGME-603) **Class 3, Credit 3 (F)**

IGME-788 **Capstone Design**
This course allows students within the Game Design and Development program to develop a capstone proposal and design document. The capstone design document specifies the scope and depth of the capstone project. In addition, it defines the group and individual responsibilities for the cohort capstone project experience. (Permission of instructor) **Class 3, Credit 3 (F)**

IGME-789 **Capstone Development**
This course provides Master of Science in Game Design and Development students with capstone project experiences. Students are expected to work in cohorts towards the implementation of a game system that properly illustrates proficiency in the application of theory and practice towards a large-scale project. For each student, individual responsibilities for the group project will be defined in consultation with both the group and the faculty. Students must successfully complete the Capstone Design course and present a satisfactory capstone project proposal to the faculty before enrolling in this course. (IGME-788) **Class 3, Credit 3 (S)**

IGME-790 **Graduate Seminar in IGM**
This is intended to allow for special one-time offerings of graduate topics. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given seminar offering. (Varies) **Class Varies, Credit 1–6 (F, S, Su)**

IGME-795 **Game Industry Themes and Perspectives**
This required course prepares students for a career in the field of game design and development. Students will attend lectures by and discussions with RIT faculty and visitors and produce material to assist in their career preparation. (Matriculation in MS Game Design and Development) **Class 2, Credit 1 (F)**

IGME-796 **Advanced Topics in Game Design**
This course examines current topics in Game Design. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member (s) who propose a specific topics course in this area. (Varies) **Class 3, Credit 3**, **(F, S, Su)**

IGME-797 **Advanced Topics in Game Development**
This course examines current topics in Game Development. Specific course details (such as prerequisites, course topics, format, learning outcomes, assessment methods, and resource needs) will be determined by the faculty member(s) who propose a specific topics course in this area. (Varies) **Class 3, Credit 3**, **(F, S, Su)**

IGME-799 **Independent Study**
The student will work independently under the supervision of a faculty adviser on a topic not covered in other courses. (Permission of instructor) **Class Varies, Credit 1–6 (F, S, Su)**

Kate Gleason College of Engineering

Harvey J. Palmer, Dean

www.rit.edu/kgcoe

Programs of study

Online learning option available

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The Kate Gleason College of Engineering offers comprehensive, innovative graduate programs in a broad range of engineering disciplines. Programs include master of science degrees, master of engineering degrees, advanced certificates, and a broad-based, cross-disciplinary doctoral program in microsystems engineering. In conjunction with the College of Science, the Kate Gleason College offers an interdisciplinary MS degree in materials science and engineering.

The master of science degree is research based and leads to either employment in industry or graduate study at the doctoral level. The master of engineering degree is a terminal master's program focused on career development for industry. A capstone experience combined with additional course work replaces the traditional thesis requirement.

Details on specific programs, including courses, research activities, thesis requirements, and assistantships, are outlined in this *Graduate Bulletin* as well as on the college and program websites.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

The college's faculty is committed to continuous learning and professional growth. They work closely with graduate students on research, thesis, and graduate project work.

Advisers: A member of the faculty is appointed as a faculty adviser for each graduate student and supervises the student's progress toward degree completion. For master of engineering programs that include an internship, a second adviser (for the internship) is assigned once an internship proposal is submitted. This adviser, in cooperation with the student's industrial adviser, will monitor and evaluate the student's internship experience and recommend to the department head the number of academic credits to be awarded for the experience.

Facilities

The college provides students with state-of-the-art laboratories, including machine tools and manufacturing, ergonomics, advanced systems integration, production systems, materials processing, biofluids, fuel cells, thermal analysis, robotics, electronics, microchip fabrication (clean room), VSLI, embedded systems, hardware design, analog devices, lasers and optics, electromagnetics, computer architecture, and digital design, to name a few. Close corporate partnerships provide the college with access to current software and equipment used in industry.

Study options

Full-time study: Students may matriculate on either a full- or part-time basis. A full-time student will generally take between 12 and 18 credits per quarter, depending upon their research or graduate project activity, and can complete the degree requirements in one calendar year. A full-time student in a master of engineering degree program may choose to alternate academic quarters with an internship.

Part-time study: The college encourages practicing engineers in the greater Rochester industrial community to pursue a program of study leading to the master of science or master of engineering degree without interrupting their employment. To facilitate this, many of the courses are scheduled in the late afternoon or early evening. Students employed full-time are limited to a maximum of two courses or 8 quarter credits each quarter. A student who wishes to register for more than 8 quarter credits must obtain the approval of his or her adviser and the department head.

Nonmatriculated status: Individuals may take graduate courses as nonmatriculated students if they have a bachelor's degree from an approved undergraduate school and the necessary background for the specific courses in which they wish to enroll. The courses taken for credit usually can be applied toward the master's degree when the student is formally admitted to the graduate program at a later date. However, the number of credits that will be transferred to the degree program from courses taken at RIT as a nonmatriculated student is normally limited to a maximum of 12 quarter credits.

Applied Statistics, MS

http://www.rit.edu/cqas/academics/msappliedstatistics
Joseph Voelkel, Graduate Program Director
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Program overview

The MS program in applied statistics is available to both full- and part-time students. Cooperative education options also are available. The MS degree is also available in an online learning format, which is especially appealing to students who are unable to attend classes on campus.

The program is primarily intended for students who do not wish to pursue a degree beyond the MS. However, a number of our students are either working on, or have attained, a doctorate degree at other universities.

Curriculum

The program requires 45 quarter credit hours and includes seven core courses, four courses from a career option, three electives, and a capstone project.

Core Courses

There are seven required courses. Students, in conjunction with their advisers' recommendations, should take the core courses early in the program. In any event, they must be completed within the first 30 quarter credit hours of the degree.

Career options

There are three standard career options, each of which is designed to allow students to specialize within their career endeavors. Specialized career options are also available.

COURSE		QUARTER CREDIT HOURS
Quality engineering		
0307-721	Statistical Process Control	3
0307-731	Statistical Acceptance Control	3
0307-781	Quality Management	3
0307-782	Quality Engineering	3
Industrial statistics		
0307-803	Design of Experiments III	3
0307-846	Statistical Data Mining	3
0307-862	Reliability Statistics I	3
0307-883	Quality Engineering by Design	3
Statistical theory and methods		
0307-824	Probability Models	3
0307-830	Multivariate-Analysis Theory	3
0307-831	Multivariate-Analysis Applications	3
0307-862	Reliability Statistics I	3

Electives and capstone

Three additional courses are chosen by students with the help of their advisers. These courses are usually departmental courses but may include (along with transfer credits) up to 9 quarter credit hours from other courses related to the program that are consistent with students' professional objectives.

Students, with adviser approval, may choose to write a research thesis or conduct a research project instead of taking the full three electives. Theses are usually for 6 quarter credit hours, and projects are usually for 3 quarter credit hours.

A required capstone course is designed to ensure that students can integrate the knowledge from their courses to solve more complex problems. This course is taken near the end of a student's course of study.

Full-time first-year students on scholarship must register for the Statistics Seminar (0307-895) in the fall, winter, and spring quarters. This is a required, non-credit-bearing course that is graded on a pass-fail basis.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Applied statistics, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0307-742	Statistical Software	3
0307-801	Design of Experiments I	3
0307-802	Design of Experiments II	3
0307-821	Theory of Statistics I	3
0307-822	Theory of Statistics II	3
0307-841	Regression Analysis I	3
0307-842	Regression Analysis II	3
	Career Option Courses	12
	Electives	9
	Capstone	3
Total Quarter Credit Hours		**45**

Applied statistics, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CQAS-611	Statistical Software	3
CQAS-721	Theory of Statistics I	3
CQAS-741	Regression Analysis	3
CQAS-722	Theory of Statistics II	3
CQAS-701	Foundations of Experimental Design	3
	Elective 1	3
Second Year		
	Elective 2	3
	Elective 3	3
	Elective 4	3
CQAS-792	Capstone	3
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in applied statistics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a current resume,
- Submit two letters of recommendation, and
- Complete a graduate application.

Additional information

Six Sigma Black Belt

Students may earn a Six-Sigma Black Belt after obtaining the MS in applied statistics or the advanced certificate in statistical quality. Students should ensure appropriate course selection by reviewing the Black Belt requirements on the center's website. In addition, students will need to complete an additional qualifying project.

Advanced certificate programs

Two advanced certificate programs, in statistical quality and in statistical methods for product and process improvement, also are available. Each requires 18 quarter credit hours and both are available to part-time students. In both programs, the courses are a subset of the MS program courses and are offered on campus and in the online learning format. The advanced certificate in statistical quality is aimed primarily at quality managers, quality engineers, or those who aspire to such positions. The advanced certificate in statistical methods for product and process improvement is designed for engineers, scientists, and other professionals who want a solid education in the statistical methods that are most closely related to their work, but who wish to finish a program in a shorter time period than the MS program.

Grades and maximum time limit

Students must attain an overall program grade-point average of 3.0 (B), with no more than two grades of C, for graduation. A minimum of 24 quarter credit hours in 800-level courses is required in the degree program. Course work must be completed within seven years. Contact the department for more details on these requirements.

Students are strongly encouraged to further develop their writing, speaking, presentation, and computer skills as they progress through the program.

Computer Engineering, MS

http://www.ce.rit.edu/academics/msce.htm
Shanchiuh Jay Yang, Department Head
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Program overview

The master of science degree in computer engineering provides students with a higher level of specialized knowledge in computer engineering, strengthening their ability to successfully formulate solutions to current technical problems, and offering a significant independent learning experience in preparation for further graduate study or for continuing professional development at the leading edge of the discipline. The program accommodates applicants with undergraduate degrees in computer engineering or related programs such as electrical engineering or computer science. (Some additional bridge courses may be required for applicants from undergraduate degrees outside of computer engineering.)

Curriculum

The degree requires 45 quarter credit hours and includes four core courses, three courses within an area of concentration, two graduate electives (subject to a faculty adviser's approval), and 9 quarter credit hours of thesis research. Core courses and graduate electives provide breadth of knowledge. Concentration courses allow students to pursue an area of specialization in the field of computer engineering by completing a cohesive set of three courses beyond the core degree requirements. This provides students with enough depth to conduct meaningful thesis research.

All computer engineering students with graduate standing are expected to attend the Computer Engineering Graduate Seminar. These courses build on the knowledge a student has previously gained through a BS degree in computer engineering or a related discipline.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Computer engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0306-720	Electronic Design Automation	4
0306-730	VLSI Design	4
0306-740	Analytical Topics for Computer Engineers	4
0306-756	Multiple Processor Systems	4
	Concentration Course 1, 2, 3	12
	Graduate Electives 1, 2	8
	Thesis Research	9
Total Quarter Credit Hours		**45**

Computer engineering, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CMPE-660	Reconfigurable Computing	3
CMPE-630	Digital Integrated Circuit Design	3
CMPE-740	Analytical Topics in Computer Engineering	3
CMPE-795	CMPE Graduate Seminar	0
CMPE-756	Multiple Processor Systems	3
	Graduate Electives	6
Second Year		
	Graduate Electives	6
CMPE-795	CMPE Graduate Seminar	0
CMPE-790	MSCE Thesis	6
Total Semester Credit Hours		**30**

Thesis research

An important aspect of graduate study is the student's preparation to lead challenging, state-of-the-art technical projects. To do this effectively, it is essential that the student obtain experiences in reviewing related work of others in the field, as well as conducting meaningful independent research under faculty mentorship.

Thesis work begins by selecting a faculty adviser, identifying a topic, forming a committee (which approves the research topic), and submitting a proposal. The thesis topic, formulated by working closely with a faculty adviser, is related to recent technical developments in the field of computer engineering. Upon completion of the research outlined in the thesis proposal, the work is reported in a document submitted to the faculty committee and a thesis defense presentation. A technical paper resulting from the thesis research is submitted to a refereed conference or journal for publication.

Areas of concentration

The following areas of concentration are available. Students are allowed to take relevant courses from other academic programs, including electrical engineering, computer science, or software engineering, to fulfill a specific research focus.

Computer Architecture

Computer architecture deals with hardware resource management, instruction set architectures and their close connection with the underlying hardware, and the interconnection and communication of those hardware components. Some of the current computer architecture challenges that are being tackled in the computer engineering department include energy efficient architectures, high performance architectures, graphic processing units (GPUs), reconfigurable hardware, chip multiprocessors, and networks-on-chips.

Control and Embedded Systems

This research area is concerned with algorithms and devices used at the core of systems that interact with our physical world. As such, this area considers the sensing, analysis, and modeling of dynamic systems with the intent of measuring information about a system, communicating this information and processing it to adapt its behavior. Application areas are robust feedback-based control where uncertainty in the dynamics and environment must be considered during the design process and signal processing algorithms and devices for system sensing and adaptation.

Digital signal Processing and Computer Vision

Digital signal processing focuses on the acquisition of signals from the physical world and their processing on a computing platform. This concentration's application areas are broad and include audio and speech processing, image and video processing, sensor-level processing, sonar and radar processing, and biomedical signal processing. Computer vision extracts information from visual data and includes methods for feature extraction, classification, and understanding of images and video.

Nanoscale circuits and systems

Modern processors demand high computational density, small form factors, and low energy dissipation with extremely high performance demands. This is enabled by the nanoscale and heterogeneous integration of transistors at massive-scale.

Such nanocomputers will open unimaginable opportunities as well as challenges to computer engineers. This concentration focuses on how to design nanocomputers in the presence of severe physical constraints, investigate dynamic reconfigurability to exploit the power of nano-scale electronics for building reliable computing systems, and study the applicability of emerging technologies to address challenges in bio-inspired systems.

Networks and security
The prevalence of interconnected computing, sensing, and actuating devices have transformed our way of life. Ubiquitous access to data using/from these devices with reliable performance s well as security assurance presents exciting challenges for engineers and scientists. Resilient to environmental uncertainty, system failures, and cyber attacks require advances in hardware, software, and networking techniques. The networks and security concentration focuses on intelligent wireless and sensor networks, cryptographic engineering, and predictive cyber situation awareness.

Admission requirements

To be considered for admission to the MS program in computer engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in computer engineering or a related field,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have an GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (GRE),
- Submit two letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Electrical Engineering, MS

http://www.rit.edu/kgcoe/eme/
Sohail Dianat, Department Head
(585) 475-7115, sadeee@rit.edu

Program overview

The master of science degree in electrical engineering allows students to customize their course work while working closely with electrical engineering faculty in a contemporary, applied research area. Upon matriculation into the program, students formulate a plan of study in consultation with an adviser. All students with graduate standing are expected to attend the Electrical Engineering Graduate Seminar for every quarter they are on campus. The MS degree is awarded upon the successful completion of a minimum of 45 quarter credit hours, including either a 9 quarter credit hour thesis or a 5 quarter credit hour graduate paper.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Electrical engineering (communication option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-693	Digital Data Communication	4
0301-729	Antenna Theory and Design	4
0301-692	Communication Networks	4
0301-717	Microwave Circuit Design	4
0301-794	Information Theory	4
0301-710	Advanced Electromagnetic Theory	4
0301-802	Wireless Communication	4
0301-816	Design and Characterization of Microsystems	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**45-49**

Electrical engineering (communication option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-692	Communication Networks	3
EEEE-693	Digital Data Communication	3
EEEE-794	Information Theory	3
EEEE-797	Wireless Communication	3
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (control option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-615	State Space Control	4
0301-769	Fuzzy Logic and Applications	4
0301-761	Modern Control Theory	4
0301-815	Multivariable Modeling	4
0301-733	Robust Control	4
0301-765	Optimal Control	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**37-41**

Electrical engineering (control option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-769	Fuzzy Logic and Applications	3
EEEE-761	Modern Control	3
EEEE-765	Optimal Control Course	3
EEEE-766	Multivariable Modeling	3
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (digital systems option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-650	Design of Digital Systems	8
0301-651	Physical Implementation	4
0301-732	Advanced Topics in Digital System Design	4
0301-741	Design for Testability	4
0301-810	Advanced Computer Architecture	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**49-53**

Electrical engineering (digital systems option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-620	Design of Digital Systems	3
EEEE-720	Advanced Topics in Digital System Design	3
EEEE-621	Design of Computer Systems	3
EEEE-721	Advanced Topics in Computer System Design	3
	Elective	3
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (electromagnetic/microwaves option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-629	Antenna Theory and Design	3
EEEE-617	Microwave Circuit Design	3
EEEE-710	Advanced EM Theory	3
EEEE-797	Wireless Communication	3
Second Year		
EEEE-718	Design and Characterization	3
	Elective	3
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (integrated electronics option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-610	Analog Electronic Design	4
0301-713	Solid State Physics	4
0301-712	Advanced Field Effect Devices	4
0301-726	Mixed Signal IC Design	4
0301-711	Advanced Carrier Injector Transistors	4
0301-730	Advanced Analog IC Design	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**45-49**

Electrical engineering (integrated electronics option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-610	Analog Electronics	3
EEEE-711	Advanced Carrier-Injection Devices	3
EEEE-712	Advanced Field-Effect Devices	3
EEEE-713	Solid-State Physics	3
	Elective	3
Second Year		
EEEE-726	Mixed-Signal IC Design	3
	Elective	3
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (signal and image processing option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-887	Digital Signal Processing	4
0301-768	Adaptive Signal Processing	4
0301-779	Digital Image Processing	4
0301-749	Speech and Image Compression	4
0301-770	Pattern Recognition	4
0301-803	Digital Video Processing	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**45-49**

Electrical engineering (signal and image processing option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-678	Digital Signal Processing	3
EEEE-779	Image Processing	3
EEEE-770	Pattern Recognition	3
EEEE-780	Digital Video Processing	3
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (robotics option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-885	Principles of Robotics	4
0301-847	Artifical Intelligence Explorations	4
0301-761	Modern Control Theory	4
0301-836	Biorobotics/Cybernetics	4
0301-895	Advanced Robotics	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**45-49**

Electrical engineering (MEMS option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0301-702	Random Signals and Noise	4
0301-703	Matrix Methods in Electrical Engineering	4
0301-789	Fundamentals of MEMS	4
0301-799	Nano and Microengineering	4
0301-760	Modern Control Theory	4
0301-798	Microfluidic MEMS	4
0301-804	MEMS Evaluation	4
Choose one of the following:		
	Thesis	9
	Graduate Paper	5
Total Quarter Credit Hours		**45-49**

Admission requirements

To be considered for admission to the MS program in electrical engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in an engineering or a related field,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (GRE),
- Submit two letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Candidates with a bachelor of science degree in non-electrical engineering fields may be considered for admission, however, they may be required to undertake bridge courses to ensure they are adequately prepared for graduate studies in electrical engineering.

Additional information

Graduation requirements

The MS degree is awarded upon the successful completion of an approved graduate program consisting of a minimum of 45 quarter credit hours with a grade-point average of 3.0 or higher. Under certain circumstances, a student chooses or may be required to complete more than the minimum number of credits.

Engineering Management, ME

http://www.rit.edu/kgcoe/ise/grad/me_em.html

Michael E. Kuhl, Graduate Program Director
(585) 475-2134, mekeie@rit.edu

Program overview

The engineering management curriculum is a combination of engineering courses from the industrial and systems engineering program and management courses from the E. Philip Saunders College of Business. The program combines technical expertise with managerial skills to focus on the management of engineering and technological enterprises. Students in the engineering management program will understand the technology involved in engineering projects and the management process through which the technology is applied. The objective of the program is to provide a solid foundation in the areas commonly needed by managers who oversee engineers and engineering projects. In addition to industrial engineering expertise, students will gain valuable knowledge in areas such as organizational behavior, finance, and accounting.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Engineering management, ME degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
	ISE Courses	12
Choose one of the following:		4
0303-716	Linear Regression Analysis	
0303-758	Design of Experiments	
	Electives	12
	Business Electives	8
Second Year		
	Business Elective	4
	Elective	4
0303-779	Engineering Capstone	4
Total Quarter Credit Hours		**48**

Engineering management, ME degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-750	Systems and Project Management	3
ISEE-77i	Product and Process Design and Development	3
Choose one of the following:		3
ACCT-703	Accounting for Decision Makers	
ACCT-706	Cost Management	
ISEE-760	Design of Experiments	3
	Engineering Management Elective	3
	Elective	3
Second Year		
	Engineering Management Electives	6
	Electives	6
ISEE-792	Engineering Capstone	3
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the ME in engineering management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science,
- Have a minimum cumulative undergraduate GPA of 3.00,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Exam (GRE) (optional),
- Submit letters of recommendation,
- Submit a statement of purpose, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Langage. Minimum scores of 550 (paper-based) or 88 (Internet-based) are required.

Industrial Engineering, MS

http://www.rit.edu/kgcoe/ise/grad/ms_ie.html
Michael E. Kuhl, Graduate Program Director
(585) 475-2134, mekeie@rit.edu

Program overview

The master of science degree in industrial engineering allows students to customize their course work while working closely with industrial engineering faculty in a contemporary, applied research area. Faculty members are currently conducting applied project and research work in the areas of contemporary manufacturing processes/systems, ergonomic/biomedical analysis, logistics and supply chain management, sustainable design and development, systems engineering/product development, and systems simulation.

Curriculum

The MS degree is awarded upon successful completion of a minimum of 45 quarter credit hours of study. This includes nine courses and a 9 quarter credit hour thesis. All students are required to complete at least three quarters of Graduate Seminar (0303-800), Graduate Thesis Seminar I (0303-888), and Graduate Thesis Research Seminar II (0303-889).

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in industrial engineering will be renamed industrial and systems engineering. This change will not affect currently matriculated students.

Industrial engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
	ISE Courses	12
0303-800	Graduate Seminar	0
Choose one of the following:		4
0303-716	Linear Regression Analysis	
0303-758	Design of Experiments	
0303-888	Thesis Research Seminar I	0
0303-889	Thesis Research II	0
	Electives	20
Second Year		
0303-890	Research and Thesis	9
Total Quarter Credit Hours		**45**

Industrial and systems engineering, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-601	Systems Modeling and Optimization	3
ISEE-771	Product and Process Design and Development	3
ISEE-795	Graduate Seminar I	0
ISEE-760	Design of Experiments	3
	Elective	9
ISEE-796	Graduate Seminar II	0
Second Year		
	Electives	6
ISEE-790	Research and Thesis	6
Total Semester Credit Hours		**33**

Admission requirements

To be considered for admission to the MS in industrial engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science,
- Have a minimum cumulative undergraduate GPA of 3.00,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,

- Submit scores from the Graduate Record Exam (GRE),
- Submit letters of recommendation,
- Submit a statement of purpose, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Langage. Minimum scores of 550 (paper-based) or 213 (computer-based) are required.

Industrial Engineering, ME

http://www.rit.edu/kgcoe/ise/grad/me_ie.html
Michael E. Kuhl, Graduate Program Director
(585) 475-2134, mekeie@rit.edu

Program overview

The master of engineering in industrial engineering focuses on the design, improvement, and installation of integrated systems of people, material, information, equipment, and energy. The program emphasizes specialized knowledge and skills in the mathematical, physical, computer, and social sciences together with the principles and methods of engineering analysis and design. The overarching goal of industrial engineering is the optimization of the system, regardless of whether the activity engaged in is a manufacturing, distribution, or a service-related capacity. The student graduates with a variety of skills in the areas of applied statistics/quality, ergonomics/human factors, operations research/simulation, manufacturing, and systems engineering.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in industrial engineering will be renamed industrial and systems engineering. This change will not affect currently matriculated students.

Industrial engineering, ME degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
	ISE Courses	12
Choose one of the following:		4
0303-716	Linear Regression Analysis	
0303-758	Design of Experiments	
	Electives	20
Second Year		
	Electives	8
0303-779	Capstone	4
Total Quarter Credit Hours		**48**

Industrial and systems engineering, ME degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-601	Systems Modeling and Optimization	3
ISEE-770	Product and Process Design and Development	3
	Electives	9
ISEE-760	Design of Experiments	3
Second Year		
	Electives	12
ISEE-792	Engineering Capstone	3
Total Semester Credit Hours		**33**

Admission requirements

To be considered for admission to the ME in industrial engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science,
- Have a minimum cumulative undergraduate GPA of 3.00,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Exam (GRE) (optional),
- Submit letters of recommendation,
- Submit a statement of purpose, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Langage. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required.

Manufacturing Leadership, MS

http://www.mml.rit.edu/
Mark W. Smith, Director
(585) 475-7102, mark.smith@rit.edu
Christine Fisher, Coordinator
(585) 475-7971, mml@rit.edu

Program overview

The master of science degree in manufacturing leadership is designed for experienced professionals moving to mid- and senior-level positions in manufacturing and service organizations. The program integrates business and engineering courses, delivering them in a part-time format where students continue to work while taking classes in the evenings or online.

Manufacturing leadership is a highly focused program developed jointly by the E. Philip Saunders College of Business and the Kate Gleason College of Engineering. Particular emphasis is placed on supply chain management, global manufacturing and operations, lean thinking, leadership, and decision making. A capstone project, oriented to the solution of a manufacturing or services management problem or process improvement initiative, enables students to apply new skills and capabilities to the solution of a pressing real-world problem, with significant financial benefit to sponsors. Two electives allow for additional depth or breadth in subjects of relevance to students and their sponsoring organizations.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Manufacturing leadership, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
Choose one of the following:		4
0101-703	Accounting for Decision Makers	
0101-794	Cost Accounting in Technical Organizations	
0102-740	Organizational Behavior and Leadership	4
0303-703	Supply Chain Management	4
0303-723	Global Facilities Planning	4
0303-760	Product/Process Design and Development	4
0303-762	Systems Modeling and Decision Making	4
0303-766	Manufacturing Systems	4
0307-781	Quality Management	4
0303-784	Systems and Project Management	4
	Electives	8
0303-891	Capstone Integrative Project	4
Total Quarter Credit Hours		**48**

Manufacturing leadership, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-740	Organizational Behavior and Leadership	3
ISEE-771	Engineering of Systems I	3
ISEE-750	Systems and Project Management	3
CQAS-682	Lean Six Sigma Fundamentals	3
Choose one of the following:		3
ACCT-794	Cost Accounting in Technical Organizations	
ACCT-703	Accounting for Decision Makers	
ISEE-745	Manufacturing Systems	3
ISEE-703	Supply Chain Management	3
ISEE-723	Global Facilities Planning	3
Choose one of the following:		3
ISEE-793	MML Capstone	
ISEE-792	Engineering Capstone	
Choose one of the following:		3
	Engineering Elective	
	Non-Business elective	
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in manufacturing leadership, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent) degree from an accredited institution,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a minimum cumulative grade-point average of 2.8.
- Have at least two years of experience in a manufacturing-related organization or business environment,
- Submit two professional recommendations,
- Submit a current resume,
- Participate in a personal interview with the admissions team (after other application materials are received), and
- Complete a graduate application.

Exceptions may be considered on a case-by-case basis. No graduate entrance exam is required, although candidates are welcome to support their application with results from the Graduate Management Admission Test (GMAT) or Graduate Record Exam (GRE).

Additional information

Prerequisite knowledge

Admitted students must possess knowledge and skills at the introductory course level in probability and statistics, engineering economy or basic accounting, and manufacturing processes.

Format

Students may start the program during any quarter and complete the course work at their own pace. Classes are available on campus (evenings) or online to accommodate the needs of local students as well as those who travel or live outside the Rochester area.

Students may take up to three courses on a nonmatriculated basis. Credits earned while enrolled as a nonmatriculated student may be applied to the degree program following formal admission.

Areas that need strengthening may be addressed by guided reading, formal course work, independent study, seminars, or other suitable means.

Mechanical Engineering, MS

http://www.rit.edu/kgcoe/mechanical/grad/msme

Program overview

The master of science degree in mechanical engineering is awarded upon successful completion of an approved graduate program consisting of a minimum of 45 quarter credit hours. A minimum of 36 quarter credit hours are to be earned in course work and 9 quarter credit hours of thesis. A maximum of 9 quarter credit hours may be transferred from graduate courses taken outside the university, provided such courses complement a student's proposed graduate program in the mechanical engineering department. Upon matriculation into the MS program, the student should formulate a plan of study in consultation with his or her adviser.

Curriculum

The program includes core courses, focus area courses, elective courses, and a thesis. All full-time MS students are required to attend the weekly graduate seminar each quarter they are on campus. At least 28 quarter credit hours of graduate-level course work, including the core and focus area courses, must be taken in the mechanical engineering department. Eight quarter credit hours may be taken as upper-level undergraduate electives or as technical courses outside of the department, with prior approval. Typical out-of-department courses include advanced engineering, mathematics, and science courses.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Mechanical engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0304-870	Mathematics for Engineers I	4
0304-871	Mathematics for Engineers II*	4
	Focus Area Courses	16
	Electives	12
0304-890	Thesis	9
0304-899	Graduate Seminar	0
Total Quarter Credit Hours		**45**

* An alternative course may be approved by an adviser and/or department head.

Mechanical engineering, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MECE-601	Math I For Engineers	3
	Focus Area Courses	9
	Electives	9
MECE-602	Math II For Engineers	3
MECE-790	MSME Thesis	6
MECE-789	Graduate Seminar	0
Total Semester Credit Hours		**30**

Focus area courses

All students must develop a focus area of study, with prior approval from their adviser and the department head. The focus area should consist of at least 12 quarter credit hours of graduate study in mechanical engineering and be related to the student's technical and professional development interests. Examples of focus areas include controls, materials science, thermo/fluids, and mechanics/design.

Independent Study

A student also may earn a limited number of credits by doing an independent study with guidance from a member of the graduate faculty. Areas for independent study include selected topics in applied mathematics, analytical mechanics, nonlinear mechanics, fracture mechanics, heat transfer, fluid mechanics, thermodynamics, control systems, optimal control, thermal stresses, composite materials, and biomechanics.

Thesis

Prior to completing 20 quarter credit hours of graduate work, students should prepare and present a formal thesis proposal to their faculty adviser. An acceptable proposal (including a statement of work, extensive literature search, and proposed timeline), signed by the student and approved by their faculty adviser and department head, is required prior to registering for thesis credits. Students must form a graduate thesis committee in coordination with their adviser and present their proposal to their committee for review and approval during the first quarter in which they have registered for thesis credit. Students are required to deliver a successful written and oral presentation of their thesis.

Admission requirements

To be considered for admission to the MS program in mechanical engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in mechanical engineering or a related field,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have an GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (minimum scores of 1200 (V&Q) and 3.0 (writing) are required),
- Submit two letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS).

Mechanical Engineering, ME

http://www.rit.edu/kgcoe/mechanical/grad/mengme
Edward Hensel, Department Head
(585) 475-2162, echeme@rit.edu

Program overview

The ME in mechanical engineering is an internship program leading to the professional terminal degree of master of engineering. The capstone experience may be a course design project, a well-organized and carefully chosen industrial internship, or an independent study project in place of a conventional thesis requirement. This master's degree is particularly well-suited for students who wish to study part time, those interested in updating their technical skills, and those not focused on a research-oriented master of science thesis.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Mechanical engineering, ME degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0304-870	Mathematics for Engineers I	4
0304-865	Computer Implementation of FEM	4
0304-823	System Modeling	4
	Focus Area Courses	16
	Electives	16
0304-889	Graduate Seminar	0
Choose one of the following:		4
0304-730	Design Project Leadership	
0304-877	Internship	
0304-888	Project w/ Paper	
0304-701	Research Methods	
Total Quarter Credit Hours		**48**

Mechanical engineering, ME degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
MECE-601	Math I For Engineers	3
	Focus Area Courses	16
	Electives	16
MECE-602	Math II For Engineers	3
Choose one of the following:		3
MECE-730	Design Project Leadership	
MECE-777	Internship	
MECE-788	Project with Paper	
MECE-701	Research Methods	
MECE-789	Graduate Seminar	0
Total Semester Credit Hours		**30**

The program, although rooted in engineering, is significantly interdisciplinary by design. The program may range over several colleges in the university, assembling courses that will best help students meet their professional objectives.

At least 32 quarter credit hours of graduate-level course work, including core courses, must be taken in the mechanical engineering department. Some possible concentration areas are business, print media, controls, manufacturing, materials science, thermo/fluids, and design engineering. A minimum of 48 quarter credit hours are required for the degree. Students may complete the program as a course-only program of study, with a capstone design project in a graduate elective course. Students may choose to complete a three-month industrial internship or a project that includes a paper (both worth 4 quarter credits) as one of their elective courses.

Focus areas

COURSE		QUARTER CREDIT HOURS
Automotive systems		
Choose four of the following:		
0304-623	Powertrain Systems and Design	4
0304-624	Vehicle Dynamics	4
0304-643	Continuous Control Systems	4
0304-710	Fuel Cell Technology	4
0304-752	Tribology Fundamentals	4
0304-758	Intermediate Engineering Vibrations	4
Business		
0101-701	Financial Accounting Systems	4
0102-740	Organizational Behavior and Leadership	4
Choose two of the following:		4
0101-706	Cost Accounting	4
0102-742	Technology Management	4
0113-730	Managing in a Global Environment	4
Controls		
0304-643	Introduction to Control Systems	4
0304-743	Intermediate Control Systems	4
0304-843	Advanced Control Systems	4
Mechanics and design		
Choose four of the following:		
0304-720	Introduction to Optimal Design	4
0303-885	Mechanics of Solids	4
0304-752	Tribology Fundamentals	4
0304-754	Fundamentals of Fatigue and Fracture Mechanics	4
Sustainability		
Choose four of the following:		
0304-710	Fuel Cell Technology	4
0304-723	Renewable Energy Systems	4
0304-733	Sustainable Energy Management	4
0303-790	Fundamentals of Sustainable Engineering	4
0303-791	Life Cycle Assessment	4
0303-792	Design for the Environment	4
Thermo/Fluids engineering		
Choose four of the following:		
0304-830	Introduction to CFD Analysis	4
0304-838	Ideal Flows	4
0304-831	CFD Applications	4
0304-851	Convective Phenomena	4
0304-756	Aerosols in the Respiratory Tract	4
Vibrations engineering		
0304-658	Introduction to Engineering Vibrations	4
0304-758	Intermediate Engineering Vibrations	4
0304-840	Signal Processing	4
0304-871	Mathematics for Engineers II	4

COURSE		SEMESTER CREDIT HOURS
Automotive systems		
Choose three of the following:		
MECE-623	Powertrain Systems and Design	3
MECE-624	Vehicle Dynamics	3
MECE-643	Continuous Control Systems	3
MECE-710	Fuel Cell Technology	3
MECE-752	Tribology Fundamentals	3
MECE-758	Intermediate Engineering Vibrations	3
Business		
ACCT-703	Accounting for Decision Makers	3
MGMT-740	Organizational Behavior and Leadership	3
Choose one of the following:		3
ACCT-706	Cost Accounting	3
MGMT-742	Technology Management	3
INTB-730	Managing in a Global Environment	3
MGMT-761	Managing Research and Innovation	3
Controls		
MECE-643	Continuous Control Systems	3
MECE-743	Digital Control Systems	3
MECE-744	Nonlinear Control Systems	3
Materials science		
MECE-644	Introduction to Composite Materials	3
MECE-746	Engineering Properties of Materials	3
MECE-754	Fundamentals of Fatigue and Fracture Mechanics	3
Mechanics and design		
Choose three of the following:		
MECE-620	Introduction to Optimal Design	3
MECE-785	Mechanics of Solids	3
MECE-752	Tribology Fundamentals	3
MECE-754	Fundamentals of Fatigue and Fracture Mechanics	3
Product development		
Choose three of the following:		
0303-786	Engineering Systems I	3
0303-788	Engineering Systems II	3
0303-784	Systems and Project Management	3
0303-751	Engineering Risk/Benefit Analysis	3
Sustainability		
Choose three of the following:		
MECE-710	Fuel Cell Technology	3
MECE-729	Renewable Energy Systems	3
MECE-733	Sustainable Energy Management	3
MECE-739	Alternative Fuels and Energy Efficiency	3
ISEE-785	Fundamentals of Sustainable Engineering	3
ISEE-786	Life Cycle Assessment	3
ISEE-787	Design for the Environment	3
Thermo/Fluids engineering		
Choose three of the following:		
MECE-731	Computational Fluid Dynamics	3
MECE-738	Ideal Flows	3
MECE-751	Convective Phenomena	3
MECE-656	Biological Applications of Fluids	3
Vibrations engineering		
MECE-658	Introduction to Engineering Vibrations	3
MECE-758	Intermediate Engineering Vibrations	3
EEEE-778	Digital Signal Processing	3

Admission requirements

To be considered for admission to the ME program in mechanical engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in mechanical engineering, physics, or a related field,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher,
- Submit two letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS).

Microelectronic Engineering, MS

http://www.rit.edu/kgcoe/eme/mems
Robert Pearson, Program Director
(585) 475-2923, repemc@rit.edu

Program overview

The objective of the master of science program in microelectronic engineering is to provide an opportunity for students to perform graduate-level research as they prepare for entry into the semiconductor industry or a doctoral program. The program requires strong preparation in the area of microelectronics and requires a thesis.

Program outcomes

The program has a number of outcomes for its students:

- Understand the fundamental scientific principles governing solid-state devices and their incorporation into modern integrated circuits.
- Understand the relevance of a process or device, either proposed or existing, to current manufacturing practices.
- Develop in-depth knowledge in existing or emerging areas of the field of microelectronics, such as device engineering, circuit design, lithography, materials and processes, and yield and manufacturing.
- Apply microelectronic processing techniques to the creation/investigation of new process/device structures.
- Communicate technical material effectively through oral presentations, written reports, and publications.

The prerequisites include a bachelor of science degree in engineering (such as electrical or microelectronic engineering), including an introductory course in device physics. Students who do not have these prerequisites can take courses during their first quarter of study and still complete the MS program in two years. Prerequisite courses do not count toward the graduate courses required for the MS degree.

Curriculum

The program consists of eight graduate courses (700-level or higher), including seven core courses and one elective course for students with a BS degree in a discipline other than microelectronic engineering. Five core courses and three elective courses are required for students with a BS in microelectronic engineering from RIT. In addition, all students are required to take a variable-credit (1 or 0 quarter credit hour) seminar/research course each quarter they are enrolled in the program. Up to 4 quarter credit hours will be allowed toward the required 36 quarter credit hours. A 9 quarter credit hour thesis, which includes an oral defense, is required of all students. The total number of credits needed for the MS in microelectronic engineering is 45 quarter credit hours.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Microelectronic engineering, MS degree†, typical course schedule (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0305-560	Transition Semiconductor Devices II	4‡
0305-701	Microelectronics I, Lab	4
0305-721	Microlithography Materials and Processes, Lab	4
0305-801	Seminar/Research§	1-4
0305-702	Microelectronics II, Lab	4
0305-731	Microelectronics Manufacturing I, Lab	4
	Full Time Equivalency*	3
0305-703	Microelectronics III, Lab	4
	Elective	4
	Full Time Equivalency*	3
	Research	
Second Year		
0305-705	Quantum and Solid State Physics for Nanostructures	4
0305-801	Seminar/Research§	1-4
	Full-time Equivalency*	
0301-712	Physics and Scaling of CMOS	4
0305-704	Semiconductor Process and Device Modeling	4
0305-899	Thesis	10
	Full-time Equivalency*	9
Total Quarter Credit Hours		**45**

* A full-time equivalency form must be completed for each quarter of the academic year for which the form is requested.
† For those students who do not have an undergraduate degree in microelectronic engineering from RIT. Those students who do have an undergraduate degree in microelectronic engineering from RIT will develop a custom course of study with their graduate adviser, including 0305-704, 705, and 712.
‡ This course's quarter credit hours are not counted toward the 48 required of the program.
§ A maximum of 4 quarter credit hours are available for Seminar/Research (0305-801).

Microelectronic engineering, MS degree†, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MCEE-601	Microelectronic Fabrication	3
MCEE-605	Lithographic Materials and Processes	3
MCEE -603	Thin Films	3
MCEE-795	Microelectronics Research Methods	1
MCEE-732	Microelectronic Man.	3
MCEE-602	VLS Process Modeling	3
	Graduate Elective*	3
MCEE-795	Microelectronics Research Methods	1
Second Year		
MCEE-704	Physical Modeling of Semiconductor Devices	3
	Graduate Elective*	3
MCEE-790	MS Thesis	6
MCEE-795	Microelectronics Research Methods	1
Total Semester Credit Hours		**33**

* With adviser approval.
† For students who do not have an undergraduate degree in microeletronic engineering from RIT. Students who do have an undergraduate degree in microelectronic engineering from RIT will develop a custom course of study with their graduate adviser.

Thesis

A thesis is required and normally is undertaken once the student has completed all course requirements. Planning for the thesis, however, should begin as early as possible. Generally, full-time students should complete their degree requirements, including thesis defense, within two years (six academic quarters and one summer quarter) from the date of entry.

Admission requirements

To be considered for admission to the MS program in microelectronic engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in engineering or a related field,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (RIT graduates exempt),
- Submit two letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Candidates applying with a bachelor's degree in non-electrical or non-microelectronic engineering fields may be considered for admission; however, they may be required to take additional bridge courses to ensure they are adequately prepared for graduate study.

Microelectronics Manufacturing Engineering, ME

http://www.rit.edu/kgcoe/eme/meme
Robert Pearson, Program Director
(585) 475-2923, repemc@rit.edu

Program overview

The master of engineering degree in microelectronics manufacturing engineering provides a broad-based education to students with a bachelor's degree in traditional engineering or science disciplines who are interested in a career in the semiconductor industry.

The ME degree is awarded upon successful completion of an approved graduate program consisting of a minimum of 45 quarter credit hours. The program consists of one transition course, seven core courses, two approved elective courses, and a minimum of 5 quarter credit hours of internship. Under certain circumstances, a student may be required to complete more than the minimum number of credits. The transition course is in an area other than that in which the BS degree was earned.

Program outcomes

After completion of the program, a student will be able to:

- Design and understand a sequence of processing steps to fabricate a solid state device to meet a set of geometric, electrical and/or processing parameters.
- Analyze experimental electrical data from a solid state device to extract performance parameters for comparison to modeling parameters used in the device design.
- Understand current lithographic materials, processes, and systems to meet imaging and/or device patterning requirements.
- Understand the relevance of a process or device, either proposed or existing, to current manufacturing practices.
- Perform in a microelectronic engineering environment, as evidenced by a three-month internship.
- Appreciate the areas of specialty in the field of microelectronics, such as device engineering, circuit design, lithography, materials and processes, and yield and manufacturing.

Curriculum

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Microelectronics manufacturing engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0305-701	Microelectronics I, Lab	4
0305-721	Microlithography Materials and Processes, Lab	4
	Transition Course	4
0305-702	Microelectronics II, Lab	4
0305-731	Microelectronics Manufacturing I, Lab	4
	Elective 1, 2	8
0305-703	Microelectronics III, Lab	4
0305-722	Microlithography Systems, Lab	4
0305-732	Microelectronics Manufacturing II, Lab	4
	Internship	5
Total Quarter Credit Hours		**45**

Microelectronics manufacturing engineering, ME degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MCEE-601	Microelectronic Fabrication	3
MCEE-605	Lithographic Materials and Processes	3
MCEE -603	Thin Films	3
MCEE-xxx	Graduate Elective	3
MCEE-795	Microelectronics Research Methods	1
MCEE -732	Evaluation of Microelectronic Manufacturing	3
MCEE-602	VLS Process Modeling	3
MCEE-615	Nanolithography Systems	3
MCEE-xxx	Graduate Elective	3
MCEE-795	Microelectronics Research Methods	1
MCEE-794	Microelectronic Engineering Internship	4
Total Semester Credit Hours		**30**

Microelectronics

The Microelectronics I, II, and III course sequence (0305-701, 702, 703) covers major aspects of integrated circuit manufacturing technology, such as oxidation, diffusion, ion implantation, chemical vapor deposition, metalization, plasma etching, etc. These courses emphasize modeling and simulation techniques as well as hands-on laboratory verification of these processes. Students use special software tools for these processes. In the laboratory, students design and fabricate silicon MOS and bipolar integrated circuits, learn how to utilize most of the semiconductor processing equipment, develop and create a process, and manufacture and test their own integrated circuits.

Microlithography

The microlithography courses are advanced courses in the chemistry, physics, and processing involved in microlithography. Optical lithography will be studied through diffraction, Fourier, and image-assessment techniques. Scalar diffraction models will be utilized to simulate aerial image formation and influences of imaging parameters. Positive and negative resist systems as well as processes for IC application will be studied. Advanced topics will include chemically amplified resists; multiple-layer resist systems; phase-shift masks; and electron beam, X-ray, and deep UV lithography.

Laboratory exercises include projection-system design, resist-materials characterization, process optimization, and electron-beam lithography.

Manufacturing

The manufacturing courses include topics such as scheduling, work-in-progress tracking, costing, inventory control, capital budgeting, productivity measures, and personnel management. Concepts of quality and statistical process control are introduced. The laboratory for this course is the student-run factory functioning within the department. Important issues such as measurement of yield, defect density, wafer mapping, control charts, and other manufacturing measurement tools are examined in lectures and through laboratory work. Computer-integrated manufacturing also is studied in detail. Process modeling, simulation, direct control, computer networking, database systems, linking application programs, facility monitoring, expert systems applications for diagnosis and training, and robotics are supported by laboratory experiences in the integrated circuit factory. An online version of this program exists for engineers employed in the semiconductor industry. Please refer to RIT's Online Guide for details.

Internship

The program requires a 5 quarter credit hour internship, which is equivalent to at least three months of full-time, successful employment in the semiconductor industry. The internship provides a structured and supervised work experience that enables students to gain job-related skills that assist them in achieving their desired career goals.

Students with prior engineering-related job experience may request "credit by experience." This request must be made with the department head and supported by a letter from the appropriate authority substantiating the student's job responsibility, duration, and performance quality.

For students who are not working in the semiconductor industry while enrolled in this program, the internship can be completed at RIT. It involves an investigation or study of a subject or process directly related to microelectronic engineering under the supervision of a faculty adviser. An internship may be taken any time after the completion of the first quarter, must total at least 5 quarter credit hours, and may be designed in a number of ways. For example, one 5 quarter credit hour internship (typically a three-month, full-time work experience), five 1 quarter credit hour experiences, or any combination of separate credits interspersed throughout the graduate program may be used, as long as the total is the equivalent of three months of work. In these cases, full graduate tuition is charged. At the conclusion of the internship, submission of a final internship report to the faculty adviser and program director is required.

Microsystems Engineering, Ph.D.

http://www.rit.edu/kgcoe/grad/phd
Bruce Smith, Director
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Program overview

The multidisciplinary doctorate degree in microsystems engineering builds on the fundamentals of traditional engineering and science combined with curriculum and research activities addressing the numerous technical challenges of micro- and nano-systems. These include the manipulation of electrical, photonic, optical, mechanical, chemical, and biological functionality to process, sense, and interface with the world at a nanometer scale. The goal of the program is to provide a foundation to explore future technology through research in nano-engineering, design methods, and technologies and their integration into micro- and nano-scaled systems. Some of the program's areas of exploration include:

- Scaling-driven nanoelectronics, including new materials, techniques, and architectures for next generation semiconductor devices innovations in device patterning and nanolithography new materials research including germanium, III-V materials, carbon nanotubes, and spintronics
- MEMS (micro-electro-mechanical systems), MEOMS (micro-electro-optical-mechanical systems) and NEMS (nano-electro-mechanical systems) device, processing and materials research for smart sensors, actuators, biochips, and micro-implantable appliances
- Photonics and nanophotonics imaging, communications, and sensing research including couplers, micro-lasers, microdetectors, integrated silicon waveguides, silicon spectrometers, and biosensors
- Photovoltaic research in silicon, organic, and stacked solar cells and thermophotovoltaics
- Scaled micro- and nano- electronics for integration into biomedical systems
- New and improved technologies in organic electronic components and devices
- Microfluidics research on the behavior, control, and manipulation of fluids at the micro-scale

Mission

The program fulfills a critical need for an expanded knowledge base and expertise in the innovation, design, fabrication, and application of micro- and nano-scale devices, components, and systems. RIT is becoming an internationally recognized leader in education, research, and economic development in the fields of microsystems and nanoscale engineering.

The curriculum of this multidisciplinary program is structured to provide each student with a sound background and a thorough foundation in engineering and science. The curriculum provides world-class education through the innovative application of educational technologies and partnerships.

Program highlights

The program is designed for students with a strong background in engineering and the physical sciences, and with an interest in hands on exploration into new fields of micro- and nano-systems.

- The program has a world-renowned, multidisciplinary faculty that shares resources and expertise ranging from nanoelectronics to nanopower research to MEMS and NEMS. The program is administered by core faculty from RIT's colleges of engineering and science.
- Unique state-of-the art research laboratories have been designed to provide a focus for microsystems and nanoscale engineering research across traditional disciplinary boundaries. An industrial scale semiconductor and microsystems clean-room is at the heart of the research facilities, providing students access to the most advanced micro- and nano-electronic processing capabilities.
- Students explore applications of microsystems and nanotechnology through close collaboration with industry and government laboratories.

• Graduates from the program have discovered exciting opportunities in new technology frontiers.

Curriculum

A total of 99 quarter credit hours of combined graduate course work and research are required for completion of the program. This includes a minimum of 60 quarter credit hours of course work and a minimum of 27 quarter credit hours of research toward the dissertation. The course work requires a combination of 16 quarter credit hours of foundation courses, 36 quarter credit hours of major and minor technical area courses, and 8 quarter credit hours of elective courses. The student must pass the Comprehensive Exam, the Qualifying Exam, the Candidacy Exam, and the Dissertation Defense Exam for completion of degree requirements.

Phase 1: The first phase prepares students with a foundation in science and engineering and determines the student's ability to conduct independent research. This includes foundation and specialization courses taken during the first year together with the successful completion of the Comprehensive Exam. The Comprehensive Exam tests the student's ability to think and learn independently, to critically evaluate current research work in a field of microsystems engineering, and to use good judgment and creativity to determine appropriate directions for future research work.

Phase 2: The second phase consists of course work in the program of study along with preliminary research. Much of this course work will support the dissertation research to be conducted in the third phase. This second phase is completed when the student has finished most of the formal course work as prescribed in the program of study, has prepared the Dissertation Proposal, and has passed the Qualifying Examination.

Phase 3: The third phase consists of the completion of the experimental and/or theoretical work needed to complete the student's dissertation along with the required publication of results. The Candidacy Exam is taken and a defense of the dissertation is completed. The defense consists of a public oral presentation and examination.

The course work requirements for the doctorate are divided into four parts to ensure that students complete a well-rounded program of study with the necessary concentration in their specialized field.

Foundation courses

Students complete the following foundation courses: Microelectronics I (0305-701), Introduction to Nanotechnology and Microsystems (0308-702), Material Science for Microsystems Engineering (0308-703), and Introduction to Theoretical Methods (1028-704).

Major technical interest area

Students will complete a sequence of three courses (12 quarter credit hours) in the major technical research area and a sequence of two courses (8 quarter credit hours) in a support area.

Minor technical interest areas

Two course sequences in each minor technical area are completed. At least one sequence must be outside of the student's undergraduate degree major.

General course requirements

The total number of credit hours taken toward the doctorate depends upon the highest degree completed by the student before entering the program. Students entering the program without prior graduate work must complete a minimum of 60 quarter credit hours of course work as outlined. The course work should consist primarily of graduate level (700 and 800) courses with no more than three upper level undergraduate (600) courses.

Students entering the program with a master's degree may be permitted to use up to 32 quarter credit hours toward the minimum 60 quarter credit hours of course work required for the degree, based on the approval of the program director.

All students are required to maintain a cumulative grade-point average of 3.0 (on a 4.0 scale) to remain in good standing in the program.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Microsystems engineering, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0305-701	Microelectronics	4
0308-702	Introduction to Nantechnology and Microsystems	4
0308-703	Material Science for Microsystems Engineering	4
1028-704	Introduction to Theroetical Methods	4
	Major Technical Interest Area Elective 1, 2, 3	12
	Major Technical Interest Support Area Course 1, 2	8
	Minor Technical Interest Area Course 1, 2, 3	12
Second Year		
	Minor Technical Interest Area Course 4	4
	Electives	8
	Research and Dissertation	9
Third Year		
	Research and Dissertation	9
Fourth Year		
	Research and Dissertation	9
Total Quarter Credit Hours*		**99**

* Total quarter credit hours will depend on the highest degree completed by the student before entering the program and how many courses from previously completed graduate course work can be counted toward the program.

Microsystems engineering, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MCSE-702	Introduction to Nanotechnology and Microsystems	3
MCEE-601	Microelectronics I	3
	Major Technical Area Elective A	3
MCSE-703	Material Science for Microsystems Engineering	3
MTSE-704	Theoretical Methods in Materials Science and Engineering	3
	Major Technical Area Elective A	3
Second Year		
	Major Technical Area Elective A	3
	Minor Technical Area Elective	3
MCSE-890	Doctoral Dissertation (Research and Thesis)	1
	Minor Technical Area Elective	3
	Technical Elective	3
MCSE-890	Doctoral Dissertation (Research and Thesis)	1
Third Year		
	Technical Elective	3
	Major Technical Area Elective B	3
MCSE-890	Doctoral Dissertation (Research and Thesis)	2
MCSE-890	Doctoral Dissertation (Research and Thesis)	5
	Major Technical Area Elective B	3
Fourth Year		
MCSE-890	Doctoral Dissertation (Research and Thesis)	6
MCSE-890	Doctoral Dissertation (Research and Thesis)	12
Total Semester Credit Hours		**66**

Examples of course sequences

COURSE	
MEMS	
0308-786	MEMS Design
0308-811	Microsystems Design and Packaging
Microelectronics	
0305-702	Microelectronics II, Lab
0305-703	Microelectronics III, Lab
0305-707	Nanoscale CMOS and Beyond
Nanopatterning	
0305-721	Microlithography Materials, Lab
0305-722	Microlithography Systems, Lab
1051-733	Optics
Electronics	
0301-726	Mixed Signal IC Design
0301-730	Advanced Analog IC Design
0301-814	RF Integrated Circuit Design
Photonics	
0308-721	Micro-optics
0308-831	Micro and Nano-Photonics
0308-841	Advanced Micro-Photonics
Microfluidics	
0301-798	Microfluidic MEMS
0304-847	Microscale Heat and Mass Transfer

Advising
Doctoral students' work is overseen by an adviser, the advisory committee, and the program's director.

Program of study
Based on the requirements of the program, students should prepare a program of study after passing the Comprehensive Exam and no later than the winter quarter of the second year. The program of study should be reviewed periodically by the student and the adviser, and modifications should be made as necessary. Upon completion of the Qualifying and Candidacy exams, the student's adviser and advisory committee may add additional course work requirements so that the student is sufficiently prepared to carry out and complete their dissertation research.

Comprehensive examination
Every student enrolled in the program must take the Comprehensive Examination, which tests student's ability to think and learn independently, to critically evaluate current research work in the field of microsystems engineering, and to use good judgment and creativity to determine appropriate directions for future research work. The exam must be completed successfully before a student can submit a thesis proposal and attempt the Qualifying Examination.

Research proposal
A research topic chosen by the student and his or her research adviser becomes the basis for the dissertation. The research proposal sets forth both the exact nature of the matter to be investigated and a detailed account of the methods to be employed. In addition, the proposal usually contains material supporting the importance of the topic selected and the appropriateness of the research methods to be employed.

Qualifying examination
The Qualifying Examination is an oral examination based on the dissertation research proposal and allows the advising committee to judge the student's ability to execute a research task and to communicate the results. The exam also serves to evaluate the proposed topic to ensure that if completed as posed it constitutes an original contribution to knowledge.

Candidacy exam
The Candidacy Exam is administered by the student's adviser and the advisory committee between the time the student passes the Qualifying Exam and registers for the Dissertation Defense. This normally occurs approximately six months prior to the dissertation defense.

Dissertation exam
The culmination of a student's work toward the doctorate degree is the publication of their research. In addition to developing experimental and technical skills during the creation of research, a student needs to acquire the necessary literary skills to communicate results to others. The preparation of the proposal and the dissertation manuscripts will demonstrate these skills. It is also expected that these skills are developed through the publication of technical papers and communications. The dissertation defense and examination is scheduled after all course requirements for the degree have been successfully completed.

Admission requirements
To be considered for admission to the doctorate program in microsystems engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in the physical sciences or engineering,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have an undergraduate GPA of 3.0 or higher, or a graduate GPA of 3.5 or higher,
- Submit scores from the Graduate Record Exam (GRE). Minimum scores of 1200 (V&Q) and 3.0 (writing) are required,
- Submit three letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Product Development, MS

http://www.mpd.rit.edu/
Mark W. Smith, Director
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Christine Fisher, Graduate Program Director
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Program overview
Product innovation is essential to business survival and growth. The creation and introduction of new products and services has reached an unprecedented level of complexity, requiring the coordination of diverse teams of professionals from research and development, marketing, finance, manufacturing, procurement, sales, and service. Companies, especially technology-based organizations, need leaders with an enterprise-wide perspective and knowledge base in both engineering and management. This includes individuals who possess a broad blend of technical and business skills, understand markets and the value-chain, and have the integrated

systems perspective needed to commercialize increasingly complex products and systems. The master of science degree in product development provides the educational foundation that technical professionals need for high-impact roles in product and technology innovation.

The program is for engineers, scientists, and technical professionals who aspire to product development leadership positions throughout their organizations. Designed by academic and industry leaders, the curriculum integrates business and technical elements to develop leaders with the knowledge, skills, behaviors, and perspective to effectively deploy best-in-class product development methods, tools, and practices. The program integrates formal education, ongoing research, and industrial practice, and continuously refreshes the curriculum through active partnerships with other world-class universities, research centers, and companies.

Students acquire the foundation skills and strategic perspective necessary to become future leaders and senior managers responsible for driving business growth through product innovation. They develop receptiveness to change and continuous improvement, an understanding of the enablers to business success, and an enhanced ability to recognize barriers to success early in the commercialization cycle, when corrective actions are least costly.

Curriculum

This is a 60 quarter credit hour program consisting of business and engineering courses (10 required courses and three electives) plus a capstone project (8 quarter credit hours).

Elective courses

Elective courses afford the opportunity for students to tailor the program to better meet personal and organizational needs. Three elective courses (12 quarter credit hours) are required. At least one elective must be from business and one from engineering. Recommended electives may include such courses as Managing Research and Innovation, Product Development in the Extended Enterprise, New Venture Creation, Supply Chain Management, Sustainable Design, and Advanced Topics in Product Development, among others.

Capstone project

Students must successfully complete a capstone project (8 quarter credit hours) during the final nine months of the program, based on a real-world problem often identified in the companies where they work. The corporate-oriented capstone project encompasses the broad integrative aspects of new product development. It synthesizes, increases, and demonstrates the student's understanding and knowledge of previous program material and underscores the behaviors essential to product development leadership. The capstone project provides immediate benefits to sponsoring organizations and is an excellent opportunity for students to gain visibility and recognition. See the program website for descriptions of previous projects.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Product development, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0303-780	Excellence in Product Development	4
0303-784	Systems and Project Management	4
0303-786	Engineering of Systems I	4
0303-788	Engineering of Systems II	4
0101-703	Accounting for Decision Makers	4
0102-740	Organizational Behavior and Leadership	4
0105-761	Marketing Concepts	4
0303-764	Operations and Manufacturing Systems	4
0303-785	Decision and Risk Benefit Analysis	4
0303-787	Systems Optimization	4
	Electives	12
	Capstone Project	8
Total Quarter Credit Hours		**60**

Product development, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-781	Excellence in New Product Development	3
ISEE-771	Engineering of Systems I	3
ISEE-772	Engineering of Systems II	3
ISEE-751	Decision and Risk Benefit Analysis	3
ACCT-703	Accounting for Decision Makers	3
ISEE-750	Systems and Project Management	3
Second Year		
MKTG-761	Marketing Concepts and Commercialization	3
DECS-743	Operations and Supply Chain Management	3
	Engineering or Business Elective	3
ISEE-797	MPD Capstone I	3
	Engineering Elective	3
ISEE-798	MPD Capstone II	3
Total Semester Credit Hours		**36**

Admission requirements

To be considered for admission to the MS program in product development, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, or a related scientific or technical field,
- Have a minimum GPA of 3.0,
- Have at least five years of experience related to product development (exceptions may be considered on a case-by-case basis),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit at least one letter of recommendation from a current or recent supervisor,
- Submit a current resume,
- Participate in a personal interview with the admissions team (after other application materials are received), and
- Complete a graduate application.

No graduate entrance exam is required, although candidates are welcome to support their application with results from the Graduate Management Admission Test (GMAT) or the Graduate Record Exam (GRE).

All application materials are available from the Office of Graduate Enrollment Services or the program office.

Additional information

Sponsorship

Most students are sponsored by an employer who is committed to improving leadership capabilities in product development. Sponsorship includes permitting students to attend classes and also involves a commitment to work with the student to provide clear expectations and well-articulated career development plans that build upon the program. Candidates are welcome to sponsor themselves. Contact the Office of Financial Aid and Scholarship for information.

Format

Students may start the program during any quarter and complete the course work at their own pace. Classes are available on campus (evenings) and online to accommodate the needs of local students as well as those who travel or who live outside the Rochester area.

Sustainable Engineering, MS

Brian Thorn, Graduate Program Director
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Program overview

Sustainable engineering refers to the integration of social, environmental, and economic considerations into product, process, and energy system design methods. Additionally, sustainable engineering encourages the consideration of the complete product and process lifecycle during the design effort. The intent is to minimize environmental impacts across the entire lifecycle while simultaneously maximizing the benefits to social and economic stakeholders. The MS program in sustainable engineering is multidisciplinary and managed by the industrial and systems engineering department.

The program builds on RIT's work in sustainability research and education and offers students the flexibility to develop tracks in areas such as renewable energy systems, systems modeling and analysis, product design, and engineering policy and management. The program is offered on campus, and available on a full- or part-time basis.

Educational objectives

The program is designed to accomplish the following educational objectives:

- Heightened awareness of issues in areas of sustainability (e.g., global warming, ozone layer depletion, deforestation, pollution, ethical issues, fair trade, gender equity, etc.).
- Clear understanding of the role and impacts of various aspects of engineering (design, technology, etc.) and engineering decisions on environmental, societal, and economic problems. Particular emphasis is placed on the potential trade-offs between environmental, social, and economic objectives.
- Strong ability to apply engineering and decision-making tools and methodologies to sustainability-related problems.
- Demonstrated capacity to distinguish professional and ethical responsibilities associated with the practice of engineering.

Curriculum

Technical in nature, the program will equip engineers with the tools they need to meet the challenges associated with delivering goods, energy, and services through sustainable means. In addition to basic course work in engineering and classes in public policy and environmental management, students are required to complete a capstone project or thesis directly related to sustainable design challenges impacting society. Many of these projects can be incorporated into sustainable research by RIT faculty in the areas of fuel-cell development, life-cycle engineering, and sustainable process implementation.

Students must successfully complete a total of 45 quarter credit hours of course work, participate in three quarters of the seminar series, and complete a thesis. This research-oriented program is designed to be completed in two years.

Core Courses

Students complete five required core courses.

Engineering electives

Students select two graduate engineering electives in an area of interest such as energy, modeling, manufacturing and materials, transportation and logistics, and product design and development.

Contextual electives

Students choose one elective from each of the following groups.

Social context:

- Energy Policy
- Technical Innovation and Public Policy
- Managing for Environmental Sustainability

Environmental technology:

- Resource Reduction
- Product Stewardship
- Industrial Waste Water Management
- Air Emissions
- Solid and Hazardous Waste Management

Sustainable engineering seminars

Three quarters of graduate seminars in sustainable engineering.

Thesis

Students complete a 9 quarter credit hour thesis.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Sustainable engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0303-760	Product and Process Design and Development	4
0303-790	Fundamentals of Sustainable Engineering	4
0303-791	Life Cycle Assessment and Costing	4
0303-792	Design for the Environment	4
0304-729	Renewable Energy Systems	4
	Engineering Electives	8
	Contextual Electives	8
	Sustainable Engineering Seminar	0
	Thesis	9
Total Quarter Credit Hours		**45**

Sustainable engineering, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-785	Fundamentals of Sustainable Engineering	3
ISEE-771	Product and Process Design and Development	3
MECE-729	Renewable Energy Systems	3
ISEE-795	Graduate Seminar	0
ISEE-786	Lifecycle Assessment	3
ISEE-787	Design for the Environment	3
	Engineering Elective	3
ISEE-796	Graduate Seminar	0
Second Year		
	Engineering Elective	3
	Social Context or Technology Elective	3
ISEE-790	Research and Thesis	3
	Technology or Social Context Elective	3
ISEE-790	Research and Thesis	3
Total Semester Credit Hours		**33**

Admission requirements

To be considered for admission to the MS program in sustainable engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in engineering, mathematics, or science,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (GRE),
- Submit a statement of purpose,

- Submit three letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Applicants who have a bachelor's degree in a field outside of engineering may be considered for admission; however, additional bridge course work may be required before full admission into the program.

Sustainable Engineering, ME

Brian Thorn, Graduate Program Director
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Program overview

Sustainable engineering refers to the integration of social, environmental, and economic considerations into product, process, and energy system design methods. Additionally, sustainable engineering encourages the consideration of the complete product and process lifecycle during the design effort. The intent is to minimize environmental impacts across the entire lifecycle while simultaneously maximizing the benefits to social and economic stakeholders. The master of engineering program in sustainable engineering is multidisciplinary and managed by the industrial and systems engineering department.

The program builds on RIT's work in sustainability research and education, and offers students the flexibility to develop tracks in areas such as renewable energy systems, systems modeling and analysis, product design, and engineering policy and management. The program is offered on campus, and available on a full- or part-time basis.

Educational objectives

The program is designed to accomplish the following educational objectives:

- Heightened awareness of issues in areas of sustainability (e.g., global warming, ozone layer depletion, deforestation, pollution, ethical issues, fair trade, gender equity, etc.).
- Clear understanding of the role and impacts of various aspects of engineering (design, technology, etc.) and engineering decisions on environmental, societal, and economic problems. Particular emphasis is placed on the potential trade-offs between environmental, social, and economic objectives.
- Strong ability to apply engineering and decision-making tools and methodologies to sustainability-related problems.
- Demonstrated capacity to distinguish professional and ethical responsibilities associated with the practice of engineering.

Curriculum

Technical in nature, the program will equip engineers with the tools they need to meet the challenges associated with delivering goods, energy, and services through sustainable means. In addition to basic course work in engineering and classes in public policy and environmental management, students are required to complete a capstone project or thesis directly related to sustainable design challenges impacting society. Many of these projects can be incorporated into sustainable research by RIT faculty in the areas of fuel-cell development, life-cycle engineering, and sustainable process implementation.

Students must successfully complete a total of 48 quarter credit hours through course work, participate in three quarters of the seminar series, and complete a capstone project. This program is designed to be completed in one year (three quarters). The curriculum includes the following:

Core

Five required core courses.

Engineering electives

Graduate courses in an area of interest such as energy, modeling, manufacturing and materials, transportation and logistics, and product design and development.

Contextual electives

One elective from each of the following groups.

Social context:

- Energy Policy
- Technical Innovation and Public Policy
- Managing for Environmental Sustainability

Environmental technology:

- Resource Reduction
- Product Stewardship
- Industrial Waste Water Management
- Air Emissions
- Solid and Hazardous Waste Management

Sustainable engineering seminars

Three quarters of graduate seminars in sustainable engineering.

Capstone project

Applications in Sustainable Engineering

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Sustainable engineering, ME degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0303-760	Product and Process Design and Development	4
0303-790	Fundamentals of Sustainable Engineering	4
0303-791	Life Cycle Assessment and Costing	4
0303-792	Design for the Environment	4
0304-729	Renewable Energy Systems	4
	Engineering Electives	16
	Contextual Electives	8
	Sustainable Engineering Seminars	0
	Capstone Project	4
Total Quarter Credit Hours		**48**

Sustainable engineering, ME degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-785	Fundamentals of Sustainable Engineering	3
ISEE-771	Engineering of Systems I	3
MECE-729	Renewable Energy Systems	3
ISEE-795	Graduate Seminar	0
ISEE-786	Lifecycle Assessment	3
ISEE-787	Design for the Environment	3
	Engineering Elective	3
ISEE-795	Graduate Seminar	0
Second Year		
	Engineering Electives	9
	Social Context Elective	3
	Technology Elective	3
ISEE-792	Engineering Capstone	3
Total Semester Credit Hours		**36**

Admission requirements

To be considered for admission to the ME program in sustainable engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university in engineering, mathematics, or science,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher,
- Submit scores from the Graduate Record Exam (GRE),
- Submit a statement of purpose,
- Submit three letters of reference from individuals well qualified to judge the candidate's ability for graduate study, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Applicants who have a bachelor's degree in a field outside of engineering may be considered for admission, however, additional bridge course work may be required before full admission into the program.

Systems Engineering, ME

http://www.rit.edu/kgcoe/ise/grad/me_se.html
Michael E. Kuhl, Graduate Program Director
(585) 475-2134, mekeie@rit.edu

Program overview

This program concentrates on the industrial and systems engineering courses that cover the science and technologies of decision making in a complex world in order to optimize the overall system rather than any one subsystem. Systems engineering improves the decision-making process by utilizing statistics, simulation, optimization, and computer science skills to enhance the design, control, operation, and understanding of systems. This discipline has shown rapid growth in both its development and recognition as a distinct field of engineering.

Curriculum

Program deactivated
Effective fall 2013, the master of engineering in systems engineering will no longer admit new students. This change will not affect currently matriculated students. Prospective students interested in systems engineering should apply for admission to the industrial and systems engineering program.

Systems engineering, ME degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
	ISE Courses	12
Choose one of the following:		4
0303-716	Linear Regression Analysis	
0303-758	Design of Experiments	
	Electives	20
Second Year		
	Electives	8
0303-779	Capstone	4
Total Quarter Credit Hours		**48**

Admission requirements

To be considered for admission to the ME in systems engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science,
- Have a minimum cumulative undergraduate GPA of 3.00,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Exam (GRE) (optional),
- Submit letters of recommendation,
- Submit a statement of purpose, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) is required.

Statistical Methods for Product and Process Improvement, Adv. Cert.

Joseph Voelkel, Graduate Program Director
(585) 475-2231, jgvcqa@rit.edu

Program overview

The advanced certificate in statistical methods for product and process improvement is designed for engineers, scientists, and other professionals who want a solid education in the statistical methods that are most closely related to their work. The program is a subset of courses taken from the MS program in applied statistics.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, a new program in statistical methods for product and process improvement will be renamed applied statistics. This change will not affect currently matriculated students.

Statistical methods for product and process improvement, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0307-801	Design of Experiments I	4
0307-802	Design of Experiments II	4
0307-841	Regression Analysis I	4
Choose three of the following:		12
0307-803	Design and Analysis of Experiments III	
0307-831	Multivariate Analysis Applications	
0307-842	Regression Analysis II	
0307-846	Statistical Data Mining	
0307-862	Reliability Statistics I*	
0307-873	Time Series Analysis	
0307-883	Quality Engineering by Design	
Total Quarter Credit Hours		**24**

* The reliability course also requires calculus with integration as a prerequisite.

Applied statistics, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CQAS-741	Regression Analysis	3
CQAS-701	Foundations of Experimental Design	3
	Elective 1	3
	Elective 2	3
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate in statistical methods for product and process improvement, candidates must fulfill the following requirements:

- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation,
- Submit a current resume, and
- Complete a graduate application.

Additional information

Prerequisites
Students should have basic familiarity with MINITAB statistical software. This may be obtained by self-study; by completion of Data Analysis Using MINITAB, a three-day, non-credit-bearing course in data analysis and statistical computing; through similar MINITAB short courses; or through Statistical Computing (0307-742), which covers both SAS and MINITAB software.

Statistical Quality, Adv. Cert.

Joseph Voelkel, Graduate Program Director
(585) 475-2231, jgvcqa@rit.edu

Program overview

The advanced certificate in statistical quality is aimed primarily at quality managers, quality engineers, or those who aspire to such positions.

Curriculum

Students have two options in which they may complete the course work for the advanced certificate.

The courses in this advanced certificate program may be applied to a graduate program at a later date. The Design of Experiments for Engineers and Scientists (0307-770) course is a 4 quarter credit hour course. It is not offered online and may not be applied toward the MS degree in applied statistics or the advanced certificate in statistical methods for product and process improvement.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in statistical quality will be renamed Lean Six Sigma. This change will not affect currently matriculated students.

Statistical quality (option 1), advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
Choose six of the following courses:		24
0307-721	Statistical Process Control	
0307-731	Statistical Acceptance Control	
0307-772	Applied Survey Design and Analysis	
0307-781	Quality Management	
0307-782	Quality Engineering	
0307-801	Design of Experiments I	
0307-802	Design of Experiments II	
Total Quarter Credit Hours		**24**

Statistical quality (option 2), advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0307-770	Design of Experiments for Engineers and Scientists	4
0307-721	Statistical Process Control	4
0307-731	Statistical Acceptance Control	4
0307-772	Applied Survey Design and Analysis	4
0307-781	Quality Management	4
0307-782	Quality Engineering	4
Total Quarter Credit Hours		**24**

Lean six sigma, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CQAS-682	Lean Six Sigma Fundamentals	3
CQAS-621	Statistical Quality Control	3
CQAS-670	Designing Experiments for Process Improvement	3
CQAS-683	Lean Six Sigma Project	3
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate in statistical quality, candidates must fulfill the following requirements:

- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation,
- Submit a current resume, and
- Complete a graduate application.

Additional information

Six Sigma Black Belt

Students may earn a Six-Sigma Black Belt after obtaining either the advanced certificate in statistical quality or the MS in applied statistics. Students should ensure an appropriate course selection by reviewing the black belt requirements on the center's website. In addition, students will complete an additional qualifying project.

Prerequisites

Students should have basic familiarity with MINITAB statistical software. This may be obtained by self-study; completion of Data Analysis Using MINITAB, a three-day, non-credit-bearing course in data analysis and statistical computing; through similar MINITAB short courses; or through Statistical Computing (0307-742), which covers both SAS and MINITAB software.

Vibrations, Adv. Cert.

Program overview

The advanced certificate in vibrations engineering provides students with specialized skills that are sought after in a variety of industrial settings. Engineers with skills in vibration engineering contribute to manufacturing production systems, aerospace systems, automotive engineering, medical product development, building mechanical and plumbing systems, consumer product development, and a host of industrial equipment and process systems. This program takes students beyond the normal preparation in vibrations engineering that students typically complete during their undergraduate program of study. Students learn to use sophisticated software tools, analytical techniques and experimental methods to design, develop, and implement solutions for problems of vibration control and minimization in engineering systems. Students are exposed to modern technologies used in industry to ensure that they are prepared for their specialized job market. The program answers a need for graduate level instruction for practicing engineers in the greater Rochester area, in a field of importance for the 21st century.

Curriculum

The advanced certificate requires students to successfully complete three required courses and one graduate elective. Students may apply the courses within this certificate program toward a master's degree.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Vibrations, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0304-658	Engineering Vibrations	4
0304-758	Intermediate Engineering Vibrations	4
0304-840	Signal Processing	4
0304-870	Mathematics for Engineers I	4
0304-871	Mathematics for Engineers II	4
0304-823	System Modeling	4
Total Quarter Credit Hours		**24***

* An alternative plan may be approved by the student's adviser and department head.

Vibrations, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MECE-601	Math I For Engineers	3
MECE-658	Introduction to Engineering Vibrations-X	3
MECE-602	Math II For Engineers	3
MECE-758	Intermediate Engineering Vibrations	3
MECE-610	System Modeling	3
EEEE-778	Digital Signal Processing	3
Total Semester Credit Hours		**18**

Graduate Faculty

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Chemical and Biomedical Engineering

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Mechanical Engineering

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Microsystems Engineering

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Lynn F. Fuller, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Professor, Microelectronic Engineering; IC Design, Semiconductor Manufacturing, MEMS and Microsystems

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P. R. Mukund, BS, MS, Ph.D., University of Tennessee—Professor, Electrical Engineering; VLSI Design, Electronic Devices, Circuit Design

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Jiandi Wan, BS, MS, Wuhuan University (China); Ph.D., Boston University—Assistant Professor, Microfluidics, Signaling Dynamics of the Microvascular System, Microemulsion-based Functional Materials, Photocatalytic Multiphase Reactions

Quarter Courses

2012–2013 Academic Year

Electrical Engineering

0301-702 Random Signals and Noise

In this course the student is introduced to random variables and stochastic processes. Topics covered are probability theory, conditional probability and Bayes theorem, discrete and continuous random variables, distribution and density functions, moments and characteristic functions, functions of one and several random variables, Gaussian random variables and the central limit theorem, estimation of a random variable, random processes, stationarity and ergodicity, auto correlation, cross-correlation and power spectrum density, response of linear prediction, Wiener filtering, elements of detection, matched filters. (Graduate standing) **Class 4, Credit 4**

0301-703 Matrix Methods in Electrical Engineering

This course deals with the elements of discrete transforms and linear algebra. Topics include: discrete-time signals and systems, the Z-transform and its application, solution of difference equations, concepts of stability, discrete Fourier analysis, DFT, FFT algorithms, topics in linear algebra and matrices, eigenvalues and eigenvectors, functions of matrices, matrix transformations and operations, matrix poly-nominals and the Cayley-Hamilton theorem, state variables, relation between transfer functions and state variable representation of LTI systems, state transition matrix, and solution of state equations. (Graduate standing) **Class 4, Credit 4**

0301-710 Advanced Electromagnetic Theory

The primary objective is to provide the mathematical and physical fundamentals necessary for a systematic analysis of electromagnetic field problems. Topics include potential representations, scalar and vector Green's functions, Green's theorem, reciprocity, duality, equivalence principle, image theorem, and radiation from apertures, scattering, integral equation solutions, perturbation and numerical methods. (Graduate standing) **Class 4, Credit 4**

0301-711 Advanced Carrier Injector Transistors

An advanced level course in electronic transport in semiconductors and the operation of bipolar devices (pn junction diodes, bipolar junction transistors and semiconductor-controlled rectifiers). Topics include electron drift, diffusion and carrier lattice interactions, energy band diagrams in non-uniformly doped semiconductors, continuity equations, impact ionization, tunneling, advanced static and dynamic analysis of diodes and bipolar transistors, design of bipolar devices. Topics also include Heterojunction physics and Heterojunction Bipolar Transistors (HBT), including SiGe HBT. **Class 4, Credit 4**

0301-712 Advanced Field Effect Devices

An advanced level course on MOSFETs and submicron MOS devices. Topics include MOS capacitors, gated diodes, long channel MOSFET, subthreshold conduction and offstate leakage, short channel effects, hot-carrier effects, ion-implanted channels, MOS scaling and advanced MOS technologies. **Class 4, Credit 4**

0301-713 Solid State Physics

An advanced level course on solid-state physics, with particular emphasis on semiconductor materials. Topics include: basic semiconductor properties, elements of quantum mechanics, general and time-independent formulation of wave mechanics, outcomes and predictions, energy band theory, statistical mechanics and equilibrium carrier statistics, excess carriers in semiconductors, carrier transport. **Class 4, Credit 4**

0301-717 Microwave Circuit Design

The primary objective is to study the fundamentals of microwave engineering with emphasis on microwave network analysis and circuit design. Topics include microwave transmission lines such as wave guides, coax, microstrip and stripline, microwave circuit theory such as S-matrix, ABCD matrices, and even odd mode analysis, analysis and design of passive circuits and components, matching networks, micro-wave resonators and filters. **Class 4, Credit 4**

0301-726 Mixed Signal IC Design

This course covers basic analog functional blocks and mixed signal blocks, in CMOS technology. Topics include: device models, current sources and active loads, precision reference, operational amplifiers, comparators, sample and hold circuits and data converters design. Course involves circuit design and layout projects. (Graduate standing) **Class 4, Credit 4**

0301-727 VLSI Design

A course in the design of very large scale integrated circuits at the level of Mead and Conway's VLSI Design. Topics include MOS devices and circuits, n-channel MOS process, data and control flow in systematic structures, implementing integrated system design, system timing and examples of LSI computer systems. **Class 4, Credit 4**

0301-729 Antenna Theory and Design

The primary objective is to study the fundamental principles of antenna theory applied to the analysis and design of antenna elements and arrays including synthesis techniques and matching techniques. Topics include antenna parameters, linear antennas, array theory, wire antennas, microstrip antennas, self and mutual impedances, equivalence principle, Huygen's principle, aperture antennas, traveling wave antennas, reflector antennas. **Class 4, Credit 4**

0301-730 Advanced Analog IC Design

An advanced course in analog integrated circuit design. Students will study bipolar and MOS realization of operational amplifiers, analog multipliers, A to D and D to A converters, switched capacitor filters and more. The students will participate in design projects including circuit design, layout and SPICE simulation. (0301-726) **Class 4, Credit 4**

0301-732 Advanced Topics in Digital System Design

The purpose of this course is to introduce students to advanced topics in digital systems design not covered in depth in undergraduate classes or topics that are new to the design community. Topics include: design of digital systems using Hardware Description Languages (VHDL/Verilog), design of digital systems using asynchronous circuits, design of digital systems using wave-pipelined circuits, clock distribution in large digital systems, design of digital systems with threshold gates, multi-valued logic and design of DSP specific blocks. For specific evaluation and grading policy, contact assigned instructor before registration. (0301-240, 347, 365, 545) **Class 4, Credit 4**

0301-733 Robust Control

One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop system to continue performing satisfactorily despite large variations in the open-loop plant dynamics. This course will provide an introduction to the analysis and design of robust feedback systems. Topics include overview of linear algebra and linear systems, H_2 and H_{00} control, spaces, modeling and paradigms for robust control; internal stability; nominal performance (asymptotic tracking); balanced model reduction; uncertainty and robustness; H_2 optimal control; H_2 control; H_2 loop shaping; controller reduction; and design for robust stability and performance. Software: MATLAB: Robust Control Toolbox, and mu-Toolbox. (0301-703) **Class 4, Credit 4**

0301-741 Design for Testability

This course deals with the design systems for testability and for maintainability. A survey of criteria for testability is given. A discussion of fault simulation and test pattern generation is included. Random test pattern generators and associated data compression schemes such as signature analysis are also described. Scanning techniques (both scan path and boundary scan) are discussed. The tradeoffs between built-in testing capacity and additional silicon structures are weighed. A small project, usually involving simulation, will be required. (0301-650) **Class 4, Credit 4**

0301-742 Advanced Topics in Embedded Systems

An introduction to the theory and application of top-down design, structure, abstraction, segmentation, high-level languages, and operating systems to real-time programs for microprocessors. Students will become proficient in a structured high-level language. Topics include structure diagrams, separate module compilation, data types, data structures, self-documenting code, procedures, meaningful variable names, linkage with other languages, object code libraries, operating system calls, multi-tasking concurrent and re-entrant programs, and symbolic debugging. **Class 4, Credit 4**

0301-761 Modern Control Theory

An advanced course in control theory, topics covered include review of state-space formulation of SISO systems, solution of state equations, STM and its properties, application of state-space concepts, state variable design, multivariate systems, preliminaries, systems of lease order, stability and control. **Class 4, Credit 4**

0301-765 Optimal Control

The course covers different optimization techniques, as applied to feedback control systems. The main emphasis is on the design of optimal controllers for digital control systems. The major topics are: different performance indices, formulation of optimization problem with equality constraints, LaGrange multipliers, Hamiltonian and solution of discrete optimization problem. Discrete Linear Quadratic Regulators (LQR), optimal and suboptimal feedback gains, Riccati equation and its solution, linear quadratic tracking problem, Dynamic Programming, Bellman's principle of optimality, and optimal controllers for discrete and continuous systems. (0301-761 or equivalent) **Class 4, Credit 4**

0301-768 **Adaptive Signal Processing**
An introduction to the fundamental concepts of adaptive systems, open and closed loop adaptive systems, adaptive linear combiner, performance function and minimization, de-correlation of error and input signal. Adaptation algorithms such as steepest descent, LMS and LMS/Newton algorithm. noise and maladjustments. Applications will include system identification, de-convolution and equalization, adaptive arrays and multipath communication channels. (0301-702 or permission of instructor) **Class 4, Credit 4**

0301-769 **Fuzzy Logic and Applications**
This course introduces fuzzy logic and its applications in areas like control systems, image processing, decision making, etc. Major topics: fuzzy sets, rule base, generation and combinations of rules, de-fuzzification. - fuzzy systems, choice of fuzzy variables, their division into fuzzy sets, choice of membership functions, the effect of these on system performance. Applications: discussion of published works and student projects using fuzzy logic. Students are required to research the published literature and/or do projects and take an active part in these discussions. **Class 4, Credit 4**

0301-770 **Pattern Recognition**
This course provides a rigorous introduction to the principles and applications of statistical pattern recognition. The topics covered include Bayesian decision theory, nearest-neighbor techniques, linear discriminant functions, and clustering. Parameter estimation and the supervised learning as well as principles of feature selection are included. (0301-702) **Class 4, Credit 4**

0301-772 **Special Topics**
Topics and subject areas that are not among the courses listed are frequently offered under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (No regular course schedule) **Class 4, Credit 4**

0301-779 **Digital Image Processing**
This introductory course in digital image processing that begins with a study of two-dimensional signal processing and transform methods with applications to images. Image sampling is discussed followed by gray level description of images and methods of contrast manipulation including linear/nonlinear transformation and histogram equalization and specification. Image smoothing methods are considered including spatial and frequency domain low pass filtering, ADHOC methods of noise removal and median filtering. Following this, methods of image sharpening are studied including derivative methods and high pass filtering. Edge and line detection methods are discussed using masks and Hough transforms, methods of image segmentation and degradation and image restoration, including deblurring. Several extensive computer and DSP lab assignments required. (0301-702, 703 or permission of instructor) **Class 4, Credit 4**

0301-780 **Independent Study**
This course number should be used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. **Credit 4**

0301-786 **MEMS Devices**
Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing, and other applications. There is a critical need to synthesize and design high performance MEMS that satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Fourth or fifth year standing for undergraduates, or graduate standing) **Class 4, Credit 4**

0301-789 **Fundamentals of MEMS**
This course introduces the student to Microelectromechanical systems (microscale transducers, actuators and sensors with ICs). Synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS will be covered. The primary emphasis of the course will be concentrated on development of basic theory to attain fundamental understanding of MEMS, the design, analysis, control, fabrication and application of MEMS in robotics, electronics, biotechnology, medicine, avionics, transportation, security, defense, etc. (Graduate standing for graduate students; 0301-531 for undergraduate students) **Class 4, Credit 4**

0301-794 **Information Theory**
This course introduces the student to the fundamental concepts and results of information theory. This is a very important course for students who want to specialize in signal processing, image processing, or digital communication. Topics include definition of information, mutual information, average information or entropy, entropy as a measure of average uncertainty, information sources and source coding, Huffman codes, run-length constraints, discrete memoryless channels, channel coding theorem, channel capacity and Shannon's theorem, noisy channels, continuous sources and channels, coding in the presence of noise, performance bounds for data transmission, rate distortion theory. (0301-702) **Class 4, Credit 4**

0301-798 **Microfuidic MEMS**
The course begins with an overview of microfluidic technology to provide a framework and to clarify the relationship of microfluidics to microelectromechanical systems (MEMS) and microsystems in general. Three major topics comprise the course: 1) selected elements of fluidic dynamics theory, and the scaling and application of that theory to microscale dimensions; 2) design, fabrication, and characterization of microfluidic devices and microsystems including exploration of major alternative fabrication technologies, process integration and materials issues, and device- and system-level packaging/encapsulation challenges; 3) applications, including microvalves, micropumps, microflow control sensor, and devices for chemical and biochemical analysis. **Class 4, Credit 4**

0301-799 **Nano and Microengineering**
This course focuses on analysis and synthesis of nano- and microelectromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and micro-engineering, distinct systems and devices will be examined. The application of nano and microengineering in nanocomputers avionics, security and transportation will be emphasized. Specific applications included are: super-fast data processing and computing, data storage, imaging, molecular intelligent automata, etc. (Graduate standing for graduate students; permission of instructor for undergraduate students) **Class 4, Credit 4**

0301-800 **Graduate Paper**
This course number is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in electrical engineering. The student must obtain the approval of an appropriate faculty member to supervise the paper before registering for this course. **Credit variable 0–5**

0301-802 **Wireless Communications**
The course will cover advanced topics in wireless communications for voice, data and multimedia. Topics covered are: 1) Channel modeling: Overview of current wireless systems, modeling wireless channels, path loss for different environments, log-normal shadowing, flat and frequency-selective multipath fading, LS estimation of channel parameters, and capacity limits of wireless communication channels. 2) Transmission over fading channels, 3) Techniques to improve the speed and performance of wireless links (adaptive modulation and diversity techniques such as maximum gain combining to compensate for flat-fading). 4) Techniques to combat frequency-selective fading (adaptive equalization, space time coding, multicarrier modulation (OFDM), and spread spectrum). 5) Applications for these systems, including the evolution of cell phones and PDAs, sensor networks will be discussed. (0301-693, 702) **Class 4, Credit 4**

0301-803 **Digital Video Processing**
In this graduate level course the following topics will be covered: Representation of digital video - introduction and fundamentals. Time varying image formation models including motion models and geometric image formation. Spatio-temporal sampling including sampling of analog and digital video, two-dimensional rectangular and periodic sampling, sampling of 3-D structures, and reconstruction from samples. Sampling structure conversion including sampling rate change and sampling lattice conversion. Two-dimensional motion estimation including optical flow based methods, block-based methods. Pel-cursive methods, Bayesian methods based on Gibbs Randon Fields. Three-dimensional motion estimation and segmentation including methods, point correspondences, optical flow and direct methods, motion segmentation, and stereo and motion tracking. (0301-779 or permission of instructor) **Class 4, Credit 4**

0301-804 **MEMS Evaluation**
This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMS evaluation will be covered. (0301-786, senior standing) **Class 4, Credit 4**

0301-805 **Modern Optics for Engineers**
This course provides a broad overview of modern optics in preparation for more advanced courses in the rapidly developing fields of lasers, fiber optics and non-linear optics. Topics covered: propagation of light, geometrical optics, polarization, interferometry, diffraction, and laser resonators. Introduction to non-linear optics: harmonic generation, optical parametric oscillators and amplifiers. At the end of the quarter, the students should have a firm foundation in classical optics. Lasers and non-linear optics will be introduced from a semi-classical perspective and will not require a quantum mechanical background. Students will write a paper on a topic of current research interest in the field. (0301-474) **Class 4, Credit 4**

0301-810 Advanced Computer Architecture
This course covers advanced topics in computer and processor architecture. Topics include: pipeline and parallel processor design, branch tables and prediction algorithms, single issue versus multiple issue processor architectures (VLIW, SIMD, superscalar), cache architectures, quantitative and qualitative evaluation of instruction set architectures. For specific evaluation and grading contact the assigned instructor before registration. (0301-240, 347, 365, 545) **Class 4, Credit 4**

0301-812 Advanced Topics-Physical Implementation
This course covers the analysis and physical design of very large scale integrated circuits. Topics covered include synthesis, cell layout, cell placement and system routing, extraction, layout versus schematic check, signal integrity, timing and noise immune design techniques. The course will address issues in current state-of-the art submicron and deep submicron CMOS technologies, with an emphasis on digital circuits and systems. For specific evaluation and grading policy contact the assigned instructor before registration. (0301 240, 347, 365, and 545) **Class 4, Credit 4**

0301-815 Multivariable Modeling
This course introduces students to the major topics, methods, and issues in modeling multiple-input multiple-output (MIMO) linear systems. The course covers methods of creating models and refining them. Modeling topics include model-order determination, canonical forms, numerical issues in high-order models, numerical issues in broadband models, methods of creating frequency-response models from time-domain measurements, methods of model-order reduction, model transformations and information loss, and estimating model accuracy of MIMO models. Use of MIMO models in controller design will be discussed. (0301-703) **Class 4, Credit 4**.

0301-816 Design and Characterization of Microwave Systems
The primary objective is the design and experimental illustration of the fundamentals of microwave circuits and antennas. Projects will involve the design, construction and characterization a microwave system to satisfy a set of specified design criteria. Microwave measurement techniques will involve the use of network analyzers, and spectrum analyzers in conjunction with the probe station. Simulated results will be obtained using some popular commercial EM software for the design of microwave circuits and antennas. (0301-717) **Class 4, Lab 3. Credit 4**

0301-821 Physics and Modeling of High Performance Semiconductors
Semiconductor devices based on III-V materials are introduced. Basic properties and physics of III-V materials and metal-semiconductor contacts and two-terminal Heterojunction devices are covered. Physical operation, non-idealities, modeling DC and microwave characteristics of Heterojunction Bipolar Transistors (HBT), Metal Semiconductor Field-Effect Transistors (MESFET) and High Electron Mobility Transistors (HEMT) are analyzed. Analysis of small and large-signal amplifiers is covered. (0301-360 or equivalent) **Class 4, Credit 4**

0301-836 Biorobotics/Cybernetics
Cybernetics refers to the science of communication and control theory that is concerned especially with the comparative study of automatic control systems (as in the nervous system and brain and mechanical electrical communications systems. This course will present material related to the study of cybernetics as well as the aspects of robotics and controls associated with applications of a biological nature. Topics will also include the study of various paradigms and computational methods that can be utilized to achieve the successful integration of robotic mechanisms in a biological setting. Successful participation in the course will entail completion of at least one project involving incorporation of these techniques in a biomedical application. (Permission of instructor or graduate standing) **Class 4, Lab 2, Credit 4**

0301-847 Artificial Intelligence Explorations
The course begins with the history and development of artificial intelligence. This course explores a variety of artificial intelligence techniques, their applications and limitations. Some of the AI techniques covered in this course are intelligent agents, problem-solving, knowledge and reasoning, uncertainty, decision making, learning (Neural networks and Bayesian networks), reinforcement learning, swarm intelligence, Genetic algorithms, particle swarm optimization, applications in robotics, controls, and communications. Students are expected to have any of the following programming skills: C/C++, Matlab, Java, or other high level programming language. Graduate students are required to write an IEEE format conference paper on their projects. **Class 4, Credit 4**

0301-877 Graduate Internship
Graduate internship is designed to enhance the educational experience of graduate students through full-time paid employment during the summer quarter. Students are encouraged to seek full time positions in the Electrical and Microelectronic Engineering field. Registration is optional and is recommended for summer quarters only. Before enrolling, students are required to complete all bridge courses as well as a minimum of 24 graduate credits and receive approval from the graduate program coordinator.

0301-885 Principles of Robotics
An introduction to a wide range of robotics-related topics, including but not limited to: sensors, interface design, robot devices and applications, mobile robots, intelligent navigation, task planning, coordinate systems and positioning, image processing, digital signal processing applications on robots, and controller circuitry design. Prerequisite of the class is the basic understanding of signals and systems, matrix theory, and computer programming. Software assignments will be given to the students in robotic applications. Students will prepare a project, in which they will complete software or a hardware design of an industrial or a mobile robot. There will be two-hour lab additional to the lectures. Graduate students are required to write a IEEE format conference paper on their projects. (0301-204, 345, 346, 453) **Class 3, Lab 2, Credit 4**

0301-887 Digital Signal Processing
A continuation of the topics studied in 0301-554. Topics include study of the design methods for digital IIR filters via s-plane transformations, study of design methods for digital FIR filters, including emphasis on the question of linear phase response, a review of the discrete Fourier transform (DFT) and an in-depth study of fast algorithms (FFTs) for implementing the DFT, including radix 2, radix 4 and mixed radix algorithms, quantization effects in discrete systems; an introduction to digital signal processing computer chips and their use in the implementation of digital processing systems, and applications of digital signal processing, including speech processing and two-dimensional image processing. Includes several design projects in the digital signal processing laboratory. (0301-554) **Class 4, Credit 4**

0301-889 Graduate Seminar
The objective of this course is to introduce full-time electrical and microelectronic engineering BS/MS and incoming graduate students to the graduate programs, campus resources to support research, and EME research activities. Presentations from faculty, upper division MS/PhD students, staff, and off campus speakers will provide a basis for student selection of research topics, comprehensive literature review, and modeling effective conduct and presentation of research. All first year graduate students enrolled full time are required to successfully complete three quarters of this seminar. **Class 1, Credit 0 (F, W, S)**

0301-890 Thesis
An independent engineering project or research problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty member to guide the thesis before registering for the thesis. A thesis may be used to earn a maximum of 9 credits.

0301-895 Advanced Robotics
This course explores advanced topics in mobile robots and manipulators. Mobile robot navigation, path planning, room mapping, autonomous navigation are the main mobile robot topics. In addition, dynamic analysis of manipulators, forces and trajectory planning of manipulators, and novel methods for inverse kinematics and control of manipulators will also be explored. The course is project based and students are required to prepare a well written paper exploring a novel area in robotics for presentation at the IEEE conference. (0301-685 required, 0301-514 recommended) **Class 4, Credit 4**

Industrial and Systems Engineering

0303-701 Linear Programming
Applied linear programming. Computational techniques for solving constrained optimization problems. Linear programming, the Simplex method and variations, duality and sensitivity testing. (1016-331 or equivalent) **Credit 4 (W)**

0303-702 Integer and Nonlinear Programming
An introduction to the mathematical foundations of integer programming and nonlinear optimization techniques. Study of algorithms and computer-aided solutions for applied optimization problems. (0303-701) **Credit 4 (S)**

0303-703 Supply Chain Management
As business competition becomes global and product life cycles shorten, the need exists for a systems approach to studying all elements of the supply chain. This course will give students breadth of knowledge in supply chain management along with strategies that can be utilized in the design and operation of efficient subsystems within the supply chain. Students will understand the supply chain in the context of the business value chain and profitability goals. This course will take a macro view, without emphasizing the details of each subcomponent within the supply chain. For example, the importance of warehouse location and its impact on the overall system will be considered without looking at details associated with material handling within a warehouse. (Requires acceptance into the MML program or permission of instructor) **Class 4, Credit 4 (F)**

0303-704 **Logistics Management**
This course discusses several strategic, tactical, and operational concepts used in improving the distribution of goods and services by companies worldwide. The course emphasis is on understanding when and how these concepts are applied, as well as on using mathematical programming and optimization methods for their adequate implementation. (0303-402, or 0303-702, or equivalent) **Class 4, Credit 4 (S)**

0303-710 **Systems Simulation**
Methods of modeling and computer simulation of stochastic and dynamic manufacturing systems are discussed. A high-level simulation language such as ProModel, ARENA, etc., will be used to model the system and examine system performance. Model validation, design of simulation experiments, variance reduction techniques and random number generation will be discussed as time permits. (0303-302, 1016-352 or equivalent) **Credit 4 (W)**

0303-711 **Advanced Simulation Techniques**
An advanced course in developing simulation models using good model building, verification and validation procedures. Emphasis will be on review and use of probability distributions, simulation output data analysis for making good decisions, comparison of alternative system configurations, use of designed experiments and the use of advanced simulation techniques. Real world case studies will be examined to convey understanding and teaching of the material. Students will be asked to build models, so simulation experience and working knowledge of a simulation language will be required. (0303-710) **Credit 4 (S)**

0303-716 **Applied Linear Regression Analysis**
A first course in least squares linear regression. Topics covered include estimation of model parameters, significance testing of model parameters, detection and treatment of influential observations, model adequacy checking and variable selection techniques. May not be used as a professional elective. (1016-352 or equivalent) **Credit 4 (S)**

0303-720 **Production Control**
This course will cover the role, the steps and the analysis methods to produce goods and services in support of the production and operations management functions. Topics include: forecasting, inventory policies and models, job shop scheduling, aggregate production planning, and ERP systems. Students will understand the importance of production control and its relationship to other functions within the organization, and the role of optimization to support production planning. Case studies and the design of actual production systems will be emphasized. (0303 701, 1016-351) **Credit 4 (W)**

0303-723 **Global Facilities Planning**
This course addresses the global planning, and design, and utilization of fixed assets associated with design of manufacturing, storage and distribution, service and support functions facilities. Topics include: strategic considerations in facilities planning to meet customer and market objectives, product, process, and schedule design; determining flow, resource, and space requirements; layout at the plant level; design of storage warehousing material handling systems design, warehousing, storage and retrieval policies, , incorporation of lean principles, and quantitative design and analysis tools. Students will understand facilities planning from a strategic and tactical perspective as well as the link between business goals, and design, and engineering activities. Visits to local companies are included. (Requires acceptance into MML program or permission of instructor) **Credit 4 (S)**

0303-727 **Advanced Manufacturing Engineering**
This course will provide an advanced treatment of manufacturing engineering in the context of industrial and systems engineering. Emphasis will be place in process design, development and engineering, using state-of-the-art solid modeling tools and materials selection software. Process tooling, gauging, and automation will be cornerstones of the course and will provide material for a variety of term projects. Advanced processing, such as electronics and microsystems, will be explored and developed in depth. Quality systems and process documentation will also be covered. (0303-343, graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

0303-728 **Production Systems Management**
Students who take this course should be interested in building on their basic knowledge of contemporary production systems and developing the breadth and depth of their understanding, with a focus on the managerial, quantitative, and systems aspects. It will also address value streams other than manufacturing, specifically logistics. A significant portion of this course is focused on lean production control systems While other ISE courses that include significant production systems content enable the student to apply the tools and principles in a competent way on the shop floor (i.e., 0303-766 Manufacturing Systems and 0303-626 Contemporary Production Systems), this course should enable the student to practice the application of the concepts in the context of systems design at the enterprise level (0303-526 or 0303-626 or equivalent). **Class 4, Credit 4 (S)**

0303-729 **Advanced Systems Integration**
Basic concepts and techniques need to specify, design and implement systems that are computer controlled. Real-time data acquisition, process control as related to computer-integrated manufacturing, and information systems topics will be introduced within the context of systems integration. Cannot be used as a professional elective for ISE majors. (0303-302 or permission of instructor) **Class 3, Lab 1, Credit 4 (W)**

0303-730 **Ergonomics and Human Factors**
A survey course of human factors and ergonomics emphasizing a systems approach in looking at human capacity for physical and mental work versus the demands placed upon the human by the task, machine and environment. Various models of human performance are covered. **Credit 4 (on demand)**

0303-731 **Advanced Topics: Ergonomics and Human Factors**
Advanced topics are selected based on current ergonomic and human factors issues and interests of students. Course is taught using a seminar format in which journal articles and other publications are read and discussed. (0303-730 or equivalent) **Credit 4 (W - even years)**

0303-732 **Biomechanics**
Theoretical fundamentals of human physiology and mechanics applied to work. Biomechanical models are developed to evaluate the effects of physical loading on the human body. Topics include musculoskeletal systems, human strength, and biomechanical modeling using biomechanical software. (0304-331, 332, 0303-730 or equivalent) **Class 4, Credit 4 (S)**

0303-733 **Cognitive Engineering**
Measurements of human performance. Fundamentals of human information processing and how they relate to the design of human-machine systems. (0303-730 or equivalent) **Credit 4 (on demand)**

0303-734 **Systems Safety Engineering**
Acquaints students with practical aspects of safety engineering. Students acquire a working knowledge of legal and technical aspects of safety. Focuses on a systems approach to safety engineering. Topics include Workers Compensation, OSHA, Consumer Product Safety Commission and various hazard analysis and utilization techniques. Students also are exposed to various theories of accident causation, research methodology and ways of evaluating safety programs and related research. Professional elective. **Class 4, Credit 4 (W - odd years)**

0303-735 **Design Project Management**
Training for multidisciplinary studies in project management for leadership of product/process development and design projects. (e.g., senior design) (Permission of instructor required) **Class 4, Credit 4 (F, S)**

0303-742 **Artificial Intelligence Applications**
An introductory course in the development and application of "intelligent" (knowledge-based) systems. An introduction to Artificial Intelligence (AI) as a tool to deal with problems that require "intelligence." Computational complexity will be used to address "hard" problems. Generic and problem-specific procedures will be used and analyzed. (0303-701 or equivalent) **Credit 4 (on demand)**

0303-756 **Decision Analysis**
This course presents the primary concepts of decision analysis. Topics important to the practical assessment of probability and preference information needed to implement decision analysis are considered. Decision models represented by a sequence of interrelated decisions, stochastic processes and multiple criteria are also considered. (1016-352 or equivalent) **Credit 4 (on demand)**

0303-758 **Design of Experiments**
This course presents the primary concepts of experimental design. Its applied approach uses theoretical tools acquired in other mathematics and statistics courses. Emphasis is placed on the role of replication and randomization in experimentation. Numerous designs and design strategies are reviewed and implications on data analysis are discussed. (1016-352 or equivalent) **Credit 4 (W)**

0303-760 **Product/Process Design and Development**
This course covers the principles of product, manufacturing process and supply chain development in an integrated fashion. Examines the linkages between design specifications and manufacturability, between product architectures, manufacturing system, between the manufacturing system and supply chain and between in-house and outsourced manufacturing. Major topics include: product strategies, product, architectures and manufacturing strategies; product development processes; product requirements benchmarking, concept development generation and evaluation; the application of systems engineering tools to product design and design for "X" (manufacturing/assembly/service/environment, etc.) and life cycle costing. **Credit 4 (F)**

0303-761 Rapid Prototyping
This course covers the relatively new field of rapid prototyping (RP). The course blends lectures with hands-on lab activities. Lectures cover the practice and theory behind RP processes such as stereolithography, 3D printing, and electron beam melting. The use of RP technologies in emerging application areas such as energy systems, biomedical devices, and functionally graded materials are also discussed. (Senior or graduate standing in engineering or permission of instructor) **Class 4, Credit 4**

0303-762 Systems Modeling and Decision Making
This course emphasizes how process modeling and simulation can be utilized to aid business and technical decision making. Students will learn to identify and analyze key decision making factors associated with topics such as sourcing and the supply chain, lean manufacturing systems, product and service delivery, activity based costing, call centers, and order-to-cash systems. Students will also learn how to identify performance measures for a manufacturing or service systems and use those measures in the evaluation of system performance. A high-level modeling language will be utilized to simulate systems and examine performance. (Requires acceptance into the MML program or permission of instructor) **Credit 4 (W)**

0303-764 Operation Management and Manufacturing Systems
This course introduces students to problems and analysis related to the design, planning, control, and improvement of manufacturing and service operations. Emphasis is placed on the principles of planning and designing modern manufacturing systems, consistent with corporate objectives and new product development strategies. The course utilizes case studies extensively and analytical problem sets. Topics include: enterprise and manufacturing strategies, operations strategy, architecting manufacturing systems, systems thinking, process and project analysis, materials management, production planning and scheduling, quality management computer-aided manufacturing, and process management options. The course equips students with the basic tools and techniques used in analyzing operations and manufacturing systems, as well as the strategic context for making decisions. (Requires acceptance into MPD program) **Credit 4**

0303-765 Data Bases-Information Systems
The course focuses on implementation of information systems applications using SQL web-based implementation (e.g., ORACLE). Students will design, develop and implement multiple database projects and also be expected to conduct literature searches on contemporary issues in information systems architectures. **Class 4, Credit 4 (F)**

0303-766 Manufacturing Systems
This course will provide an introduction to concepts and techniques in the design and analysis of manufacturing systems. A blend of traditional and modern approaches is used to assess and analyze the performance of a given manufacturing system as well as to provide a framework for system redesign and improvement. Topics include factory physics, queuing theory, cellular manufacturing, and lean manufacturing. (Permission of instructor) **Credit 4**

0303-771 Special Topics in Industrial Engineering
This is a variable topics course that can be in the form of a regular course or independent study under faculty supervision. **Credit 4**

0303-775 Data Structures Using C
An introductory course in data structures and algorithms using the (visual) C++ programming language. Topics include sorting, searching and lists. This course can be used as a foundation for many computer- based courses in engineering. **Class 4, Credit 4 (F - odd years)**

0303-777 Engineering Internship
This course number is used by students in the master of engineering degree program to register for an internship experience. The number of credits is to be determined by the student's faculty adviser and is subject to the approval of the graduate committee of the College of Engineering. **Credit variable**

0303-778 Leadership Capstone
For students enrolled in the BS/ME dual degree program. Student must either: 1) serve as a team leader for the multidisciplinary senior design project, where they must apply leadership, project management, and system engineering skills to the solution of unstructured, open- ended, multi-disciplinary real-world engineering problems, or 2) demonstrate leadership through the investigation of a discipline-related topic. **Credit 0**

0303-779 Engineering Capstone
For the Master of Engineering programs in industrial engineering, engineering management, and systems engineering. Students must investigate a discipline-related topic in a field related to industrial engineering, engineering management, or systems engineering. The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular area. The capstone should draw upon skills and knowledge acquired in the program. (Restricted to EIEG, EIEM, EIES, EIEA) **Credit 4 (W)**

0303-780 Excellence in New Product Development
Success in today's competitive global economy depends substantially on a firm's ability to define, develop, and introduce outstanding new products more efficiently and effectively than its competitors. This course introduces students to best practices and attributes of world-class product development leaders and organizations. Critical success factors and inhibitors to the commercialization of complex products and systems are discussed, along with state-of-the-art methodologies, processes, and tools. Emphasis is placed on the role of the product development manager in leading product strategy, high performing product development teams, and transformational initiatives essential to competitiveness **Credit 4**

0303-781 Advanced Topics in Product Development
This modular course is designed to complement previous coursework in the MPD program, with an emphasis on engineering concepts and tools needed by technical leaders of product development projects. The course is intended to fill gaps in the MPD program by covering important topics for product development leaders that were not covered or could use additional coverage. Prerequisite: the successful completion of all course work in the MPD program. **Credit 4**

0303-782 Product Development in the Extended Enterprise
Today's complex products and shorter product development life cycles have dramatically increased dependence on external resources. This course will examine a broad range of collaborative arrangements from traditional contracting and functional outsourcing to cross-enterprise partnerships, in the context of the product delivery process and the challenges faced by product development managers. (Enrollment in MS in Product Development) **Class 4, Credit 4**

0303-784 Systems and Project Management
Systems and Project Management ensures progress toward objectives, proper deployment and conservation of human and financial resources, and achievement of cost and schedule targets. The focus of the course is on the utilization of a diverse set of project management methods and tools. Topics include strategic project management, project and organization learning, cost, schedule planning and control, structuring of performance measures and metrics, technical teams and project management, information technology support of teams, risk management, and process control. Course delivery consists of lectures, speakers, case studies, and experience sharing, and reinforces collaborative project-based learning and continuous improvement.) **Credit 4 (W, S - MPD only)**

0303-785 Decision and Risk Benefit Analysis
This course addresses decision making in the face of risk and uncertainty. Various methodologies will be introduced that are useful in describing and making decisions about risks, with particular emphasis on those associated with the design of products. Students will be exposed to issues related to balancing risks and benefits in situations involving human safety, product liability, environmental impact, and financial uncertainty. Presentations will be made of risk assessment studies, public decision processes, and methods for describing and making decisions about the societal risks associated with engineering projects. Topics include probabilistic risk assessment, cost-benefit analysis, reliability and hazard analysis, decision analysis, portfolio analysis, and project risk management. **Credit 4**

0303-786 Engineering of Systems I
The engineering of a system is an essential aspect of its development that focuses on the overall concept, performance requirements and behavioral aspects of the system. This course treats the creation of products, product platforms and product families as systems that create value for both the customer and the enterprise. Topics include value creation and strategy, product development processes, translating market requirements to system requirements, functional analysis, development of the system's architecture, development of platforms and modules, and lean product development. Students will learn several systems analysis techniques and apply them in a team-based project. (Acceptance into the MPD program or permission of instructor) **Credit 4 (W)**

0303-787 Systems Optimization
This course is an application-oriented introduction to optimization, focused on the understanding of system tradeoffs. It introduces modeling methodology (linear, integer and nonlinear programming), modeling tools (sensitivity and post-optimality analysis), optimization software, applications in production planning and scheduling, inventory planning, personnel scheduling, project scheduling, distribution systems planning, facility sizing and capacity expansion, communication systems design, and product development. (Requires acceptance into the MPD program or permission of instructor) **Credit 4 (F)**

0303-788 **Engineering of Systems II**
The engineering of a system is an essential aspect of its development that focuses on the overall concept, performance, requirements and behavioral aspects of the system. This course builds on the concepts discussed in Engineering of Systems I. Topics include an introduction to computer and software architecture, defining the structure and work content of the product development organization, refinement and flow- down of requirements to subsystems, performance and life cycle trade studies, interface management, robust design, and certification planning. Students will learn several systems analysis techniques and apply them in a team based project. (Requires acceptance into the MPD program or permission of instructor, 0303-786) **Credit 4 (S)**

0303-789 **Systems Dynamics**
Systems dynamics deals with the time-based behavior and control of nonlinear systems. This course will introduce the concepts of systemic thinking, nonlinear dynamics, and control principles as they apply to enterprise issues such as the product development process, innovation diffusion, product differentiation, supply chain dynamics, and organizational learning. Topics include casual models, system arche- types, feedback and feed forward loops, exponential growth, goal seeking behavior, instability and sensitivity analysis. A continuous time simulation tool, such as I Think, Stella or Vensim, will be utilized to model and analyze the behavior of a variety of enterprise systems. (Requires acceptance into the MPD program or permission of instructor) **Credit 4**

0303-790 **Fundamentals of Sustainable Engineering**
The product life cycle is reviewed from various perspectives and highlights the leverage over material, process, and environmental costs available at the design phase. An additional project is required that draws upon basic engineering knowledge. (0303-343, 0304-344). **Class 4, Credit 4 (F)**

0303-791 **Lifecycle Assessment/Costing**
This course will introduce students to the challenges posed when trying to determine the total costs and environmental impacts associated with a product/process design across its entire lifecycle. Various assessment and costing models and their inherent assumptions will be reviewed and critiqued. (0303-520/620) **Class 4, Credit 4 (W)**

0303-792 **Design for Environment**
A course on systematic approaches of designing and developing environmentally responsible products. Topics covered include: guidelines for product structure, materials selection, fastening, labeling and finishing, techniques to reduce environmental impact (such as design to minimize material usage, design for disassembly, design for recycling, design for remanufacturing, design to minimize hazardous materials, design for energy efficiency, design to regulations/standards), and environmental impact inventory methods. (0303-343, 0304-344 or equivalent) **Class 4, Credit 4 (S)**

0303-793 **Applications in Sustainable Engineering**
Students investigate a discipline-related topic in a field related to sustainable engineering through the completion of an individual or team-based project. The topic is chosen in conference with a faculty adviser. The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular area. The capstone should draw upon skills and knowledge acquired in the program. (Graduate standing) **Class 4, Credit 4 (W)**

0303-800 **Graduate Seminar**
Seminar series intended to present the state of the art in industrial engineering. Other research-related topics may be presented such as library search techniques, thesis writing, etc. All MS industrial engineering students are required to register for at least 3 quarters. (Graduate standing in MS in industrial engineering) **Credit 0 (F, W, S)**

0303-801 **Design for Manufacture**
This course presents an overview of the factors influencing product design and the manufacturing cycle. Topics include component design and analysis, design for manufacturability as well as function and design for manual and automated assembly. The various manufacturing processes as they relate to modern trends in DFM are covered. (0303-343) **Class 4, Credit 4 (S)**

0303-886 **Systems Engineering**
An introduction to systemic thinking, systems architecture, and systems analysis with a focus on devices that are integrated into the larger systems. Systems engineering, systems architecture and product development processes are introduced and applied in a term-long project centered on a device of the student's choosing. Students identify customer requirements, translate them to critical design parameters, define a system architecture, then analyze the behavior, design windows, reliability and life-cycle cost trade-offs. (Enrollment in the Ph.D. microsystems engineering degree program or permission of the instructor) **Class 4, Credit 4 (W)**

0303-890 **Research and Thesis**
In conference with a faculty adviser, an independent engineering project or research problem is selected. The work may be of a theoretical and/or computational nature. A state-of-the-art literature search in the area is normally expected. A formal written thesis and an oral defense with a faculty thesis committee are required. Submission of bound copies of the thesis to the library and to the department and preparation of a written paper in a short format suitable for submission for publication in a refereed journal are also required. Approval of department head and faculty adviser needed to enroll. **Credit variable 1–9 (F, W, S, Su)**

0303-891 **Capstone Integrative Project**
For the MS in Manufacturing Leadership (MML) program. The purpose of the project is for students to demonstrate integrative application of knowledge and skills that they have acquired during the program. A capstone project will be oriented to the solution of manufacturing, operations, or supply chain management problem or to technically related processes. Each project will define an actual problem and solve it, or select and develop a needed process. Each project must be approved in advance by the Capstone Coordinator. A suitable project will be multi-disciplinary or multi-functional in nature and will have significant impact on one or more competitive capabilities of the organization, e.g., quality, lead time, cost, flexibility, or service. Team-based projects are strongly recommended. (Completion of 50% of course work in the MML program) **Credit 4 (W)**

0303-892 **Capstone Research Project**
For the MS program in product development (MPD). Students in the MPD program must demonstrate intellectual leadership in the field of new product development. The general intent of the capstone project is to demonstrate the students' knowledge of the integrative aspects of new product development in the context of a corporate-oriented problem solving research project. The project should address issues of significance to multiple functions or disciplines and should draw upon skills and knowledge acquired from various courses and experience in the program. Students are encouraged to start work on the project in advance of receiving formal credit during the final two quarters of the program. Team-based projects are strongly recommended (Completion of 50% of coursework in the MPD) **Credit 4 (each course)**

0303-888 **Graduate Thesis Seminar I**
The first in a two course sequence that introduces students to research methods in industrial engineering. The primary focus of this two-course sequence is on conducting critical reviews of research literature, initiating background research on a thesis topic, and preparing a formal thesis proposal. At the conclusion of the first course students are expected to complete a critical literature review and plan of study for the Master of Science degree. At the end of the second course, students are expected to submit a formal thesis proposal and associated literature review. This course is specifically designed for students enrolled in the MS program offered through the department. (Matriculated in the MS program) **Class 2, Credit 0**

0303-889 **Graduate Thesis Seminar II**
The second course in a two course sequence that introduces students to research methods in industrial engineering. The primary focus of this two-course sequence is on conducting critical reviews of research literature, initiating background research on a thesis topic, and preparing a formal thesis proposal. At the conclusion of the first course students are expected to complete a critical literature review and plan of study for the Master of Science degree. At the end of the second course, students are expected to submit a formal thesis proposal and associated literature review. This course is specifically designed for students enrolled in the MS program offered through the department. (0303-888 and matriculated in the MS program) **Class 2, Credit 0**

Mechanical Engineering

0304-701 **Research Methods**
This course introduces students to research methods in mechanical engineering. A primary focus of the course is on conducting critical reviews of research literature, preparing a formal thesis proposal, and initiating background research on a thesis topic. At the conclusion of the course, the students are expected to submit a formal thesis proposal, literature review, and plan of study for the completion of the Master of Science degree. This course is specifically designed for students enrolled in the dual degree MS/BS program offered through the department. (Consent of instructor. Restricted to dual degree students.) **Class 4, Credit 4**

0304-710 **Fuel Cell Technology**
Fuel cell technology is an emerging technology for electric power on demand, and can be used for stationary power generation or for driving vehicles. Fuel cell, the heart of this technology, is an electro- chemical devise that produces electricity via cell reactions from useful chemical energy stored in fuel. After learning fuel cell basics and operating principles, fuel cell performance will be considered from energy and thermodynamic viewpoints. Types discussed are polymer electrolyte membrane fuel cell (PEMFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cell (SOFC). Modeling of one fuel cell type will demonstrate design and analysis of systems and the information and components needed to make the system successful. Also discussed: thermal system design and analysis issues, limitations, cost effectiveness and efficiency. **Class 4, Credit 4**

0304-714 **Thermal Radiation Heat Transfer**
Course focuses on the following topics: fundamentals of radiative heat transfer, the blackbody, electromagnetic theory, properties of solid materials, gray surfaces, and shape factors; energy exchange between surfaces and in enclosures when no attenuating media is present. An introductory discussion of radiative transfer in the presence of an attenuating medium is also included. (Graduate standing and departmental approval required) **Class 4, Credit 4**

0304-720 **Optimization**
This course is an introduction to basic optimization techniques for engineering design synthesis. It covers concepts of design variables, constraints, objective functions, penalty functions, Lagrange multipliers. Techniques include solving constrained and unconstrained optimization problems through classical approaches, steepest descent, conjugate directions, conjugate gradient, controlled random searches, sequential linear programming, as well as some heuristic methods. Numerical solutions are obtained using commercially available software. A design project is required. (0304-440) **Class 4, Credit 4**

0304-729 **Renewable Energy Systems**
This course provides an overview of renewable energy system design. Energy resource assessment, system components, and feasibility analysis will be covered. Possible topics to be covered include photovoltaics, wind turbines, solar thermal, and hydropower. Students will be responsible for a final design project. (0304-415, 514) **Class 4, Credit 4**

0304-730 **Design Project Management**
This course focuses on preparing students to take on a leadership role in design project teams. Topics include product development processes, management of design project teams, developing a business case for design projects, understanding customer needs and translating them into engineering specifications, tools for developing design concepts, tools for assessing the feasibility of design concepts, conducting engineering tradeoffs and analysis to synthesize a preliminary design. Students use the concepts and tools discussed throughout the course in a team-based environment to develop project readiness packages for subsequent use by senior design teams. (0304-514 or permission of instructor) **Class 4, Credit 4**

0304-733 **Sustainable Energy Management**
This course, Sustainable Energy Management and the Built Environment, provides an overview of mechanical and associated control systems within buildings with an emphasis on sub-systems which possess the most visible energy signature in terms of energy usage, energy inefficiency, and societal/global impact. Fundamentals of system operation are explored as well as energy management techniques. Using domestic and international case studies which highlight energy management within the built environment, students will explore methods by which engineers have achieved solutions aligned with sustainability. (0304-643, 660) **Class 4, Credit 4**

0304-739 **Alternative Fuels and Energy Efficiency**
This course, Alternative Fuels and Energy Efficiency for Transportation, provides an overview of the potential alternative fuels and energy efficiency technologies for powering current and future vehicles. Alternative fuel production technologies and utilization of fuels such as biodiesel, ethanol, and hydrogen will be covered. The primary technical and environmental issues associated with these alternative fuels will be discussed. Approaches to improving vehicle efficiency will also be explored. Students will be responsible for a final design or research project. (0304-640) **Class 4, Credit 4**

0304-743 **Intermediate Control Systems**
This course builds on the fundamentals of continuous feedback control to introduce the student to computer (digital) regulation of systems in closed-loop. Discrete-time modeling and stability of signals and systems are discussed. Analog and digital control schemes are compared using s domain to z-domain conversion, and time-domain response characterization. Closed-loop system design objective specification and evaluation is conducted through numerical simulation and experimental observation. Various discrete-time controller designs are implemented on motor control modules (used previously in 0304-643) for velocity and position feedback regulation. (0304-643) **Studio Lab 4, Credit 4**

0304-746 **Engineering Properties of Materials**
This course presents the principles behind various properties of materials from an atomic and molecular perspective. Topics from physical chemistry and solid state physics and engineering are covered. Topics include: crystallography, thermodynamics of condensed phases, and thermal, elastic, electrical and magnetic properties. This course is oriented for advance undergraduate and graduate students with previous knowledge of materials science. (0304-344) **Class 4, Credit 4**

0304-752 **Tribology Fundamentals**
This course provides an overview of the role of fluid-film lubrication in mechanical design, with strong emphasis on applications. Various forms of the Reynolds equation governing the behavior of lubricant films for planar, cylindrical, and spherical geometry are derived. Mobility and impedance concepts as solution methods of the Reynolds equation are introduced for the performance assessment of lubricated journal bearings under static and dynamic loading. Short, long, and finite bearing assumptions are discussed. Finite element methods for the analysis of fluid-film bearings of arbitrary geometry will be introduced. (0304-415, 437 or equivalent, finite element background desirable but not required) **Class 4, Credit 4**

0304-754 **Fundamentals of Fatigue and Fracture Mechanics**
This course is an introduction to the fatigue life prediction methodologies and basic fracture mechanics. Students will be introduced to linear elastic fracture mechanics, including stress intensity factor and crack tip plastic zone models. The fatigue methodologies to be covered include the Stress-Life Theory (used for machine elements), Strain-Life Theory (used for large-displacement samples and low cycle fatigue problems), and a fracture mechanics approach to fatigue analysis (used in the aircraft and space industries). (0304-437, 440) **Class 4, Credit 4**

0304-758 **Intermediate Engineering Vibrations**
This course is a continuation of the introductory vibration course, 0304-658. Advanced topics such as flexibility and stiffness influence coefficients, continuous systems modeling of strings, rods, bars and beams, and modeling using finite element method will be discussed. (0304-658) **Class 3, Lab 2, Credit 4**

0304-799 **Special Topics**
Topics and subject areas that are not among the courses listed here are frequently offered under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate standing) **Class 4, Credit 4**

0304-816 **Finite Elements**
This is an introductory course on the modern theory of finite element analysis. Although the necessary mathematics will be kept to a minimum, the course content has been designed to provide the skills necessary to write an F. E. program and to understand the structure and capabilities of commercially available codes. Applications to problems in structural mechanics, heat transfer and fluid mechanics. (0304-870, 885) **Class 4, Credit 4**

0304-823 **Systems Modeling**
This course is designed to introduce the student to advanced systems modeling techniques and response characterization. Mechanical, electrical, fluid, and mixed type systems will be considered. Energy-based modeling methods such as Lagrange's methods will be used extensively for developing systems models. System performance will be assessed through numerical solution using MATLAB/Simulink. Linearization of nonlinear system models and verification methods are also discussed. (0304-543 or equivalent) **Class 4, Credit 4**

0304-828 **Special Topics**
In response to student and/or faculty interest, special courses which are of current interest and/or logical continuations of regular courses will be presented. These courses will be structured as ordinary courses with specified prerequisites, contact hours and examination. (Graduate standing) **Class 4, Credit 4**

0304-830 **Introduction to CFD Analysis**
This graduate core course covers basic numerical techniques applicable to equations in fluid mechanics and heat transfer. Numerical methods required for programming partial differential equations are introduced. Course work involves analytical programming and design examples. Commercial software is also explored. (0304-838, 851) **Class 4, Credit 4**

0304-831 **CFD Applications**
This course introduces the students to some of the commercial CFD codes being used for solving thermal-fluid problems. After an introduction to in-house CFD codes, students are expected to complete an individual CFD study project including a written report and a presentation of the results as part of the course requirements. (0304-416) **Class 4, Credit 4**

0304-833 **Heat Exchanger Design**
This course presents an overview of the different heat exchangers used in industry including shell-and-tube, plate, tube-fin, and plate-fin heat exchangers. Analytical modeling of recuperators, regenerators, and transient performance is also covered. Thermal design methods for designing shell-and-tube and compact heat exchangers are presented. Students are required to carry out a major design project in the course. (0304-514; 0304-550 or 851) **Class 4 Credit 4**

0304-834 **Boiling and Condensation**
This course provides a basic understanding of the phase change phenomena associated with boiling and condensation heat transfer. This knowledge is applied in the design of industrial systems such as evaporators, condensers and distillation columns. Students are required to undertake a major design project in the course. (0304-514, 550) **Class 4, Credit 4**

0304-838 **Ideal Flows**
This graduate core course covers the fundamental topics in the theory of aerodynamics and high speed flows. The course discusses modern aerodynamic applications in the areas of wing and airfoil design, wind tunnel testing and compressible flows. (0304-415) **Class 4, Credit 4**

0304-843 **Advanced Control Systems**
Introduction to advanced control systems, including elements of continuous, digital, and nonlinear control systems theory. Topics include continuous to digital control conversion using finite difference solutions; continuous to digital control conversions using state equation approach; stability of discrete systems; PID control design for digital systems; frequency domain control system design methods (PID, lead, lag, lead-lag compensation design) for continuous systems, and for digital systems using phase loss methods and bilinear transformations; z-transforms for discrete systems; digital control system design using root locus; deadbeat control design; nonlinear control design using feedback linearization; sliding control method; eigen-structure assignment methods; fuzzy logic; neural-net; and introduction to H-infinity control. (0304 743) **Class 4, Credit 4**

0304-847 **Microscale Heat/Mass Transfer**
Deals with the effects of microscale dimensions on fluid flow, and heat transfer phenomena. The basic difference associated with these phenomena at microscale levels are presented through analytical equations, presenting theoretical aspects followed by practical examples. Topics covered include microscale heat conduction, heat transfer in thin film, transport equations for single-phase flow for high Knudsen number flows, gas compressibility, effects, single phase pressure drop equations for gases and liquids, heat transfer equations, laminar to turbulent transition, slip flow, transition flow, free molecular flow, two-phase flow considerations, and practical applications in micro-scale thermal and fluid flow devices. Each student will also work on an independent analytical or experimental project. (0304-413, 415, 416, 514. Consent of instructor.) **Class 4, Credit 4**

0304-848 **Special Topics-Thermal Fluids**
In response to student and/or faculty interest, special courses that are of current interest and/or logical continuation of regular courses will be presented. (Graduate standing) See instructor for more details. **Class 4, Credit 4**

0304-851 **Convective Phenomena**
This course introduces the student to the flow of real incompressible fluids. The differential approach is used to develop and solve the equations governing the phenomena of mass, momentum, and heat transfer. The material in the course provides the necessary background for a study of computational fluid dynamics. (0304-415, 514) **Class 4, Credit 4**

0304-852 **Advanced Turbomachinery**
This course introduces the student to some of the advanced topics in turbomachinery. Topics include airfoil theory, two-and three- dimensional flow analysis in radial and axial turbomachines, and turbomachinery flow stability characteristics. Students are expected to do a design project using FLUENT Computational Fluid Dynamics code. (0304-550, 652) **Class 4, Credit 4**

0304-865 **Computer Implementation of F.E.M.**
This course emphasizes the application of the finite element method to problems in the area of static and dynamic structural analysis, heat transfer, and analogous solution. A standard commercial software package is used for these applications where the general structure, operating characteristics and use of a complex program are presented. Topics include the finite element method; shape factors, element formulation, and the element library; program sequencing; general modeling methods (loads, constraints, material factors, mesh generation, interactive graphics, model conditioning); convergence, error analysis and the "patch" test, vibration and heat transfer analysis, and analogous analysis such as acoustics, illumination, etc. (0304-518 or equivalent) **Class 4, Credit 4**

0304-870 **Mathematics for Engineers I**
This course trains students to utilize mathematical techniques from an engineering perspective, and provides essential background for success in graduate level studies. An intensive review of linear and nonlinear ordinary differential equations and Laplace transforms is provided. Laplace transform methods are extended to boundary-value problems and applications to control theory are discussed. Problem solving efficiency is stressed, and to this end, the utility of various available techniques are contrasted. The frequency response of ordinary differential equations is discussed extensively. Applications of linear algebra are examined, including the use of eigenvalue analysis in the solution of linear systems and in multivariate optimization. An introduction to Fourier analysis is also provided. (1016-318, graduate standing) **Class 4, Credit 4**

0304-871 **Mathematics for Engineers II**
This is a course in partial differential equations focused primarily on separation of variable techniques, and teaches the necessary vector space theory so that the problem solving methodology may be understood completely. Algebraic vector space concepts, such as the basis, are extended to functions, and operator theory is introduced as a means of unifying the solution structure of linear algebraic and differential equation systems. Existence and uniqueness is examined by considering the null and range spaces of algebraic and differential operators, the adjoint operator, and Fredholm's Alternative. Eigenvalue analysis is extended to functions, including an examination of Sturm-Liouville theory. Solutions of Laplace's equation, the heat equation, the wave equation, and the biharmonic equation are examined in a variety of geometries (0304-870 recommended; Graduate standing required) **Class 4, Credit 4**

0304-874 **Numerical Analysis**
This course emphasizes the development and implementation of methods available to solve engineering problems numerically. Specific topics include root finding for algebraic and transcendental equations, systems of linear and non-linear equations, interpolation of numerical data and curve fitting, numerical differentiation and integration, ordinary and partial differential equations, including initial and boundary value problems. (Graduate standing) **Class 4, Credit 4**

0304-877 **Internship**
This course number is used by students in the master of engineering degree program for earning internship credits. Students must submit a proposal for the internship, to be approved by an employing supervisor and the department prior to enrolling. Students are required to submit an evaluation report at the conclusion of the internship. **Credit variable**

0304-880 **Independent Study**
An opportunity for the advanced student to undertake an independent investigation in a special area under the guidance of a faculty member. A written proposal is to be forwarded to the sponsoring faculty member and approved by the department head prior to the commencement of work. (Graduate standing) **Credit variable (maximum of 4 credits per quarter)**

0304-885 **Advanced Mechanics of Solids**
This course extends the student's knowledge of stressed mechanical components covered in Mechanics of Materials and lays the foundation for a follow-on course in finite elements. The basic relationships between stress, strain, and displacements are covered in more depth. Stress and strain transformations, plane elastic problems, and energy techniques are covered. Topics from Advanced Strength of Materials include beam bending and torsion problems not covered in Mechanics of Materials. (0304-347) **Class 4, Credit 4**

0304-888 **Project with Paper**
This course is used by students in the master of engineering degree program for conducting an independent project. The student must demonstrate an acquired competence in an appropriate topic within mechanical engineering. The topic is chosen in conference with a faculty advisor. The work may involve an independent research and/or a design project and/or literature search with a demonstration of acquired skill. A written paper, approved by the adviser and the department, and an oral presentation of the work are required. **Credit 4**

0304-889 **Graduate Seminar**
This seminar course presents topics of contemporary interest to graduate students enrolled in the program. Presentations include off campus speakers, and assistance with progressing on your research. Selected students and faculty may make presentations on current research under way in the department. All graduate students enrolled full time (whether dual degree or single degree) are expected to attend each quarter they are on campus. **Credit 0 (F, W, S)**

0304-890 **Research and Thesis**
In conference with an advisor, a topic is chosen. Periodic progress reports and a final written document with an oral examination are required. (Approval of a thesis proposal approved by a thesis advisor and the department) **Credit variable 5–9**

Microelectronic Engineering

0305-701 **Microelectronics I**
This course introduces the beginning graduate student to the fabrication of solid-state devices and integrated circuits. The course presents an introduction to basic electronic components and devices, lay outs, unit processes common to all IC technologies such as substrate preparation, oxidation, diffusion and ion implantation. The course will focus on basic silicon processing. The students will be introduced to process modeling using a simulation tool such as SUPREM. There is a lab for the on campus section (01), and a discussion of laboratory results and a graduate paper for the distance learning-section (90). The lab consists of conducting a basic metal gate PMOS process in the RIT clean room facility to fabricate and test a PMOS integrated circuit test ship. Laboratory work also provides an introduction to basic IC fabrication processes and safety. **Class 3, Lab 3, Credit 4 (S)**

0305-702 **Microelectronics II**
The fundamental silicon based processing that includes state-of-the- art issues such as thin oxide growth, atomistic diffusion mechanisms, advanced ion implantation and rapid thermal processing (RTP). Computer simulation tools (i.e. SUPREM) are used to model processes, build device structures, and predict electrical characteristics, which are compared to actual device structures that are fabricated in the associated laboratory for on campus and additional course work for distance learning students. A topical graduate research paper is required. Controlled experiments using poly-silicon-Insulator-Semiconductor FET processing is conducted to build and test a variety of devices employing ion implantation, CVD and plasma etching. Extensive use of CAE and SUPREM. (0305-701) **Class 3, Lab 3, Credit 4 (W)**

0305-703 **Microelectronics III**
This course focuses on the deposition and etching of thin films of conductive and insulating materials for IC fabrication. A thorough overview of vacuum technology is presented to familiarize students with the challenges of creating and operating in a controlled environment. Chemical Vapor Deposition (CVD) and electroplating technologies are discussed as methods of film deposition. Plasma etching and Chemical Mechanical Planarization (CMP) are studied as methods for selective removal of materials. Applications of these processes to IC manufacturing are presented. There is an associated laboratory for on campus students and additional course work distance learning students. A topical graduate research paper is required Labs include: vacuum pump-down and evaporation, dc sputtering, reactive magnetron sputtering, chemical mechanical planarization, atmospheric and low pressure chemical vapor deposition and plasma and reactive ion etching. **Class 3, Lab 3, Credit 4**

0305-704 **Semiconductor Process and Device Modeling**
A senior graduate level course on the application of simulation tools for design and verification of microelectronic processes and operation of semiconductor devices. Technology CAD tools include Silvaco (Athena/Atlas) process/device simulators, as well as other simulation tools for specific processes, and math programs that can be used for custom simulation. Various models that describe front-end silicon processes are explored emphasizing the importance of complex interactions and 2D effects, as devices are scaled deep submicron. Includes laboratory exercises on simulation and modeling. (0305-560, 701, 702) **Class 3, Lab 3, Credit 4 (W)**

0305-705 **Quantum and Solid State Physics for Nanostructures**
This course describes the key elements of quantum mechanics and solid state physics that are necessary in understanding the modern semiconductor devices. Quantum mechanical topics include solution of Schrodinger equation solution for potential wells and barriers, subsequently applied to tunneling and carrier confinement. Solid state topics include electronic structure of atoms, crystal structures, direct and reciprocal lattices. Detailed discussion is devoted to energy band theory, effective mass theory, energy-momentum relations in direct and indirect band gap semiconductors, intrinsic and extrinsic semiconductors, statistical physics applied to carriers in semiconductors, scattering and generation and recombination processes. **Class 4, Lab 0, Credit 4 (F)**

0305-706 **SiGe and SOI Devices and Technologies**
This course introduces students to the fundamentals of SiGe and Silicon on Insulator (SOI) devices and fabrication technologies. The course will first discuss the band structure of the SiGe material system, and how its properties of band structure and enhanced mobility may be utilized to improve traditional Si devices. Basic heterojunction theory is introduced to students. Some specific applications that are introduced include heterojunction bipolar transistors (HBTs), SiGe-channel MOS devices, and high-electron mobility transistors (HEMTs). Fabrication technologies for realizing SOI substrates that include SIMOX and SMART CUTTM technologies are described. The physics of transistors built on SOI substrates will be discussed. At the completion of the course, students will write a term paper summarizing the literature in a key topical area of this course. **Class 4, Lab 0, Credit 4 (S, alternate years)**

0305-707 **Nanoscale CMOS and Beyond**
This course is an in-depth study of the principles and practice of scaling-driven CMOS front and back end processing. The course discusses the Semiconductor Industry Association (SIA) International Technology Roadmap for Semiconductors (ITRS) and exposes students to the next generation of nanometer-scale CMOS with device concepts that include quantum mechanical phenomena such as channel confinement and dopant fluctuations. Front end processing includes super steep retrograde wells, high-k gate insulators, metal gate, and ultra shallow source/ drains. Back end topics include interconnect modeling and delay, Low k dielectric and copper damanscence processes. The use of novel substrates such as strained silicon, SiGe and Ge will be described. (0305-560, 701, 702, of nanometer-scale CMOS with device concepts that take advantage of 703) **Class 4, Credit 4 (W)**

0305-714 **Micro/Nano Characterization**
This mechanical elective with weekly lab component focuses on tools and techniques for micro- and nano-characterization of materials, surfaces and thin films. The course covers the principles and applications of four experimental techniques: quantitative imaging, x ray diffraction, scanning probe microscopy, and micro- and nano- indentation. Students will learn the physics of interaction processes used for characterization, quantification and interpretation of collected signals, and fundamental detection limits for each technique. (0304-344 or 1028-701 or 0305-460) **Class 3, Lab 2, Credit 4 (W or S)**

0305-715 **Photovoltaics Science and Engineering**
This course focuses on the principles and engineering fundamentals of photovoltaic (PV) energy conversion. The course will cover modern silicon PV devices, including the basic physics, ideal and non-ideal models, device parameters and design, and device fabrication. The course will discuss crystalline, multi-crystalline, amorphous devices thin films solar cells and their manufacturing. Students will be made familiar on how basic semiconductor processes are employed in solar cells manufacturing. The course will further introduce third generation advanced photovoltaic concepts including compound semiconductors, spectral conversion, and organic and polymeric devices. PV applications, environmental and economic issues will also be discussed. Evaluation will include in addition to assignments and exams, a research/term paper on a current PV topic. **Class 4, Credit 4, (W)**

0305-717 **Memory Systems**
This course targets the overlapping areas of device physics, VLSI Design, advanced processes, electrical characterization and circuit architecture as it applies to modern memory systems. While there are no specific set of pre-requisite courses, students should be willing to work on problems involving the previously mentioned topics. Course work will trace the design, development, fabrication, packaging and testing of SRAM, DRAM and Flash Memory, and then branch off into MRAM, FRAM and PRAM technology. The course wraps up with an exploration of future memory system candidates such as quantum, molecular and optical memory systems. Students will write a term paper on an aspect of memory systems of particular interest to them. (Proposed topic must still be approved by the instructor.**)** **Class 4, Credit 4 (S, alternate years)**

0305-721 **Microlithography Materials and Processes**
This course covers the chemical aspects of microlithography and resist processes. Fundamentals of polymer technology will be addresses and the chemistry of various resist platforms including novolac, styrene and a acrylate systems will be covered. Double patterning materials will also be studied. Topics include the principles of photoresist materials, including polymer synthesis, photochemistry, processing technologies and methods of process optimization. Also advanced lithographic techniques and materials and processes are applied to optical lithography. There is an associated laboratory for on campus students and additional course work for distance learning students. A topical graduate research paper is required. **Class 3, Lab 3, Credit 4**

0305-722 **Microlithography Systems**
This course covers the physical aspects of lithography. Topics include iImage formation in optical projection, optical proximity, and high-energy systems (DUV/VUV, e-beam/SCALPE, X-ray, and EUV) are studied. Fresnel diffraction, Fraunhofer diffraction, and Fourier optics are utilized to understand diffraction-limited imaging processes, illumination, lens parameters, image assessment (resolution, alignment and overlay), phase-shift masking, and resist interactions. Lithographic systems are designed and optimized through use of modeling and simulation packages. Current status of the practical implementation of advanced technologies in industry as well as future requirements will be presented. There is an associated laboratory for on campus students and additional course work for distance learning students. A topical graduate research paper is required. **Class 3, Lab 3, Credit 4**

0305-731 **Microelectronics Manufacturing I**
This course focuses on CMOS manufacturing. Topics include CMOS process technology, work in progress tracking, CMOS calculations, process technology, long channel and short channel MOSFET, isolation technologies, back-end processing and packaging. There is an associated laboratory for on campus students and additional coursework for distance learning. The laboratory for this course is the student-run factory. Lot tracking, data collection, lot history, cycle time, turns, CPK and statistical process control are introduced to the students. Silicon wafers are processed through an entire CMOS process and tested. Students design unit processes and integrate them into a complete process. Students evaluate the process steps with calculations, simulations and lot history, and test completed devices. **Class 3, Lab 3, Credit 4 (W)**

0305-732 **Microelectronics Manufacturing II**
This course focuses on techniques used to evaluate and improve CMOS manufacturing. Topics include query processing, measuring factory performance, factory modeling and scheduling, cycle time management, cost of ownership, defect reduction and yield enhancement, reliability, 6 sigma manufacturing, process modeling and RIT's advanced CMOS process. There is a lab for the on campus section (01) and a graduate paper for the distance learning section (90). Laboratory experiences are related to the operation of the student run integrated circuit factory. Silicon wafers are processed through a complete CMOS process. (0305-731) **Class 3, Lab 3, Credit 4 (S)**

0305-760 **Principles of Semiconductor Devices**
This course will discuss the fundamentals underlying the operations of basic semiconductor devices employed in modern integrated circuits. The course includes modules on semiconductor fundamentals, P-N junction diodes, metal-semiconductor junctions, metal-oxide semiconductor capacitors, field effect transistors, and bipolar junction transistors presented through a series of lectures that qualitatively and quantitatively explain the operation of semiconductor devices. Each module features a segment on "deviations from ideality" that are observed in practical semiconductor devices and will provide insight into the constraints imposed by VLSI design rules and processing. This course is an online course only intended for professionals employed in various aspects of the semiconductor industry. **Class 4, Credit 4 (F, S)**

0305-770 **Independent Study**
This course number should be used by students who plan to study a topic on an independent basis under the guidance of a faculty member. A written proposal with an independent study form is to be submitted to the sponsoring faculty member and approved by the department head prior to the commencement of work. **Credit variable. (Maximum of 4 credits per quarter)**

0305-777 **Internship**
This course number is used to fulfill the internship requirement for the master of engineering degree program. The student must obtain the approval of the department head before registering for this course. **Credit variable**

0305-801 **Seminar/Research**
Weekly seminar series intended to present the state of the art in microelectronics research. Other research-related topics will be presented such as library search techniques, contemporary issues, ethics, patent considerations, small business opportunities, technical writing, technical reviews, effective presentations, etc. Required of all MS microelectronic engineering students for one credit up to a total 4 credits. After 4 credits, graduate students are required to register each quarter for zero credits. (Graduate standing in MS in microelectronic engineering) **Credit 1–4 (F, W, S)**

0305-830 **Metrology for Yield and Failure Analysis**
Successful IC manufacturing must detect defects (the non-idealities) that occur in a process), eliminate those defects that preclude functional devices (yield enhancement), and functionality for up to ten years of use in the field (reliability). Course surveys current CMOS manufacturing to compile a list of critical parameters and steps to monitor during manufacturing. This survey is followed with an in depth look at the theory and instrumentation of the tools utilized to monitor these parameters. Tool set includes optical instrumentation, electron microscopy, surface analysis techniques, and electrical measurements. Case studies from industry and prior students are reviewed. Students are required to perform a project either exploring a technique not covered in class, or to apply their course knowledge to a practical problem. (0305-560, 701) **Class 4, Credit 4 (F)**

0305-870 **Microelectromechanical Systems**
This course will provide an opportunity for students to become familiar with the technology and applications of microeletromechanical systems (MEMS)--one of the fastest growing areas in the semiconductor business. MEMS represents the integration of microelectronic chips with microsensors, probes, lasers, and actuators. Topics include basic principles of MEMS and fabrication methodologies. The accompanying laboratory will carry out design and fabrication of MEMS structures/devices using microfabrication techniques. **Class 3, Lab 3, Credit 4 (W, S)**

0305-890 **Special Topics**
This is a variable credit, variable special topics course that can be in the form of a regular course or independent study under faculty supervision. Some of the topics are SOI device technology, compound semiconductors and devices, quantum devices, and Nanotechnology. **Class 4, Lab 0, Credit 4**

0305-899 **Thesis**
The master's thesis in microelectronic engineering requires the student to prepare a written thesis proposal for approval by the faculty; select a thesis topic, adviser and committee; present and defend thesis before a thesis committee; submit a bound copy of the thesis to the library and to the department; prepare a written paper in a short format suitable for submission for publication in a journal; complete course work and thesis within a seven-year period; register for one credit of Continuation of Thesis each school term (except summer quarter) after the 45 credits required for the master's degree until the thesis is completed. (Graduate standing in MS in microelectronic engineering) **Credit variable 1 to 9 (F, W, S, Su)**

Computer Engineering

0306-710 **Network Modeling, Design and Simulation**
This course covers theories for network design and modeling and case studies to apply the theories. Mathematical models, such as queuing theory, graph theory, and optimization techniques for analyzing network topology, traffic, and algorithms are introduced. State-of-the-art network problems and solutions are discussed and analyzed using the various network theories as well as network simulation tools (e.g., OPNET). Students are expected to actively research technical papers and participate in in-class discussions. Assignments include homework, exams, paper readings, projects, and individual presentations. (0306-381, 694/794; or permission of instructor) **Class 4, Credit 4**

0306-715 **Wireless Networks**
As interest in wireless technology is booming, wireless networks are enjoying very fast growth. This course covers fundamental techniques in design and operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, radio propagation models, error control techniques, handoff, power control, common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc), radio resource and network management. As an example for the third generation air interfaces, wireless internet and sensor networks are discussed in detail since they are expected to have a large impact on future wireless networks. This course is intended for graduate students who have some background on computer networks, but it is also open to senior undergraduates. (0306-694 or permission of instructor) **Class 4, Credit 4**

0306-720 **Electronic Design Automation**
The creation of large, complex electronic systems has grown beyond the capabilities of any number of designers without computer support. Successful completion of large design projects requires that computers be used in virtually all aspects of design. This course explores some of the basic design automation tools and algorithms in order to understand their capabilities, limitations and internal operations. Topics covered include review of the VHDL hardware description language, simulation techniques, design synthesis, placement and routing, and design verification methods. Laboratory projects in the use and creation of design automation tools are required. (0306-351, 0306-561 or equivalent; 0306 630/730 recommended) **Class 3, Lab 3, Credit 4**

0306-722 **Advanced Computer Architectures**
This course emphasizes the impact of VLSI and communication issues on computer architecture. Topics include highly concurrent, multiprocessor and reconfigurable computer systems as well as data flow architectures. Modeling techniques for system verification are included. (0306-551) **Class 4, Credit 4**

0306-724 **High Performance Architecture**
This course will focus on learning and understanding the available hardware options to satisfy the needs of high performance and computational intensive applications. Special attention will be paid to single platform massively parallel devices, their programming and efficient use of the hardware resources. The course will include hands on work with the actual device, lab work, and technical reports and conference paper reading as a relevant source of information. (0306-381 and 0306-551 or department approval) **Class 2, Lab 2, Credit 4**

0306-730 **VLSI Design**
An introduction to the design and implementation of Very Large Scale Integration (or VLSI), including NMOS and PMOS devices, CMOS circuits and digital subsystems. The procedures for designing and implementing digital integrated systems will be covered including the Mead and Conway structured design approach consisting of the use of stick diagramming, scaling of CMOS design rules and techniques for estimating time delays. Emphasis will be placed on the use of static CMOS circuits and regular structures such as programmed logic arrays in custom and standard cell-based designs. The use of workstations with Mentor Graphics design tools for circuit simulation and physical layouts will be stressed. Graduate level laboratory design projects will be required. (0306-561, 460 or equivalent) **Class 4, Lab 2, Credit 4 (F, W, S)**

0306-731 **VLSI Design Projects**
A second course in the design and implementation of Very Large Scale Integration (VLSI) circuits and systems. Emphasis will be placed on the design and use of dynamic precharge and precharge-evaluate CMOS circuitry including Domino, NORA and Zipper CMOS logic, and sub- systems. Basic requirements of a clocking system and a general clocking strategy for timing design in both static and dynamic CMOS circuits will be investigated. Topics on the design and use of a standard cell library in the implementation of large system designs will be covered. The use of workstations with Mentor Graphics design tools and Synopsys synthesis tool suite will be required in laboratory projects leading to the design, VHDL synthesis and testing of an integrated circuit device. (0306-730) **Class 4, Lab 2, Credit 4 (S)**

0306-732 Low Power Design
This course covers the theory and practical aspects of low-power integrated circuit design in CMOS technology. Topics include: estimation and modeling power dissipation in CMOS circuits at different design abstractions, power optimization techniques with emphasis on transistor and system level, energy efficient SRAM cells and cache designs, low power design methodology, effect of device scaling, process variations and their impact on power optimization, and post-CMOS logic gates. Assignments and projects focus on designing low-power circuits using Synopsys CAD tools. Presentations and term papers based on recent energy efficient research articles are required. (0306-630/730, 351, 0306-561 or equivalent) **Class 4, Lab 2, Credit 4**

0306-740 Analytical Topics for Computer Engineers
This course begins by reviewing signal and system analysis techniques for analyzing linear systems. It includes Fourier techniques and moves on to present fundamental computational techniques appropriate for a number of applications areas of computer engineering. A section on numerical linear algebra covers techniques for analyzing discrete time signals and systems. Other course topics include symbolic logic and optimization techniques. (0306-451 and 1016-265, 306, 331, 345 or equivalent) **Class 4, Credit 4 (F, W)**

0306-756 Multiple Processor Systems
Introduces basic concepts of parallel and high-performance computing and current methodologies and trends in the design and programming of multiprocessor systems. Theoretical models of parallel computing and performance metrics are studied and contrasted with practical parallel system architectures, programming environments, and benchmarking techniques. Parallel architectures are classified according to mode and degree of parallelism, memory organization, and type and topology of interconnection networks used in the design. In depth study of various architectures with representative samples of current commercial machines is included. Students complete programming assignments on a parallel computer illustrating practical issues. A review and analysis of a commercial parallel processor system or an active research topic is required; written review is presented in class. (0306-551) **Class 4, Credit 4 (S)**

0306-758 Fault Tolerant Digital Systems
This course addresses the following advanced topics: formal models and concepts in fault diagnosis, test generation, design for testability techniques, design techniques to achieve fault tolerance, system evaluation techniques, design of practical fault-tolerant systems, and fault-tolerant design of VLSI circuits and systems. (0306-561, 550) **Class 4, Credit 4**

0306-763 Embedded and Real-time Systems
A first course in an elective sequence begins by presenting a general roadmap of real-time and embedded systems. Conducted in a studio class/lab format with lecture material interspersed with lab work, this course introduces a representative family of microcontrollers exemplifying unique positive features as well as limitations of microcontrollers in embedded and real-time systems. Microcontrollers will be used as external, independent performance monitors of more complex real-time systems. Much of the material focuses on a commercial real-time operating system, using it for programming projects on development systems and embedded target systems. Fundamental material on real-time operating systems will be presented, including scheduling algorithms, priority inversion, and hardware-software co-design. (4010-361 and 0306-250 or equivalent, 4003-440 recommended) **Class 4, Credit 4**

0306-764 Modeling of Real-time Systems
This course introduces the modeling of real-time software systems. It takes an engineering approach to the design of these systems by analyzing a model of the system before beginning implementation. UML will be the primary modeling methodology. Non-UML methodologies will also be discussed. Implementations of real-time systems will be developed manually from the models and using automated tools to generate the code. **Class 4, Credit 4**

0306-772 Special Topics in Computer Engineering
Topics and subject areas that are not among the courses listed here are frequently offered under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. **Credit variable (no regular course schedule)**

0306-775 Robotics
This course deals with mobile robotics. The development of the field and an overview of the different approaches to mobile robot guidance (knowing where we are and where we want to go) navigation (formulating a plan to get where we want to go) and control (following a desired path) will be given. The emphasis of the course will be on algorithms and techniques and relevant projects will be assigned. (0306-451) **Class 4, Credit 4**

0306-776 Robust Control
One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop control system to continue to perform satisfactorily despite large variations in the (open-loop) plant dynamics and the environment. This new approach has been successfully applied to high performance servo drive systems, unmanned aerial vehicles, visual feedback systems and mobile robots among others. This course will provide an introduction to state-of-the-art techniques for analysis and design of robust feedback systems. MATLAB will be used extensively for analysis, design and simulation. (0306-553 or equivalent, 1016-331 or equivalent is recommended) **Class 4, Credit 4**

0306-784 Digital Image Processing Algorithms
Emphasizes both theory and implementation of image processing algorithms. Two-dimensional sampling, transforms, and filtering are introduced and used for image enhancement, compression, restoration, segmentation, and applications in color and video processing. Project assignments involve Matlab implementation of algorithms and paper reviews. (0306-451, 1016-345 or instructor's permission) **Class 4, Credit 4**

0306-785 Computer Vision
This course covers both fundamental concepts and the more advanced topics in Computer Vision. Topics include image formation, color, texture and shape analysis, linear filtering, edge detection and segmentation. In addition, students are introduced to more advanced topics, such as model based vision, object recognition, digital image libraries and applications. Homework, literature reviews and programming projects are integrated with lectures to provide a comprehensive learning experience. (0306-451, 1016-345) **Class 4, Credit 4**

0306-790 Graduate Seminar in Computer Engineering
The purpose of the Graduate Seminar in Computer Engineering is to prepare graduate students to effectively conduct their thesis research. Current literature topics in the computer engineering discipline are reviewed through interactive presentations and discussions. Professional communications are stressed for the purpose of giving presentations and writing thesis documents and technical papers. Student assignments include literature surveys, in class presentations, and critical analysis reports. (Graduate standing or permission of instructor) **Class 1, Credit 0 (F, W, S)**

0306-794 Data and Computer Communications
Provides a unified view of the broad field of data and computer communications and networking. Emphasis is on the basic principles underlying the technology of data and computer networks. Critical issues in data communication networks as well as the current and evolving standards in computer communication architecture are discussed. The topology, access control and performance of various types of networks are studied in detail. A comprehensive student project is required. (1016-345 or permission of instructor) **Class 4, Credit 4 (F, W)**

0306-795 Network Security
This course covers a set of advanced topics in wireless and wired network security design. It targets deep-level network security protocols design. The topics include Applied Cryptography fundamentals, Internet security (IPSec, Kerbos, Email security, etc.), Wireless LAN security, Sensor Network, security, and Ad hoc network security. Class projects include Java/C-based RC4/Hash design, Milinx-based TCP security experiments and Wireless security research. (0306-694 or equivalent) **Class 4, Credit 4**

0306-890 Thesis
Thesis research investigates an independent problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty adviser to guide the thesis before registering. Thesis may be used to earn a minimum of 1 and a maximum of 9 credits. **Credit variable**

Quality and Applied Statistics

0307-702 Statistics for Data Mining
This course provides an introduction to the statistical thinking, terminology, principles, and methods needed to gain a reasonable understanding of the statistical principles used in standard data-mining techniques. Topics include normal, binomial, t, and chi-square distributions; estimation, hypothesis-testing, and statistical intervals; lift charts and ROC curves; linear regression, logistic regression, classification trees, naïve Bayes, mixtures of distributions, and the EM algorithm; cross validation, and bagging. This course does not count as credit for either the CQAS advanced certificates or MS degree (1016-351 or equivalent) **Credit 4**

0307-711 Fundamentals of Statistics I
For those taking statistics for the first time. Topics include organizing observed data for analysis, understanding of variability, graphical methods, and summary statistics; simple, conditional, and joint probabilities; combinations, permutations; binomial, Poisson, and normal distributions; sampling distributions and the Central Limit Theorem. This course does not count as credit for either the CQAS advanced certificates or MS degree. **Credit 3 or 4**

0307-712 Fundamentals of Statistics II
Continuation of 0307-711. Topics include estimation, confidence intervals, and hypothesis testing; tests for independence and analysis of categorical data; two-sample problems; designed experiments with one or two factors; introduction to analysis of variance, simple and multiple linear regression, and correlation. This course does not count as credit for either the CQAS advanced certificates or MS degree. (0307-711 or equivalent) **Credit 3 or 4**

0307-714 Principles of Applied Statistics
Review of fundamental probability theory; review of key distributions in statistics; syntheses of key ideas; use of simulations; probability plotting; linear combinations of random variables; hypothesis testing; importance of assumptions; confidence intervals and other statistical intervals; goodness-of-fit tests; multiple comparisons. This course does not count as credit toward either the CQAS advanced certificate or MS degree. (0307-712 or equivalent) **Credit 3**

0307-721 Statistical Process Control
A practical course designed to provide in-depth understanding of the principles and practices of statistical process control. Topics include statistical concepts relating to processes, Shewhart charts for measurement and attribute data, CUSUM charts, EWMA charts, measures of chart performance, tolerances, specifications, process capability studies, short-run control charts. (0307-712 or equivalent) **Credit 3 or 4**

0307-731 Statistical Acceptance Control
How to apply modern process-oriented sampling plans to assess performance of product and processes. Topics include single, double, multiple and sequential sampling plans, variables sampling, techniques for sampling continuous production, skip-lot plans, chain plans, AOQL schemes, AQL sampling systems and recent contributions to the literature. (0307-712 or equivalent) **Credit 3 or 4**

0307-742 Statistical Computing
This course focuses on the programming language used in SAS statistical software to read in raw data, create and manipulate SAS data sets, and create SAS macros. This course covers the material required for "SAS Base Programmer" certification. Students seeking employment in statistical professions are encouraged to attain this certification. Corresponding Minitab commands and macro programming will also be covered. (0307-712 or equivalent) **Credit 3**

0307-751 Mathematics for Statistics
This is a survey of the mathematical tools of some of the more rigorous statistics courses of the MS program. The topics include partial and higher-order differentiation, various methods of integration, the gamma and beta functions, and a brief overview of linear algebra, all in the context of application to statistics. (The course assumes calculus prerequisites for the program have been met; it is not a substitute for the program's calculus requirements.) (0307-712 or equivalent) **Credit 3**

0307-770 Design of Experiments for Engineering and Science
This course covers the fundamentals of the logical and economical approach to the design and analysis of engineering, scientific and industrial experiments. It integrates the essential organizational aspects of experimentation with proven statistical approaches. Designs covered include the two-level factorial and fractional factorial, response surface designs (CCD), blocking designs when randomization is restricted, and nested designs to uncover sources of variation. The appropriate analysis methods complement the designs. Simulation modeling and robust design show the power and applicability of the information derived from the designed experiments. This course is intended for non-CQAS students. It does not count as credit for either the CQAS advanced certificates or MS degree. (1016-314 or 1016-319 or 1016-351 or 0307-712 or equivalent) **Credit 4**

0307-772 Applied Survey Design and Analysis
This course is an introduction to sample survey design with emphasis on practical aspects of survey methodology. Topics include survey planning, sample design and selection, survey instrument design, data collection methods, and analysis and reporting. Application areas discussed will include program evaluation, opinion polling, customer satisfaction, product or service design, and evaluating marketing effectiveness. Data collection methods to be discussed will include face-to-face, mail, Internet and telephone. (0307-712 or equivalent) **Credit 3 or 4**

0307-781 Quality Management
This course focuses on ASQ's Certified Quality Manager body of knowledge and introduces process improvement methodologies, including the Six-Sigma framework. Topics include quality standards and awards, organization for quality, customer satisfaction, continuous improvement, team management, quality costs, project management, and process improvement methodologies. **Credit 3 or 4**

0307-782 Quality Engineering
This course, in conjunction with 0307-781, covers the non-statistical elements in ASQ's Certified Quality Engineer body of knowledge. Topics include quality philosophies, elements of a quality system, quality planning, supplier management, quality auditing, quality and management tools, process and material control, measurement systems, and safety and reliability. **Credit 3 or 4**

0307-801 Design of Experiments I
Topics include completely randomized designs, randomized complete block designs, Latin square designs, incomplete block designs; general factorial designs, including fixed, random, and mixed-effects models and expected mean squares; nested designs; split-plot designs. (0307-712 or equivalent) **Credit 3 or 4**

0307-802 Design of Experiments II
How to design and analyze experiments, with an emphasis on applications in engineering and the physical sciences. Topics include the role of statistics in scientific experimentation; general principles of design, including randomization, replication, and blocking; replicated and unreplicated two-level factorial designs; two-level fractional-factorial designs; response surface designs; evolutionary operation. (0307-801) **Credit 3 or 4**

0307-803 Design and Analysis of Experiments III
A continuation of the DOE sequence, covering more advanced, but applied, topics and providing a strong foundation for handling complex and nonstandard situations. Topics include design and analysis of general, complete balanced designs, including continued study of variance components, mixed models, split-plot, and arbitrarily complex "no-name" designs; restricted and unrestricted forms of the model; design and analysis of general unreplicated designs; optimal designs for non-standard situations, using D optimality and related criteria. (0307-802, 841; 0307-742 suggested) **Credit 3**

0307-821 Theory of Statistics I
This course introduces the student to the fundamental principles of statistical theory while laying the groundwork for study in the course sequel and future reading. Topics include classical probability, probability mass/density functions, mathematical expectation (including moment-generating functions), special discrete and continuous distributions, and distributions of functions of random variables. (1016-283 or equivalent and any of 0307-362/714, 1016-352 or equivalent) **Credit 3**

0307-822 Theory of Statistics II
Building on foundations laid in the first course, this second course in statistical theory answers some of the "How?" and "Why?" questions of statistics. Topics include the sampling distributions and the theory and application of point and interval estimation and hypothesis testing. (0307-821) **Credit 3**

0307-824 Probability Models
An introduction to stochastic processes, this course is intended to encourage a greater appreciation of statistical theory. Topics include Poisson processes and their relationship to uniform, exponential, gamma and beta distributions; the basics of queuing theory; and discrete-time Markov chains. Characteristic functions and using Taylor series to approximate the mean and variance of functions of one or more random variables are among miscellaneous topics. (0307-821) **Credit 3**

0307-830 Multivariate-Analysis Theory
Multivariate data are characterized by multiple responses. This course concentrates on the mathematical and statistical theory that underlies the analysis of multivariate data. Some important applied methods are covered. Topics include matrix algebra, the multivariate normal model, multivariate t-tests, repeated measures, MANOVA and principal components. (Basic matrix algebra; 0307-712 or equivalent; 0307-801 is useful; 0307-822 recommended; 0307-742 suggested) **Credit 3**

0307-831 Multivariate-Analysis Applications
This course includes some theory, but concentrates on the applications of multivariate analysis methods. The course relies heavily on the use of computer software. Topics include principal components, factor analysis, canonical correlation, discriminant analysis, cluster analysis and scaling. (Basic matrix algebra; 0307-712 or equivalent, 0307-830 is useful; 0307-742 suggested) **Credit 3 or 4**

0307-834 **Multivariate Statistics for Imaging Science**
This course introduces multivariate statistical techniques and shows how they are applied in the field of Imaging Science. The emphasis is on practical applications, and all topics will include case studies from imaging science. Topics include the multivariate Gaussian distribution, principal components analysis, singular value decomposition, orthogonal subspace projection, cluster analysis, canonical correlation and canonical correlation regression, regression, multivariate noise whitening, least squares energy minimization, and signal-to-noise optimization with generalized eigenvector (matched filter). This course is intended for students from the Imaging Science department. It does not count as credit for either the CQAS advanced certificates or CQAS MS degree. (Basic matrix algebra; 0307-712 or equivalent; 0307-841 or equivalent recommended) **Credit 4**

0307-841 **Regression Analysis I**
A course that studies how a response variable is related to a set of predictor variables. Regression techniques provide a foundation for the analysis of observational data and insight into the analysis of data from designed experiments. Topics include happenstance data versus designed experiments, simple linear regression, the matrix approach to simple and multiple linear regression, analysis of residuals, transformations, weighted least squares and introduction to dummy variables. (0307 712 or equivalent; 0307-801 is useful) **Credit 3 or 4**

0307-842 **Regression Analysis II**
A continuation of 0307-841. Topics include dummy variables, orthogonal polynomials, selection of best linear models, regression applied to analysis of variance problems, the geometry of least squares, ridge regression, generalized linear models, nonlinear estimation, and model building. (0307-841; 0307-742 suggested) **Credit 3 or 4**

0307-846 **Statistical Data Mining I**
This course is designed to give the student the foundational tools to help discover and navigate the increasingly popular field of statistical data mining. We provide a gentle yet thorough introduction to supervised learning with topics such as multiple linear and nonlinear regression, pattern recognition using techniques such as logistic regression and support vector machines. We also cover unsupervised learning, featuring cluster analysis, feature selection, dimensionality reduction and latent variable models. The course culminates with modern techniques of model selection and model aggregation. (702, or 714 and 841, or permission of instructor) **Class 3, Credit variable 3 or 4**

0307-851 **Nonparametric Statistics**
This course emphasizes how to analyze certain designs when the normality assumption cannot be made, with an emphasis on applications. This includes certain analyses of ranked data and ordinal data. The course provides a review of hypothesis testing and confidence interval construction. Topics include sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, runs tests, chi-square tests, rank correlation, rank order tests and Kolmogorov-Smirnov statistics. (0307-801) **Credit 3**

0307-856 **Interpretation of Data**
How to use statistics in troubleshooting processes and interpreting data. Topics include coordination of use of statistical measures, employing control charts in data analysis, outlier tests, analysis of small-sample data, narrow-limit gauging, analysis of means for variables and attributes data, identification of assignable causes. (0307-801) **Credit 3**

0307-862 **Reliability Statistics I**
A methods course in statistical aspects of reliability. Topics include applications of normal, log-normal, exponential and Weibull models to reliability problems; censored data; probability and hazard plotting; series systems and multiple-failure modes; maximum likelihood estimation; introduction to accelerated-life models and analysis. (1016-282 or equivalent, 0307-801, 841. 0307-822 is strongly recommended as a prerequisite or co-requisite) **Credit 3**

0307-873 **Time Series Analysis and Forecasting**
A course in statistical methods for modeling and forecasting of time series data with emphasis on model identification, model fitting and diagnostic checking. Topics include survey of forecasting methods, regression methods, moving averages, exponential smoothing, seasonality, analysis of forecast errors, Box-Jenkins models, and transfer function models. (0307-841) **Credit 3 or 4**

0307-883 **Quality Engineering by Design**
This course introduces the Taguchi approach to off-line quality control including loss function, signal-to-noise utility function, parameter design and tolerance design, leading to improved products and processes at lower costs. During the presentations of the Taguchi concepts, full attention is given to the controversial aspects of these methods, the basis for the controversies, and alternatives to the methods that follow better statistical protocol. Students get to see the power of robust design in a set of carefully constructed exercises that illustrate the major components of parameter design and tolerance design. (0307-802; 0307-742 suggested) **Credit 3**

0307-884 **Categorical Data Analysis**
The course develops statistical methods for modeling and analysis of data for which the response variable is categorical. Topics include: contingency tables, matched pair analysis, Fisher's exact test, logistic regression, analysis of odds ratios, log linear models, multi-categorical logit models, ordinal and paired response analysis. (0307-841) **Class 3, Credit 3 or 4**

0307-886 **Sample Size Determination**
This course presents procedures to determine the proper sample size needed for the most commonly applied statistical methods. Topics include confidence intervals and hypothesis tests for the parameters of applied distributions and approximations to distributions. Sample size determination for designed experiments is covered extensively. (0307-818) **Credit 3**

0307-889 **Independent Study Project**
Credit will be assigned at the discretion of the candidate's instructor and will depend on the extent of the project. A written proposal is required of the candidate and may be modified at the discretion of the instructor before approval is given to proceed. (Consent of instructor) **Credit 1, 2, 3, 6, or 9**

0307-891 **Special Topics in Applied Statistics**
This course number provides for the presentation of subject matter of important specialized value in the field of applied statistics not offered as a regular part of the statistics program. (Consent of instructor) **Credit 3**

0307-894 **Capstone**
This course is designed to provide a capstone experience for MS students at the end of the graduate studies, and will require a synthesis of knowledge obtained from earlier coursework (0307-742, 802, 822, 842 and consent of instructor) **Credit 3**

0307-895 **Statistics Seminar**
This course, required for full-time students, offers opportunities for additional learning through formal seminars, informal presentations, and special projects. **Credit 0**

0307-896 **Thesis**
For students working for the MS degree who are writing a research thesis. (Consent of department chair) **Credit 3, 6, or 9**

0307-899 **Individual Achievement Project**
Research project under faculty supervision for students working for the MS degree. (Consent of faculty supervisor) **Credit 1–9**

Microsystems Engineering

0308-701 **Lasers**
This course introduces students to the design, operation and applications of lasers (Light Amplification by Stimulated Emission of Radiation). Topics: Ray tracing, Gaussian beams, Optical cavities, Atomic radiation, Laser oscillation and amplification, Mode locking and Q switching, and Applications of lasers. Graduate students will have additional requirements. (0301-482) **Class 4, Credit 4**

0308-702 **Introduction to Nanotechnology and Microsystems**
This course will introduce first year Microsystems Engineering students to microsystems and nanotechnology. Topics include micro and nano systems; MEMS, bioMEMS, MOEMS, and NEMS; nanomaterials; nanopatterning; characterization and analytical techniques; self-assembly approaches; nanoelectronics and nanophotonics; nanomagnetics; organic electronics; and microfluidics. The course will be taught by faculty in the individual fields of nanotechnology and microsystems. **Class 4, Credit 4**

0308-703 **Material Science for Microsystems Engineering**
To provide an introduction to the operating principles of optoelectronic devices used in various current and future information processing and transmission systems. Emphasis in this course will be on the active optoelectronic devices used in optical fiber communication systems. Topics include pulse propagation in dispersive media, polarization devices, optical fiber, quantum states of light, fundamental of lasers, semiconductor optics, light-emitting diodes, laser diodes, semiconductor photon detectors, optical modulators, quantum wells, and optical fiber communication systems. (0301-482) **Class 4, Credit 4**

0308-704 **Quantum Mechanics for Engineers**
This course gives students comprehensive understanding of the foundations of quantum mechanics. The course also provides practical solution techniques which can be applied to a variety of nanoscale problems. Topics include: Waves and Schrodinger's equation; Time-dependent Schrodinger equation; Operator approach to quantum mechanics; Dirac Notation; Solution approaches and approximation methods; Time-dependent perturbation theory with applications to absorption and Fermi's golden rule. If time allows: Angular momentum and the Hydrogen Atom; Spin. (1016-306 or equivalent, 0301-453 or equivalent) **Class 4, Credit 4**

0308-711 **Microsystem Fundamentals**
This course covers the fundamentals of microsystems with emphasis on a broad range of applications. The course covers the underlying principles of micro-actuators and micro-sensors; analysis and modeling of micro-devices; scaling laws; microfuidics; photonics; microsystems fabrication processes; microelectromechanical (MEMS) and micro- optoelectromechanical (MOEMS) systems analysis; applications in the fields of telecommunications and sensing will be presented. **Credit 4, Lecture**

0308-712 **Nonlinear Optics**
This course introduces nonlinear concepts applied to the field of optics. Students learn how materials respond to high intensity electric fields and how the materials response: enables the generation of other frequencies, can focus light to the point of breakdown or create waves that do not disperse in time or space (solitons), and how atoms can be cooled to absolute zero using a laser. Students will be exposed to many applications of nonlinear concepts and to some current research subjects, especially at the nanoscale. Students will also observe several nonlinear-optical experiments in a state-of-the-art photonics laboratory. (0301-482) **Class 4, Credit 4**

0308-720 **Independent Study**
This course number should be used by students who plan to study a topic on an independent basis under the guidance of a faculty member. A written proposal with an independent study form is to be submitted to the sponsoring faculty member and approved by the program director prior to the commencement of work. **Credit 4**

0308-721 **Micro-optics**
This course covers the propagation and diffraction of light and micro-optical components. Subjects covered: diffraction, Fourier optics, diffractive optical elements analysis and design, fabrication of micro-optic components and micro-optics for microsystems applications. (0301-474 or equivalent) **Class 4, Credit 4**

0308-731 **Integrated Optical Devices and Systems**
This course covers principles, analysis and design of integrated optical devices and systems. The integration of various active and passive optoelectronic devices in a system is the focus of the course. Topics include optical waveguides, optical couplers, semiconductor lasers, modulators, optical detectors, micro-optical resonators, photonic crystals, optical signal processing systems, design tools, fabrication techniques, and the applications of optical integrated circuits. Some of the current state-of-the-art devices and systems will be investigated by reference to journal articles. **Class 4, Credit 4**

0308-751 **Microsciences and Microsystems Design**
This course covers fundamental issues and design concerns used to construct microelectromechanical Systems (MEMS) devices. Subjects include: micro fluid science, microscale heat transfer, mechanical behavior of microstructures, as well as design, simulations and optimization of micro devices. Course is intended for engineering students, for Microsystems Engineering and other related disciplines. (1017-313) **Class 4, Credit 4**

0308-771 **Optoelectronics**
This course provides an introduction to the operating principles of optoelectronic devices used in various digital transmission and information processing systems. Emphasis is on the generation (via lasers) and detection of optical signals. Topics covered: (1) geometrical optics, interferometry, and polarization; (2) photons in semiconductors, semiconductor photon sources (light-emitting diode and laser diode), semiconductor photon detectors, and modulators; (3) optoelectronic systems and related engineering applications. (0301-482) **Class 4, Credit 4**

0308-786 **MEMS Design**
Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing and other applications. There is a critical need to synthesize and design high-performance MEMS that satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Fifth-year BS/MS, MS and PhD students) **Class 4, Credit 4**

0308-798 **Microfluidic MEMS**
The course begins with an overview of microfluidic technology to provide a framework and to clarify the relationship of microfluidics to microelectromechanical systems (MEMS) and microsystems in general Three major topics comprise the course: 1) selected elements of dic dynamics theory, and the scaling and application of that theory to microscale dimensions; 2) design, fabrication, and characterization of microfluidic devices and microsystems including exploration of major alternative fabrication technologies, process integration and materials issues, and device- and system-level packaging/encapsulation challenges; 3) applications, including microvalves, micropumps, microflow control sensor, and devices for chemical and biochemical valves, micropumps, microflow control sensor, and devices for chemical and biochemical analysis. **Class 4, Credit 4**

0308-799 **Nano and Microengineering**
This course focuses on analysis and synthesis of nano- and micro electromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and micro-engineering, distinct systems and devices will be examined. The application of nano and microengineering in nanocomputers, avionics, security and transportation will be emphasized. Specific applications included are: super fast data processing and computing, data storage, imaging, molecular intelligent automata, etc. **Class 4, Credit 4**

0308-804 **MEMS Evaluation**
This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMS evaluation will be covered. (0301-786, 0305-870) **Class 4, Credit 4**

0308-811 **Microsystem Design and Packaging**
Design considerations; design process; mechanical design; photonic design; modeling; system integration; packaging technologies; microsystems packaging; assembly of microsystems; testing; design case studies. (0308-711) **Class 4, Credit 4**

0308-821 **Micro-Optics and Photonics**
Light propagation; passive optical components; micro-optics; digital devices; laser diodes; photodiodes; micro-optical systems; design case studies. (0308-711) **Class 4, Credit 4**

0308-831 **Micro- and Nano-Photonics**
This course covers the generation and propagation of light in guided media. Subjects covered: two and three-dimensions slab wave guides, coupled-wave analysis, wave guide modeling and design, photonic crystals structures, photonic band gap devices in one and two dimensions and fabrication of photonic wave guides. (0308-721) **Class 4, Credit 4**

0308-841 **Advanced Microphotonics**
This course covers the latest advances in the field of microphotonics as published in the current literature. Subjects covered will include: silicon photonics as applied to light generation, detection and guiding, photonic crystals and microring resonators. The class format will be based on reviewing, analyzing and critiquing recent published research results in this field. Active student participation is required. (0308-721) **Class 4, Credit 4**

0308-890 **Dissertation and Research**
Research in an appropriate topic as arranged by doctoral candidate and dissertation adviser in fulfillment of the dissertation requirement. Department approval required. **Credit 0–4**

0308-990 **Doctoral Dissertation I**
Research in an appropriate topic as arranged by doctoral candidate and dissertation adviser in fulfillment of the dissertation requirement. Departmental approval required. **Credit 4**

0308-991 **Doctoral Dissertation II**
Research in an appropriate topic as arranged by doctoral candidate and dissertation adviser in fulfillment of the dissertation requirement. **Credit 8**

Semester Courses

Effective fall 2013

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Electrical Engineering

EEEE-602 **Random Signals and Noise**

In this course the student is introduced to random variables and stochastic processes. Topics covered are probability theory, conditional probability and Bayes theorem, discrete and continuous random variables, distribution and density functions, moments and characteristic functions, functions of one and several random variables, Gaussian random variables and the central limit theorem, estimation theory, random processes, stationarity and ergodicity, auto correlation, cross-correlation and power spectrum density, response of linear prediction, Wiener filtering, elements of detection, matched filters. (Graduate standing) **Class 3, Lab 0, Credit 3 (F, S)**

EEEE-603 **Matrix Methods in EE**

Matrix Methods in EE provides the foundations for linear algebra and its applications in analyzing and solving a variety of electrical engineering problems especially in the areas of control, circuit analysis, communication, and signal/image processing. Topics include: Basic concepts, matrix algebra, partitions, determinants, Inverse, solutions to linear equations using techniques such as Gauss elimination, Gauss-Jordan reduction, LU decomposition, and Cramer rule, special matrices, vector spaces and subspaces, the nullspace, projection and subspaces, matrix factorization, eigenvalues and eigenvectors, diagonalization, Singular Value Decomposition (SVD), functions of matrices, matrix polynomials and Cayley-Hamilton theorem, state-space modeling, optimization techniques, least square technique, total least squares, and numerical linear algebra. Electrical engineering applications will be discussed throughout the course. (Graduate standing) **Class 3, Lab 0, Credit 3 (F, S)**

EEEE-610 **Analog Electronics**

This is a foundation course in analog integrated electronic circuit design and is a perquisite for the graduate courses in analog integrated circuit design EEEE-726 and EEEE-730. The course covers the following topics: (1) CMOS technology (2) CMOS active and passive element models (3) Noise mechanisms and circuit noise analysis (4) Current mirrors (5) Differential amplifiers, cascade amplifiers (6) Multistage amps and common mode feedback (7) Stability analysis of feedback amplifiers; (8) Advanced current mirrors, amplifiers, and comparators (9) Band gap and translinear cells (10) Matching. (EEEE-482 or equivalent background, or Graduate standing) **Class 2, Lab 3, Credit 3 (F)**

EEEE-617 **Microwave Circuit Design**

The primary objective is to study the fundamentals of microwave engineering with emphasis on microwave network analysis and circuit design. Topics include microwave transmission lines such as wave-guides, coax, microstrip and stripline, microwave circuit theory such as S-matrix, ABCD matrices, and even odd mode analysis, analysis and design of passive circuits and components, matching networks, microwave resonators and filters. Microwave circuit design projects will be performed using Ansoft's Designer software. (EEEE-374) **Class 3, Lab 0, Credit 3 (S)**

EEEE-620 **Design of Digital Systems**

The purpose of this course is to expose students to complete, custom design of a CMOS digital system. It emphasizes equally analytical and CAD based design methodologies, starting at the highest level of abstraction (RTL, front-end)), and down to the physical implementation level (back-end). In the lab students learn how to capture a design using both schematic and hardware description languages, how to synthesize a design, and how to custom layout a design. Testing, debugging, and verification strategies are formally introduced in the lecture, and practically applied in the lab projects. Students are further required to choose a research topic in the area of digital systems, perform bibliographic research, and write a research paper following a prescribed format. (EEEE-420) **Class 3, Lab 3, Credit 3 (F)**

EEEE-621 **Design of Computer Systems**

The purpose of this course is to expose students to the design of single and multicore computer systems. The lectures cover the design principles of instructions set architectures, non-pipelined data paths, control unit, pipelined data paths, hierarchical memory (cache), and multicore processors. The design constraints and the interdependencies of computer systems building blocks are being presented. The operation of single core, multicore, vector, VLIW, and EPIC processors is explained. In the first half of the semester, the lab projects enforce the material presented in the lectures through the design and physical emulation of a pipelined, single core processor. This is then being used in the second half of the semester to create a multicore computer system. The importance of hardware/software co-design is emphasized throughout the course. Students are further required to choose a research topic in the area of computer systems, perform bibliographic research, and write a research paper following a prescribed format. (EEEE-420) **Class 3, Lab 3, Credit 3 (S)**

EEEE-629 **Antenna Theory**

The primary objective is to study the fundamental principles of antenna theory applied to the analysis and design of antenna elements and arrays including synthesis techniques and matching techniques. Topics include antenna parameters, linear antennas, array theory, wire antennas, microstrip antennas, antenna synthesis, aperture antennas and reflector antennas. A significant portion of the course involves design projects using some commercial EM software such as Ansoft Designer, Ansoft HFSS and SONNET and developing Matlab codes from theory for antenna synthesis and antenna array design. The measurement of antenna input and radiation characteristics will be demonstrated with the use of network analyzers, and spectrum analyzers in an anechoic chamber. (EEEE-374) **Class 3, Lab 0, Credit 3 (F)**

EEEE 661 **Modern Control Theory**

This course deals with a complete description of physical systems its analysis and design of controllers to achieve desired performance. The emphasis in the course will be on continuous linear systems. Major topics are: state space representation of physical systems, similarities/differences between input-output representation (transfer function) and state spate representations, conversion of one form to the other, minimal realization, solution of state equations, controllability, observability, design of control systems for desired performance, state feedback, observers and their realizations. (EEEE-603) **Class 3, Lab 0, Credit 3 (F)**

EEEE 669 **Fuzzy Logic and Applications**

In this course students are introduced to fuzzy systems and their applications in areas like control systems, signal and image processing, communications etc. Major topics are: Fuzzy sets and set operations, Evaluations of the rule sets using different implications, composition, aggregation and defuzzification methods. Applications in control systems: Development of fuzzy logic controllers for both linear and nonlinear systems and analysis and simulation studies of the designed systems. Function approximation using fuzzy systems. Students are also required to search published research works in other application areas like signal/image processing, communication, pattern recognition etc. and present their results to the class. (EEEE-414 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

EEEE-670 **Pattern Recognition**

This course provides a rigorous introduction to the principles and applications of pattern recognition. The topics covered include maximum likelihood, maximum a posteriori probability, Bayesian decision theory, nearest-neighbor techniques, linear discriminant functions, and clustering. Parameter estimation and supervised learning as well as principles of feature selection, generation and extraction techniques, and utilization of neural nets are included. Applications to face recognition, classification, segmentation, etc. are discussed throughout the course. (EEEE-603 and EEEE-602) **Class 3, Lab 0, Credit 3 (S)**

EEEE-678 **Digital Signal Processing**

In this course, the student is introduced to the concept of multi rate signal processing, poly phase decomposition, transform analysis, filter design with emphasis on linear phase response, and discrete Fourier transforms. Topics covered are: Z-transforms, sampling, transform analysis of linear time invariant systems, filter design techniques, discrete Fourier transforms (DFT), fast algorithms for implementing the DFT including Radix 2, Radix 4 and Mixed Radix Algorithms, quantization effects in discrete systems and Fourier analysis of signals. (EEEE-353) **Class 3, Lab 0, Credit 3 (F)**

EEEE-681 **Biorobotics/Cybernetics**

Cybernetics refers to the science of communication and control theory that is concerned especially with the comparative study of automatic control systems (as in the nervous system and brain and mechanical- electrical communications systems). This course will present material related to the study of cybernetics as well as the aspects of robotics and controls associated with applications of a biological nature. Topics will also include the study of various paradigms and computational methods that can be utilized to achieve the successful integration of robotic mechanisms in a biological setting. Successful participation in the course will entail completion of at least one project involving incorporation of these techniques in a biomedical application. Students are required to write an IEEE conference paper on their projects. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-682 **Artificial Intelligence Explorations**

The course will start with the history of artificial intelligence and its development over the years. There have been many attempts to define and generate artificial intelligence. As a result of these attempts, many artificial intelligence techniques have been developed and applied to solve real life problems. This course will explore variety of artificial intelligence techniques, and their applications and limitations. Some of the AI techniques to be covered in this course are intelligent agents, problem-solving, knowledge and reasoning, uncertainty, decision making, learning (Neural networks and Bayesian networks), reinforcement learning, swarm intelligence, Genetic algorithms, particle swarm optimization, applications in robotics, controls, and communications. Students are expected to have any of the following programming skills listed above. Students will write an IEEE conference paper. (Graduate standing) **Class 3, Lab 0, Credit 3 (F)**

EEEE-683 **Principles of Robotics**

An introduction to a wide range of robotics-related topics, including but not limited to sensors, interface design, robot devices applications, mobile robots, intelligent navigation, task planning, coordinate systems and positioning image processing, digital signal processing applications on robots, and controller circuitry design. Pre- requisite for the class is a basic understanding of signals and systems, matrix theory, and computer programming. Software assignments will be given to the students in robotic applications. Students will prepare a project, in which they will complete software or hardware design of an industrial or mobile robot. There will be a two-hour lab additional to the lectures. Students are required to write an IEEE conference paper on their projects. (Graduate standing) **Class 3, Lab 2, Credit 3 (F)**

EEEE-689 **Fundamentals of MEMS**

Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing, and other applications. There is a critical need to synthesize and design high performance MEMS which satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Graduate standing) **Class 3, Lab 0, Credit 3 (F)**

EEEE-692 **Communication Networks**

This course covers communication networks in general and the Internet in particular. Topics include layers service models, circuit and packet switching, queuing, pipelining, routing, packet loss and more. A five-layer model is assumed and the top four levels are covered in a top-down approach: starting with the application layer, going down through the transport layer to the network layer and finally the data link layer. Emphasis is placed on wireless networks and network security. Students would perform a basic research assignment consisting of a literature survey, performance analysis and dissemination of results in written and oral presentation. (EEEE-353, MATH-251) **Class 3, Lab 0, Credit 3 (F)**

EEEE-693 **Digital Data Communication**

Principles and practices of modern digital data communication systems. Topics include pulse code transmission and error probabilities, M-ary signaling and performance, AWGN channels, band-limited and distorting channels, filter design, equalizers, optimal detection for channels with memory, synchonization methods, non-linear modulation, and introduction to multipath fading channels, spread spectrum and OFDM. Students would perform a basic research assignment consisting of a literature survey, performance analysis and dissemination of results in written and oral presentation. (EEEE-484, EEEE-602) **Class 3, Credit 3 (F)**

EEEE-699 **Graduate Co-op**

One semester of full-time, paid employment in the electrical engineering field. See the graduate program coordinator or RIT's Office of Cooperative Education for further details. (Department approval) **Credit 0 (F, S, Su)**

EEEE-710 **Advanced Electromagnetic Theory**

The primary objective is to provide the mathematical and physical fundamentals necessary for a systematic analysis of electromagnetic field problems. Topics included: electromagnetic theorems and principles, scattering and radiation integrals, TE and TM in rectangular and circular waveguides, hybrid LSE and LSM modes in partially filled guides, dielectric waveguides, the Green's function. The course will also include projects using advanced EM modeling software tools. (EEEE-617 and EEEE-629) **Class 3, Lab 0, Credit 3 (S)**

EEEE-711 **Advanced Carrier Injection Devices**

A graduate course in the fundamental principles and operating characteristics of carrier-injection-based semiconductor devices. Advanced treatments of pn junction diodes, metal-semiconductor contacts, and bipolar junction transistors form the basis for subsequent examination of more complex carrier-injection devices, including tunnel devices, transferred-electron devices, thyristors and power devices, light-emitting diodes (LEDs), and photodetectors. Topics include heterojunction physics and heterojunction bipolar transistors (HBT). (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-712 **Advanced Field Effect Devices**

An advanced-level course on MOSFETs and submicron MOS devices. Topics include MOS capacitors, gated diodes, long-channel MOSFETs, subthreshold conduction and off-state leakage, short-channel effects, hot-carrier effects, MOS scaling and advanced MOS technologies. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-713 **Solid-State Physics**

An advanced-level course on solid-state physics, with particular emphasis on the electronic properties of semiconductor materials. Topics include crystal structure, wave propagation in crystalline solids, lattice vibrations, elements of quantum mechanics, elements of statistical mechanics, free-electron theory of metals, Boltzmann transport equation, quantum-mechanical theory of carriers in crystals, energy band theory, equilibrium carrier statistics, excess carriers in semiconductors, carrier transport. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-718 **Design and Characterization of Microwave Systems**

There are two primary course objectives. Design of experiments to characterize or measure specific quantities, working with the constraints of measurable quantities using the vector network analyzer, and in conjunction with the development of closed form analytical expressions. Design, construction and characterization of microstrip circuitry and antennas for specified design criteria obtaining analytical models, using software tools and developing measurements techniques. Microwave measurement will involve the use of network analyzers, and spectrum analyzers in conjunction with the probe station. Simulated results will be obtained using some popular commercial EM software for the design of microwave circuits and antennas. (EEEE-617, EEEE-629) **Class 2, Lab 3, Credit 3 (F)**

EEEE-720 **Advanced Topics in Digital Systems Design**

In this course the student is introduced to a multitude of advanced topics in digital systems design. It is expected that the student is already familiar with the design of synchronous digital systems. The lecture introduces the operation and design principles of asynchronous digital systems, synchronous and asynchronous, pipelined and wave pipelined digital systems. Alternative digital processing paradigms are then presented: data flow, systolic arrays, networks-on-chip, cellular automata, neural networks, and fuzzy logic. Finally, digital computer arithmetic algorithms and their hardware implementation are covered. The projects reinforce the lectures material by offering a hands-on development and system level simulation experience. (Graduate standing) **Class 3, Credit 3 (F)**

EEEE-721 **Advanced Topics in Computer Systems Design**

In this course the student is introduced to advanced topics in computer systems design. It is expected that the student is already familiar with the design of a non-pipelined, single core processor. The lectures cover instruction level parallelism, limits of the former, thread level parallelism, multicore processors, optimized hierarchical memory design, storage systems, and large-scale multiprocessors for scientific applications. The projects reinforce the lectures material, by offering a hands-on development and system level simulation experience. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-726 **Mixed-Signal IC Design**

This is the first course in the graduate course sequence in analog integrated circuit design EEEE-726 and EEEE-730. This course covers the following topics: (1) fundamentals of data conversion (2) Nyquist rate digital-to-analog converters (3) quantization noise and analysis (4) Nyquist rate analog-to-digital converters (5) sample and hold circuits (6) voltage references (7) static and dynamic testing of digital-to-analog converters (8) cell based design strategies for integrated circuits (9) advanced topics in data conversion. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-730 **Advanced Analog IC Design**

This is the second course in the graduate course sequence in analog integrated circuit design EEEE-726 and EEEE-730. This course covers the following topics: (1) fundamentals of filter design (2) filter approximations (3) frequency and impedance scaling (4) delay equalization (5) sensitivity analysis (6) sampled data theory (7) CMOS integrated filters including switched capacitor and gm-C filters (8) phase locked loops (EEEE-726) **Class 3, Lab 0, Credit 3 (F)**

EEEE-733 **Robust Control**

This course will provide an introduction to the analysis and design of robust feedback control systems. Topics covered: overview of linear algebra and linear systems, H_2 and H_{-} spaces, modeling and paradigms for robust control; internal stability; nominal performance (asymptotic tracking); balanced model reduction; uncertainty and robustness; H_2 optimal control; H_{-} control; H_{-} loop shaping; controller reduction; and design for robust stability and performance. (EEEE-661) **Class 3, Lab 0, Credit 3 (S)**

EEEE-765 **Optimal Control**
The course covers different optimization techniques, as applied to feedback control systems. The main emphasis will be on the design of optimal controllers for digital control systems. The major topics are: Different performance indices, formulation of optimization problem with equality constraints, Lagrange multipliers, Hamiltonian and solution of discrete optimization problem. Discrete Linear Quadratic Regulators (LQR), optimal and suboptimal feedback gains, Riccati equation and its solution, linear quadratic tracking problem. Dynamic programming—Bellman's principle of optimality—optimal controllers for discrete and continuous systems—systems with magnitude constraints on inputs and states. (EEEE-661) **Class 3, Lab 0, Credit 3 (S)**

EEEE-766 **Multivariable Modeling**
This course introduces students to the major topics, methods, and issues in modeling multiple-input multiple-output (MIMO) linear systems. The course covers methods of creating models and refining them. Modeling topics include model-order determination, canonical forms, numerical issues in high-order models, creating frequency-response models from time-domain measurements, creating state-space models from frequency-response data, model-order reduction, model transformations and information loss, and estimating model accuracy of MIMO models. Use of MIMO models in controller design will be discussed. (EEEE-603; corequisite: EEEE-661) **Class 3, Lab 0,Credit 3 (F)**

EEEE-768 **Adaptive Signal Processing**
An introduction to the fundamental concepts of adaptive systems; open and closed loop adaptive systems; adaptive linear combiner; performance function and minimization; decorrelation of error and input signal. Adaptation algorithms such as steepest decent, LMS and LMS/Newton algorithm. Noise and misadjustments. Applications will include system identification, deconvolution and equalization, adaptive arrays and multipath communication channels. (EEEE-602 and EEEE-603) **Class 3, Lab 0, Credit 3 (F, S)**

EEEE-779 **Digital Image Processing**
This is an introductory course in digital image processing. The course begins with a study of two dimensional (2D) signal processing and transform methods with applications to images. Image sampling is discussed extensively followed by gray level description of images and methods of contrast manipulation including linear/nonlinear transformations, histogram equalization and specification. Image smoothing techniques are considered including spatial and frequency domain low pass filtering, AD-HOC methods of noise removal and median filtering. Following this, methods of image sharpening are studied including derivatives and high pass filtering. Edge and line detection algorithms are discussed using masks and Hough transforms. Finally, methods of image segmentation, restoration, compression and reconstruction are also discussed. Several extensive computer lab assignments are required. (EEEE-678) **Class 3, Lab 0, Credit 3 (F)**

EEEE-780 **Digital Video Processing**
In this graduate level course the following topics will be covered: Representation of digital video—introduction and fundamentals; Time-varying image formation models including motion models and geometric image formation; Spatio-temporal sampling including sampling of analog and digital video; two dimensional rectangular and periodic Sampling; sampling of 3-D structures, and reconstruction from samples; Sampling structure conversion including sampling rate change and sampling lattice conversion; Two-dimensional motion estimation including optical flow based methods, block-based methods, Pel-recursive methods, Bayesian methods based on Gibbs Random Fields; Three-dimensional motion estimation and segmentation including methods using point correspondences, optical flow and direct methods, motion segmentation, and stereo and motion tracking. (EEEE-779) **Class 3, Lab 0, Credit 3 (S)**

EEEE-784 **Advanced Robotics**
This course explores advance topics in mobile robots and manipulators. Mobile robot navigation, path planning, room mapping, autonomous navigation are the main mobile robot topics. In addition, dynamic analysis of manipulators, forces and trajectory planning of manipulators, and novel methods for inverse kinematics and control of manipulators will also be explored. The prerequisite for this course is Principles of Robotics. However, students would have better understanding of the topics if they had Control Systems and Mechatronics courses as well. The course will be a project based course requiring exploration of a novel area in Robotics and writing an IEEE conference level paper. (Graduate standing) **Class 3, Lab 0, Credit 3 (S)**

EEEE-785 **Fundamentals of MEMS**
Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing, and other applications. There is a critical need to synthesize and design high performance MEMS which satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Graduate standing) **Class 3, Lab 0, Credit 3 (F)**

EEEE-786 **Microfluidic MEMS**
A graduate course which explores microfluidic principles and technologies. An introductory overview of microfluidic technology provides a framework and clarifies the relationship of microfluidics to microelectromechanical systems (MEMS) and microsystems. Three major topics comprise the course: (1) selected elements of fluid dynamics theory, and the scaling and application of that theory to microscale dimensions; (2) design, fabrication, and characterization of microfluidic devices and microsystems, including exploration of major alternative fabrication technologies, process integration and materials issues, and device- and system-level packaging/encapsulation challenges; (3) applications, including microvalves, micropumps, microflow control sensors, and devices for chemical and biochemical analysis and synthesis. (Graduate standing) **Class 3, Lab 0, Credit 3 (F)**

EEEE-787 **MEMS Evaluation**
This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMS evaluation will be covered. (Graduate standing) **Class 3, Credit 3 (S)**

EEEE-789 **Special Topics**
Topics and subject areas that are not regularly offered are provided under this course. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate standing) **Class 3, Credit 3 (F, S)**

EEEE-790 **Thesis**
An independent engineering project or research problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty member to guide the thesis before registering for the thesis. A thesis may be used to earn a maximum of 6 credits. (Graduate standing and department approval) **Credit 1-6 (F, S, Su)**

EEEE-792 **Graduate Paper**
This course is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in electrical engineering. The student must obtain the approval of an appropriate faculty member to supervise the paper before registering for this course. (Department approval required) **Class 0, Credit 0-3 (F, S, Su)**

EEEE-794 **Information Theory**
This course introduces the student to the fundamental concepts and results of information theory. This is a very important course for students who want to specialize in signal processing, image processing, or digital communication. Topics include definition of information, mutual information, average information or entropy, entropy as a measure of average uncertainty, information sources and source coding, Huffman codes, run-length constraints, discrete memoryless channels, channel coding theorem, channel capacity and Shannon's theorem, noisy channels, continuous sources and channels, coding in the presence of noise, performance bounds for data transmission, rate distortion theory. (EEEE-602) **Class 3, Lab 0, Credit 3 (S)**

EEEE-795 **Graduate Seminar**
The objective of this course is to introduce full time electrical engineering BS/MS and incoming graduate students to the graduate programs, campus resources to support research. Presentations from faculty, upper division MS/PhD students, staff, and off campus speakers will provide a basis for student selection of research topics, comprehensive literature review, and modeling effective conduct and presentation of research. All first year graduate students enrolled full time are required to successfully complete three quarters of this seminar. **Class 1, Credit 0 (F, S)**

EEEE-797 **Wireless Communication**
The course will cover advanced topics in wireless communications for voice, data and multimedia. Topics covered are: 1) channel modeling: Overview of current wireless systems, modeling wireless channels, path loss for different environments, log-normal shadowing, flat and frequency-selective multipath fading, LS estimation of channel parameters, and capacity limits of wireless communication channels. 2) transmission over fading channels, 3) techniques to improve the speed and performance of wireless inks (adaptive modulation and diversity techniques such as maximum gain combining to compensate for flat-fading). 4) techniques to combat frequency-selective fading (adaptive equalization, space time coding, multicarrier modulation (OFDM), and spread spectrum). 5) applications for these systems, including the evolution of cell phones and PDAs, sensor networks will be discussed. (EEEE-602 and EEEE-693) **Class 3, Lab 0, Credit 3 (S)**

EEEE-799 **Independent Study**
This course is used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. **Credit 1–3 (F, S, Su)**

Industrial and Systems Engineering

ISEE-601 Systems Modeling and Optimization
An introductory course in operations research focusing on modeling and optimization techniques used in solving problems encountered in industrial and service systems. Topics include deterministic and stochastic modeling methodologies (e.g., linear and integer programming, Markov chains, and queuing models) in addition to decision analysis and optimization tools. These techniques will be applied to application areas such as production systems, supply chains, logistics, scheduling, healthcare, and service systems. (MATH-233 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-626 Contemporary Production Systems
The focus of this course is Lean. Lean is about doing more with less—less human effort, less equipment, less time, less space. In other words, lean is about the application of industrial engineering principles and tools to the entire supply chain or value stream. The focus of this course will be learning and applying the principles and tools of lean such as value, value stream mapping, takt, flow, pull, kaizen, standard work, line design, and others, all in the context of continuous process improvement. By the end of this course, the student will possess the essential tools and skills to apply lean in their production system from either a line (supervisor or manager) or staff role. (Background in production systems and mfg processes) **Class 3, Lab 0, Credit 3 (F)**

ISEE-661 Applied Linear Regression Analysis
In any system where parameters of interest change, it may be of interest to examine the effects that some variables exert (or appear to exert) on others. "Regression analysis" actually describes a variety of data analysis techniques that can be used to describe the interrelationships among such variables. In this course we will examine in detail the use of one popular analytic technique: least squares linear regression. Cases illustrating the use of regression techniques in engineering applications will be developed and analyzed throughout the course. (CQAS-252, MATH-233 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-699 Graduate Co-op
Up to six months of full-time, paid employment in the field of industrial engineering. See the graduate program coordinator or RIT's Office of Cooperative Education for further details. (Completion of 2 semesters of full time study; completion of the Co-op Preparation Seminar; and permission of the ISE Department) **Credit 0 (F, S, Su)**

ISEE-701 Linear Programming
Applied linear programming. Computational techniques for solving constrained optimization problems. Linear programming, the Simplex method and variations, duality and sensitivity testing. (ISEE-601 or MATH-233 and ISEE-301 or equivalents) **Class 3, Lab 0, Credit 3 (S)**

ISEE-702 Integer and Nonlinear Programming
An introduction to the mathematical foundations of integer programming and nonlinear optimization techniques. Study of algorithms and computer-aided solutions for applied optimization problems. (ISEE-701 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-703 Supply Chain Management
Supply chain management is unique in that it is one of the oldest business activities and yet has been recently discovered as a potentially powerful source of competitive advantage. Supply chain system activities planning production levels, forecasting demand, managing inventory, warehousing, transportation, and locating facilities have been performed since the start of commercial activity. It is difficult to visualize any product that could reach a customer without a consciously designed supply chain. Yet it is only recently that many firms have started focusing on supply chain management. There is a realization that no company can do any better than its supply chain and logistics systems. This becomes even more important given that product life cycles are shrinking and competition is intense. Logistics and supply chain management today represents a great challenge as well as a tremendous opportunity for most firms. (Background in operations management or production systems) **Class 4, Lab 0, Credit 3 (F)**

ISEE-704 Logistics Management
This course discusses several strategic, tactical, and operational concepts used in improving the distribution of goods and services by companies worldwide. The course emphasis is on understanding when and how these concepts are applied, as well as on using mathematical programming and optimization methods for their adequate implementation. (ISEE 420 or ISEE 720) **Class 3, Lab 0, Credit 3 (S)**

ISEE-710 Systems Simulation
Methods of modeling and computer simulation of stochastic and dynamic manufacturing systems are discussed. A high-level simulation language such as ARENA will be used to model the system and examine system performance. Model validation, design of simulation experiments, variance reduction techniques and random number generation will be discussed as time permits. (ISEE-200 and CQAS-252 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

ISEE-711 Advanced Simulation
An advanced course in developing simulation models using good model building, verification and validation procedures. Emphasis will be on review and use of probability distributions, simulation output data analysis for making good decisions, comparison of alternative system configurations, use of designed experiments and the use of advanced simulation techniques. Real world case studies will be examined to convey understanding and teaching of the material. Students will be asked to build models, so simulation experience and working knowledge of a simulation language will be required. (ISEE-410, or ISEE-710, or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-720 Production Control
This course will cover the role, the steps and the analysis methods to produce goods and services in support of the production and operations management functions. Topics include: forecasting, inventory policies and models, production systems and philosophies (e.g. JIT/Lean), job shop scheduling, aggregate production planning, and Material Requirement Planning (MRP). Students will understand the importance of production control and its relationship to other functions within the organization. Case studies and the design of actual production systems will be emphasized. (ISEE-301, or ISEE-601, and CQAS-251) **Class 3, Lab 0, Credit 3 (F)**

ISEE-723 Global Facilities Planning
Facilities planning determines how an activity's tangible fixed assets best support achieving the activity's objective. This course will provide knowledge of the principles and practices of facility layout, material handling, storage and warehousing, and facility location for manufacturing and support facilities. Tools for sizing the resources needed, planning, design, evaluation, selection, and implementation will be covered. The focus of the course will cover both management and design aspects, with the focus being more heavily on the management aspects. (Background in operations management or production systems) **Class 3, Lab 0, Credit 3 (S)**

ISEE-728 Production Systems Management
The focus of this course is Lean. Students who take this course should be interested in building on their basic knowledge of (lean) contemporary production systems and developing the breadth and depth of their understanding, with a focus on the managerial, quantitative, and systems aspects. It will also address value streams beyond manufacturing—specifically logistics. This course should enable the student to practice the application of lean concepts in the context of systems design at the enterprise level. (ISEE-421 or ISEE-626) **Class 3 Lab 0, Credit 3 (S)**

ISEE-730 Biomechanics
Course focuses on treatment of human body as a mechanical system to evaluate the effects external forces have on the musculoskeletal system. Course uses static models of equilibrium and computer software to analyze the effects of physical tasks on the body and to assess the likelihood of injury. Topics include musculoskeletal system, static modeling, and bioinstrumentation. (MECE-200 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-731 Advanced Topics in Human Factors and Ergonomics
Advanced topics are selected based on current ergonomic and human factors issues and interests of students. Course is taught using a seminar format. Students are required to select, read, and discuss scientific literature relevant to the fields of human factors and ergonomics. (ISEE-330, or equivalent, or permission from instructor) **Class 3, Lab 0, Credit 3 (S)**

ISEE-732 Systems Safety Engineering
Acquaints students with practical aspects of safety engineering. Students acquire a working knowledge of legal and technical aspects of safety. Focuses on a systems approach to safety engineering. Topics include Workers Compensation, OSHA, Consumer Product Safety Commission, NIOSH Guidelines and various hazard analysis and utilization techniques. Students also are exposed to various theories of accident causation, research methodology and ways of evaluating safety programs and related research. (Fourth-year standing or greater) **Class 3, Lab 0, Credit 3 (S)**

ISEE-740 Design for Manufacture and Assembly
Course reviews operating principles of prevalent processes such as casting, molding, and machining. Students will use this knowledge to select appropriate production processes for a given component. For each process covered, guidelines governing proper design for manufacturability practices will be discussed and applied. (ISEE-343 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

ISEE-741 Rapid Prototyping and Manufacturing
This course begins with an introduction to commercial rapid prototyping processes, the materials involved, and the physics behind how they work. The course then transitions to research topics involving novel processes, applications, and materials. Class activities include a mix of lecture, lab, and project work. (ISEE-140 or equivalent, or MECE-305 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

ISEE-745 **Manufacturing Systems**
This course will provide an introduction to concepts and techniques in the design and analysis of production systems. A blend of traditional and modern approaches is brought into the classroom. At the end of the quarter, the student will be able to assess and analyze the performance of a given manufacturing system as well as to provide a framework for system redesign and improvement. Modern aspects such as lean manufacturing and setup time reduction are included in the context of the course. (Graduate/MML standing or permission of instructor) **Class 3, Lab 0, Credit 3 (F)**

ISEE-750 **Systems and Project Management**
Systems and Project Management ensures progress toward objectives, proper deployment and conservation of human and financial resources, and achievement of cost and schedule targets. The focus of the course is on the utilization of a diverse set of project management methods and tools. Topics include strategic project management, project and organization learning, cost, schedule planning and control, structuring of performance measures and metrics, technical teams and project management, information technology support of teams, risk management, and process control. Course delivery consists of lectures, speakers, case studies, and experience sharing, and reinforces collaborative project-based learning and continuous improvement. **Class 3, Lab 0, Credit 3 (F)**

ISEE-751 **Decision and Risk Benefit Analysis**
This course addresses decision making in the face of risk and uncertainty. Various methodologies will be introduced that are useful in describing and making decisions about risks, with particular emphasis on those associated with the design of products. Students will be exposed to issues related to balancing risks and benefits in situations involving human safety, product liability, environmental impact, and financial uncertainty. Presentations will be made of risk assessment studies, public decision processes, and methods for describing and making decisions about the societal risks associated with engineering projects. Topics include probabilistic risk assessment, cost-benefit analysis, reliability and hazard analysis, decision analysis, portfolio analysis, and project risk management. (CQAS-251 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

ISEE-752 **Decision Analysis**
This course presents the primary concepts of decision analysis. Topics important to the practical assessment of probability and preference information needed to implement decision analysis are considered. Decision models represented by a sequence of interrelated decisions, stochastic processes and multiple criteria are also considered. (CQAS-251 or equivalent) **Class 3, Lab 0, Credit 3 (F)**

ISEE-760 **Design of Experiments**
This course presents an in-depth study of the primary concepts of experimental design. Its applied approach uses theoretical tools acquired in other mathematics and statistics courses. Emphasis is placed on the role of replication and randomization in experimentation. Numerous designs and design strategies are reviewed and implications on data analysis are discussed. Topics include: consideration of type 1 and type 2 errors in experimentation, sample size determination, completely randomized designs, randomized complete block designs, blocking and confounding in experiments, Latin square and Graeco Latin square designs, general factorial designs, the 2k factorial design system, the 3k factorial design system, fractional factorial designs, Taguchi experimentation. (CQAS-252 or equivalent) **Class 3, Lab 0, Credit 3 (S)**

ISEE-771 **Engineering of Systems I**
This course covers the principles of product, manufacturing process and supply chain development in an integrated fashion. It will examine the methodologies and tools to systematically define, develop and produce world-class products. Students will work on a project to put these methodologies and tools into practice. Major topics include: product planning and definition, characterization of user value, lean product development, product requirements and benchmarking, concept generation, design for "X" (manufacturing/ assembly/ service/ environment, etc.), sustainable design, design for lean six sigma. (Fifth-year and graduate students) **Class 3, Lab 0, Credit 3 (F)**

ISEE-772 **Engineering of Systems II**
The engineering of a system focuses on the overall concept, performance, requirements and behavioral aspects of the system. This course builds on the concepts discussed in Engineering of Systems I. Topics include concept generation and innovation techniques, outsourced product development, requirements engineering and management, critical parameter management, robust design and latitude development, quality by design, advanced product development project management, and lean product development. Students will learn several systems analysis techniques and may include a team based project. (ISEE-771) **Class 3, Credit 3 (S)**

ISEE-775 **Advanced Systems Integration**
Introductory course in concepts and techniques needed to specify, design, and implement integrated manufacturing systems. Upon completion of this course, one should have knowledge of the information flow in a manufacturing enterprise, understanding of basic concepts and issues in integrating various types of information systems, comprehension of sensors, transducers, and other techniques in capturing, analyzing, and displaying data at various levels within a manufacturing enterprise. Students will be expected to write programs to perform low-level control of electro-mechanical devices. In addition to lectures, the course will be augmented with lab exercises. **Class 3, Lab 0, Credit 3 (S)**

ISEE-781 **Excellence in New Product Development**
Success in today's competitive global economy depends substantially on a firm's ability to define, develop, and introduce outstanding new products more efficiently and effectively than its competitors. This course introduces students to best practices and attributes of world-class product development leaders and organizations. Critical success factors and inhibitors to the commercialization of complex products and systems are discussed, along with state-of-the-art methodologies, processes, and tools. Emphasis is placed on the role of the product development manager in leading product strategy, high performing product development teams, and transformational initiatives essential to competitiveness. (Industry experience in product development) **Class 3, Lab 0, Credit 3 (S)**

ISEE-782 **Product Development in the Extended Enterprise**
Today's complex products and shorter product development life cycles have dramatically increased dependence on external resources. This course will examine a broad range of collaborative arrangements from traditional contracting and functional outsourcing to cross-enterprise partnerships, in the context of the product delivery process and the challenges faced by product development managers. (Industry experience in product development) **Class 3, Lab 0, Credit 3 (offered on demand)**

ISEE-783 **Advanced Topics in New Product Development**
This modular course is designed to complement previous coursework in the MPD program, with an emphasis on leadership/engineering concepts and tools needed by technical leaders of product development projects and organizations. The course is intended to fill gaps in the MPD program by covering important topics for product development leaders that were not covered or topics for which students have expressed interest in additional coverage. (Industry experience in product development and completion of all required courses in the MPD program). **Class 3, Lab 0, Credit 3 (offered on demand)**

ISEE-785 **Fundamentals of Sustainable Engineering**
This is a high level survey course that reviews the product lifecycle from various perspectives and highlights the leverage over material, process, and environmental impacts available at the design phase. Tools and strategies for reducing the environmental impacts associated with the sourcing, manufacture, use, and retirement of products will be reviewed and evaluated. **Class 3, Lab 0, Credit 3 (F)**

ISEE-786 **Lifecycle Assessment**
This course introduces students to the challenges posed when trying to determine the total lifecycle impacts associated with a product or a process design. Various costing models and their inherent assumptions will be reviewed and critiqued. The inability of traditional costing models to account for important environmental and social externalities will be highlighted. The Lifecycle Assessment approach for quantifying environmental and social externalities will be reviewed and specific LCA techniques (Streamlined Lifecycle Assessment, SimaPro) will be covered. (ISEE-775) **Class 3, Lab 0, Credit 3 (S)**

ISEE-787 **Design for the Environment**
This course will provide the student with systematic approaches for designing and developing environmentally responsible products. In particular, design trade-offs will be explored. (ISEE-140, MECE-305) **Class 3, Lab 0, Credit 3 (S)**

ISEE-789 **Special Topics**
Topics and subject areas that are not regularly offered are provided under this course. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate status) **Class 3, Credit 3 (F, S)**

ISEE-790 **Thesis**
In conference with a faculty adviser, an independent engineering project or research problem is selected. The work may be of a theoretical and/or computational nature. A state-of-the-art literature search in the area is normally expected. A formal written thesis and an oral defense with a faculty thesis committee are required. Submission of bound copies of the thesis to the library and to the department and preparation of a written paper in a short format suitable for submission for publication in a refereed journal are also required. Approval of department head and faculty adviser needed to enroll. (Graduate standing and instructor approval) **Credit 1-6 (F, S, Su)**

ISEE-792 **Engineering Capstone**
For the Master of Engineering programs in industrial engineering, engineering management, and systems engineering. Students must investigate a discipline-related topic in a field related to industrial engineering, engineering management, or systems engineering. The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular area. The capstone should draw upon skills and knowledge acquired in the program. (Fifth-year or graduate standing) **Class 3, Lab 0, Credit 3 (F, S)**

ISEE-793 **Manufacturing Leadership Capstone**
For the MS in Manufacturing Leadership (MML) program. The purpose of the project is for students to demonstrate integrative application of knowledge and skills that they have acquired during the program. A capstone project will be oriented to the solution of manufacturing, operations, or supply chain management problem or to technically related processes. Each project will define an actual problem and solve it, or select and develop a needed process. Each project must be approved in advance by the capstone coordinator. A suitable project will be multi-disciplinary or multi-functional in nature and will have significant impact on one or more competitive capabilities of the organization, e.g., quality, lead time, cost, flexibility, or service. Team-based projects are strongly recommended. (Completion of 50% of course work in the MML program) **Class 3, Lab 0, Credit 3 (F, S)**

ISEE-795 **Graduate Seminar I**
The first in a two course sequence that introduces students to research methods in industrial engineering and presents the state of the art in industrial engineering research. The two-course sequence is designed to promote discussion and interaction on IE research topics and to present research methods such as conducting critical reviews of research literature, initiating background research on a thesis topic, and preparing a formal thesis proposal. **Class 1, Credit 0 (F)**

ISEE-796 **Graduate Seminar II**
The second in a two course sequence that introduces students to research methods in industrial engineering and presents the state of the art in industrial engineering research. The two-course sequence is designed to promote discussion and interaction on IE research topics and to present research methods such as conducting critical reviews of research literature, initiating background research on a thesis topic, and preparing a formal thesis proposal. (Fifth-year or graduate status) **Class 1, Credit 0 (S)**

ISEE-797 **Product Development Capstone I**
For the MS in Product Development (MPD) program. Students in the program must demonstrate intellectual leadership in the field of new product development. The general intent of the Capstone is to demonstrate the students' knowledge of the integrative aspects of new product development in the context of a corporate-oriented problem solving research project. The project should address issues of significance to multiple functions or disciplines and should draw upon skills and knowledge acquired from various courses and experiences in the program. Students are encouraged to start work on the project in advance of receiving formal credit. Team-based projects are strongly recommended. (Completion of 50% of course work in the MPD program) **Class 3, Lab 0, Credit 3 (S)**

ISEE-798 **Production Development Capstone II**
For the MS in Product Development (MPD) program. Students in the program must demonstrate intellectual leadership in the field of new product development. The general intent of the Capstone is to demonstrate the students' knowledge of the integrative aspects of new product development in the context of a corporate-oriented problem solving research project. The project should address issues of significance to multiple functions or disciplines and should draw upon skills and knowledge acquired from various courses and experiences in the program. Students are encouraged to start work on the project in advance of receiving formal credit. Team-based projects are strongly recommended. (ISEE-797) **Class 3, Lab 0, Credit 3 (Su)**

ISEE-799 **Independent Study**
This course is used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. Students registering for more than four credit hours must obtain the approval of both the department head and the adviser. **Credit 1-6 variable (F, S, Su)**

Mechanical Engineering

MECE-601 **Math I for Engineers**
This course trains students to utilize mathematical techniques from an engineering perspective, and provides essential background for success in graduate level studies. An intensive review of linear and nonlinear ordinary differential equations and Laplace transforms is provided. Laplace transform methods are extended to boundary-value problems and applications to control theory are discussed. Problem solving efficiency is stressed, and to this end, the utility of various available techniques are contrasted. The frequency response of ordinary differential equations is discussed extensively. Applications of linear algebra are examined, including the use of eigenvalue analysis in the solution of linear systems and in multivariate optimization. An introduction to Fourier analysis is also provided. **Class 3, Credit 3 (F)**

MECE-602 **Math II for Engineers**
This is a course in partial differential equations focused primarily on separation of variable techniques, and teaches the necessary vector space theory so that the problem solving methodology may be understood completely. Algebraic vector space concepts, such as the basis, are extended to functions, and operator theory is introduced as a means of unifying the solution structure of linear algebraic and differential equation systems. Existence and uniqueness is examined by considering the null and range spaces of algebraic and differential operators, the adjoint operator, and Fredholm's Alternative. Eigenvalue analysis is extended to functions, including an examination of Sturm-Liouville theory. Solutions of Laplace's equation, the heat equation, the wave equation, and the biharmonic equation are examined in a variety of geometries (MECE-601 Math I for Engineers) **Class 3, Credit 3 (S)**

MECE-605 **Finite Elements**
This course emphasizes the application of the finite element method to problems in the area of static and dynamic structural analysis, heat transfer, and analogous solution. A standard commercial software package is used for these applications where the general structure, operating characteristics and use of a complex program are presented. Topics include the finite element method; shape factors, element formulation, and the element library; program sequencing; general modeling methods (loads, constraints, material factors, mesh generation, interactive graphics, model conditioning); convergence, error analysis and the "patch" test, vibration and heat transfer analysis, and analogous analysis such as acoustics, illumination, etc. (Graduate student) **Class 3, Credit 3**

MECE-606 **Systems Modeling**
This course is designed to introduce the student to advanced systems modeling techniques and response characterization. Mechanical, electrical, fluid, and mixed type systems will be considered. Energy-based modeling methods such as Lagrange's methods will be used extensively for developing systems models. System performance will be assessed through numerical solution using MATLAB/Simulink. Computer projects using Matlab/Simulink will be assigned and graded in this course. Linearization of nonlinear system models and verification methods are also discussed. (MECE-320 or equivalent) **Class 3, Credit 3**

MECE-620 **Introduction to Optimal Design**
This course is an introduction to basic optimization techniques for engineering design synthesis. Topics covered include: techniques, the general problem statement, necessary conditions of optimization, numerical techniques for unconstrained optimization, constrained optimization through unconstrained optimization, and direct methods. Numerical solutions are obtained using MATLAB software. A design project is required. (MECE-317) **Class 3, Credit 3**

MECE-623 **Powertrain Systems and Design**
This course will introduce the analysis and design of power transmission systems. Topics covered include spur, helical, bevel, and worm gears, gear trains, planetary gear systems, power transmission shafts, belt and chain drives, and systems such as electric and hydraulic power transmission. The transmission of power at the required speed and torque is the primary function of most power transmission systems, and is the focus of this course. Students will use this foundation to complete a case study project whereby they review and analyze how power is transmitted from the primary source to the remainder of the driveline by means such as manual transmissions, automatic transmissions, continuously variable transmissions, and direct drive systems. (MECE-350) **Class 3, Credit 3**

MECE-624 **Vehicle Dynamics**
Deals with the fundamentals of ground vehicle stability and control. The contribution of tire lateral force, stiffness, and aligning torque to vehicle stability is discussed. Bicycle and four-wheel vehicle models are analyzed for neutral, under- and oversteer characteristics. The effects of suspension geometry, chassis stiffness and roll stiffness on stability and handling are analyzed. (MECE-320) **Class 3, Credit 3**

MECE-633 **Sustainable Energy Management**
This course, Sustainable Energy Management, provides an overview of mechanical systems within energy intensive applications such as power plants, automobiles, and buildings with an emphasis on advanced thermodynamic analyses of sub-systems which possess the most visible energy signature in terms of energy usage, energy inefficiency, thermoeconomic costing, and exergy destruction. Fundamentals of system operation are explored as well as various sustainability measures. In addition, the interrelationship between energy intensive applications and public policy instruments and strategies are examined. Students will explore methods by which engineers evaluate energy-intensive systems to assess alignment with sustainability and communicate findings to inform the public policy process cycle. (MECE-310 or permission of instructor) **Class 3, Credit 3**

MECE-638 **Design of Machine Systems**
This is an applied course in the selection of components and integration of those components into electro-pneumatic-mechanical devices and systems. Topics involve all aspects of machine design, including drive components and systems, motion generation and control, and electrical control hardware and strategy. (MECE-205, MECE-350) **Class 3, Credit 3**

MECE-643 **Continuous Control Systems**
Introduces the student to the study of linear control systems, their behavior and their design and use in augmenting engineering system performance. Topics include control system behavior characterization in time and frequency domains, stability, error and design. This is accomplished through classical feedback control methods that employ the use of Laplace transforms, block diagrams, root locus, and Bode diagrams. An integrated laboratory will provide students with significant hands-on analysis and design-build-test experience. (MECE-320) **Class 3, Credit 3**

MECE-644 **Introduction to Composite Materials**
Cooperative education is a central element of the BS degree program in mechanical engineering at RIT. BS students will complete one year of practical work experience during their program of study. Students will participate in two summer work experiences and two academic year work experiences. (MECE-305, MECE-203) **Class 3, Credit 3**

MECE-656 **Biological Transport Phenomena**
Review of the fundamentals of momentum, energy and mass transport within the context of biological systems ranging from the organelles in cells to whole plants and animals and their environments. Use of theoretical equations and empirical relations to model and predict the characteristics of diffusive, convective and radiative transport in complex biological systems and their environments. Emphasis is placed on the physical understanding of these systems through the construction of simplified mathematical models amenable to analytical, numerical or statistical formulations and solutions. (MECE-210, MECE-310) **Class 3, Credit 3**

MECE-657 **Biomedical Device Engineering**
This course is an introduction to the design of medical devices and issues that are unique to these devices. Course content includes some historical background, an overview of existing devices and trends, material selection, interfaces of medical devices with biological tissues, product testing, reliability, and regulations specific to the design and validation of medical devices. A substantial part of the course is a project, in which students will be required to work in teams to complete a preliminary design of a novel device, including appropriate analysis and documentation. Analysis methods learned from prior coursework in the students discipline will be applied to this component of the course. (MECE-353) **Class 3, Credit 3**

MECE-658 **Introduction to Engineering Vibrations**
The theory of mechanical vibrations with an emphasis on design applications and instrumentation. Fourier analysis techniques, numerical and experimental analysis and design methods are presented in addition to theoretical concepts. Vibrations of single-degree of freedom systems are covered, including free-damped and undamped motion; and harmonic and transient-forced motion, such as support motion, machinery unbalance and isolation. Modal analysis of multidegree of freedom systems is introduced. In addition to laboratory exercises on vibration instrumentation, an independent design project is assigned (MECE-320) **Class 2, Credit 3**

MECE-699 **Graduate Co-op**
Up to six months of full-time, paid employment in the mechanical engineering field. See the ME graduate program coordinator or RIT's Office of Cooperative Education for further details. (Department approval)

MECE-701 **Research Methods**
This course introduces students to research methods in mechanical engineering. A primary focus of the course is on conducting critical reviews of research literature, preparing a formal thesis proposal, and initiating background research on a thesis topic. At the conclusion of the course, the students are expected to submit a formal thesis proposal, literature review, and plan of study for the completion of the Master of Science degree. This course is specifically designed for students enrolled in the dual degree MS/BS program offered through the department. (Consent of instructor. Restricted to dual degree students.) **Class 3, Credit 3 (F)**

MECE-710 **Fuel Cell Technology**
Fuel cell technology is an emerging technology for electric power on demand, and can be used for stationary power generation or for driving vehicles. Fuel cell, the heart of this technology, is an electro-chemical devise that produces electricity via cell reactions from useful chemical energy stored in fuel. After learning fuel cell basics and operating principles, fuel cell performance will be considered from energy and thermodynamic viewpoints. Types discussed are polymer electrolyte membrane fuel cell (PEMFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cell (SOFC). Modeling of one fuel cell type will demonstrate design and analysis of systems and the information and components needed to make the system successful. Also discussed: thermal system design and analysis issues, limitations, cost effectiveness and efficiency. **Class 3, Credit 3**

MECE-729 **Renewable Energy Systems**
This course provides an overview of renewable energy system design. Energy resource assessment, system components, and feasibility analysis will be covered. Possible topics to be covered include photovoltaics, wind turbines, solar thermal, and hydropower. Students will be responsible for a final design project. (MECE-352, MECE-310) **Class 3, Credit 3**

MECE-730 **Design Project Leadership**
This course focuses on preparing students to take on a leadership role in design project teams. Topics include product development processes, management of design project teams, developing a business case for design projects, understanding customer needs and translating them into engineering specifications, tools for developing design concepts, tools for assessing the feasibility of design concepts, conducting engineering tradeoffs and analysis to synthesize a preliminary design. Students use the concepts and tools discussed throughout the course in a team-based environment to develop project readiness packages for subsequent use by senior design teams. **Class 3, Credit 3 (S)**

MECE-731 **Computational Fluid Dynamics**
This course covers basic numerical techniques applicable to equations in fluid mechanics and heat transfer. Numerical methods required for programming partial differential equations are introduced. Course work involves analytical programming and design examples. This course introduces the students to some of the commercial CFD codes being used for solving thermal-fluid problems. Students complete an individual CFD study project including a written report and a presentation of the results. (MECE-317, MECE-210) **Class 3, Credit 3**

MECE-738 **Ideal Flows**
This course covers the fundamental topics in the theory of aerodynamics and high speed flows. The course discusses modern aerodynamic applications in the areas of wing and airfoil design, wind tunnel testing and compressible flows. (MECE-210; corequisite MECE-601) **Class 3, Credit 3**

MECE-739 **Alternative Fuels and Energy Efficiency**
This course provides an overview of the potential alternative fuels and energy efficiency technologies for powering current and future vehicles. Alternative fuel production technologies and utilization of fuels such as biodiesel, ethanol, and hydrogen will be covered. The primary technical and environmental issues associated with these alternative fuels will be discussed. Approaches to improving vehicle efficiency will also be explored. Students will be responsible for a final design or research project. (MECE-352) **Class 3, Credit 3**

MECE-743 **Digital Control Systems**
This course builds on the fundamentals of continuous feedback control to introduce the student to computer (digital) regulation of systems in closed-loop. Discrete-time modeling and stability of signals and systems are discussed. Analog and digital control schemes are compared using s domain to z-domain conversion, and time-domain response characterization. Closed-loop system design objective specification and evaluation is conducted through numerical simulation and experimental observation. Various discrete-time controller designs are implemented and evaluated using Matlab/Simulink. (MECE-643) **Class 3, Credit 3 (F)**

MECE-744 **Nonlinear Control Systems**
This course introduces the student to methods used to design advanced control systems. Topics of this course include: review of linear feedback and PID control design, Lyapunov Stability, input-output stability, frequency domain analysis of feedback systems, non-linear control design using feedback linearization, optimal control, and the sliding mode control method. Students are expected to complete computer projects using Matlab/Simulink. (MECE-643) **Class 3, Credit 3**

MECE-746 **Engineering Properties of Materials**
This course presents the principles behind various properties of materials from an atomic and molecular perspective. Topics from physical chemistry and solid state physics and engineering are covered. Topics include: crystallography, thermodynamics of condensed phases, and thermal, elastic, electrical and magnetic properties. This course is oriented for advance undergraduate and graduate students with previous knowledge of materials science (MECE-305) **Class 3, Credit 3**

MECE-751 **Convective Phenomena**
This course introduces the student to the flow of real incompressible fluids. The differential approach is used to develop and solve the equations governing the phenomena of mass, momentum, and heat transfer. The material in the course provides the necessary background for a study of computational fluid dynamics. (MECE-738) **Class 3, Credit 3**

MECE-752 **Tribology Fundamentals**
This course provides an overview of the role of fluid-film lubrication in mechanical design, with strong emphasis on applications. Various forms of the Reynolds equation governing the behavior of lubricant films for planar, cylindrical, and spherical geometry are derived. Mobility and impedance concepts as solution methods of the Reynolds equation are introduced for the performance assessment of lubricated journal bearings under static and dynamic loading. Short, long, and finite bearing assumptions are discussed. Finite element methods for the analysis of fluid-film bearings of arbitrary geometry will be introduced. (MECE-210, MECE-350) **Class 3, Credit 3**

MECE-754 **Fundamentals of Fatigue and Fracture Mechanics**
This course is an introduction to the fatigue life prediction methodologies and basic fracture mechanics. Students will be introduced to linear elastic fracture mechanics, including stress intensity factor and crack tip plastic zone models. The fatigue methodologies to be covered include the Stress-Life Theory (used for machine elements), Strain-Life Theory (used for large-displacement samples and low cycle fatigue problems), and a fracture mechanics approach to fatigue analysis (used in the aircraft and space industries). (MECE-317, MECE-350) **Class 3, Credit 3**

MECE-758 **Intermediate Engineering Vibrations**
This course is a continuation of the introductory vibration course, MECE-658. Advanced topics such as flexibility and stiffness influence coefficients, continuous systems modeling of strings, rods, bars and beams, and modeling using the finite element method will be discussed. (MECE-658) **Class 3, Credit 3**

MECE-777 **Graduate Internship**
This course number is used by students in the master of engineering degree program for earning internship credits. Students must submit a proposal for the internship, to be approved by an employing supervisor and the department prior to enrolling. Students are required to submit an evaluation report at the conclusion of the internship. (Department permission) **Class 3, Credit 3 (F, S, Su)**

MECE-785 **Mechanics of Solids**
This course extends the student's knowledge of stressed mechanical components covered in Mechanics of Materials and lays the foundation for a follow-on course in finite elements. The basic relationships between stress, strain, and displacements are covered in more depth. Stress and strain transformations, plane elastic problems, and energy techniques are covered. Topics include beam bending and torsion problems not covered in Mechanics of Materials. (MECE-203) **Class 3, Credit 3**

MECE-789 **Special Topics**
Topics and subject areas that are not regularly offered are provided under this course. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate status) **Class 3, Credit 3 (F, S)**

MECE-790 **Thesis**
n conference with an adviser, a topic is chosen. Periodic progress reports and a final written document with an oral examination are required. (Department permission) **Credit 1-6 (F, S, Su)**

MECE-792 **Project with Paper**
This course is used by students in the master of engineering degree program for conducting an independent project. The student must demonstrate an acquired competence in an appropriate topic within mechanical engineering. The topic is chosen in conference with a faculty adviser. The work may involve an independent research and/or a design project and/or literature search with a demonstration of acquired skill. A written paper, approved by the adviser and the department, and an oral presentation of the work are required. (Department permission) **Class 3, Credit 3 (F, S, Su)**

MECE-795 **Graduate Seminar**
This seminar course presents topics of contemporary interest to graduate students enrolled in the program. Presentations include off campus speakers, and assistance with progressing on your research. Selected students and faculty may make presentations on current research under way in the department. All graduate students enrolled full time (whether dual degree or single degree) are expected to attend each quarter they are on campus. **Class 1, Credit 0 (F, S)**

MECE-799 **Independent Study**
This course is used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. Students registering for more than four credit hours must obtain the approval of both the department head and the adviser. (Instructor approval) **Credit 1–3 (F, S, Su)**

Microelectronic Engineering

MCEE-601 **Microelectronic Fabrication**
This course introduces the beginning graduate student to the fabrication of solid-state devices and integrated circuits. The course presents an introduction to basic electronic components and devices, lay outs, unit processes common to all IC technologies such as substrate preparation, oxidation, diffusion and ion implantation. The course will focus on basic silicon processing. The students will be introduced to process modeling using a simulation tool such as SUPREM. There is a lab for the on campus section (01), and a discussion of laboratory results and a graduate paper for the distance learning-section (90). The lab consists of conducting a basic metal gate PMOS process in the RIT clean room facility to fabricate and test a PMOS integrated circuit test ship. Laboratory work also provides an introduction to basic IC fabrication processes and safety. (Graduate standing or permission of the instructor) **Class 3, Lab 3, Credit 3 (F)**

MCEE-602 **VLSI Process Modeling**
This is an advanced level course in silicon process technology. A detailed study of several of the individual processes utilized in the fabrication of VLSI circuits will be done, with a focus on engineering challenges such as shallow-junction formation and ultra-thin gate dielectrics. Front-end silicon processes will be investigated in depth including diffusion, oxidation, ion implantation, and rapid thermal processing. Particular emphasis will be placed on non-equilibrium effects. Device design and process integration details will also be emphasized. SUPREM-IV (Silvaco Athena) will be used extensively for process simulation. A project will involve the complete simulation of a twin-well CMOS process. (MCEE-601) **Class 3, Lab 2, Credit 3 (F, S)**

MCEE-603 **Thin Films**
This course focuses on the deposition and etching of thin films of conductive and insulating materials for IC fabrication. A thorough overview of vacuum technology is presented to familiarize the student with the challenges of creating and operating in a controlled environment. Physical and Chemical Vapor Deposition (PVD and CVD) are discussed as methods of film deposition. Plasma etching and Chemical Mechanical Planarization (CMP) are studied as methods for selective removal of materials. Applications of these fundamental thin film processes to IC manufacturing are presented. This is a writing intensive course. (MCEE-601) **Class 3, Lab 3, Credit 3 (F, S)**

MCEE-605 **Lithography Materials and Processes**
Microlithography Materials and Processes covers the chemical aspects of microlithography and resist processes. Fundamentals of polymer technology will be addressed and the chemistry of various resist platforms including novolac, styrene, and acrylate systems will be covered. Double patterning materials will also be studied. Topics include the principles of photoresist materials, including polymer synthesis, photochemistry, processing technologies and methods of process optimization. Also advanced lithographic techniques and materials, including multi-layer techniques for BARC, double patterning, TARC, and next generation materials and processes are applied to optical lithography. (CHMG-131 or equivalent) **Class 3, Lab 3, Credit 3 (F, S)**

MCEE-615 Nanolithography Systems
An advanced course covering the physical aspects of micro- and nano-lithography. Image formation in projection and proximity systems are studied. Makes use of optical concepts as applied to lithographic systems. Fresnel diffraction, Fraunhofer diffraction, and Fourier optics are utilized to understand diffraction-limited imaging processes and optimization. Topics include illumination, lens parameters, image assessment, resolution, phase-shift masking, and resist interactions as well as non-optical systems such as EUV, maskless, e-beam, and nanoimprint. Lithographic systems are designed and optimized through use of modeling and simulation packages. (MCEE-605) **Class 3, Lab 3, Credit 3 (F, S)**

MCEE-699 Graduate Co-op
Up to six months of full-time, paid employment in the microelectronic engineering field. See the graduate program coordinator or RIT's Office of Cooperative Education for further details. (Department approval) **Credit 0 (F, S, Su)**

MCEE-704 Physical Modeling of Semiconductor Devices
MCEE-704 is a senior or graduate level course on the application of simulation tools for physical design and verification of the operation of semiconductor devices. The goal of the course is to provide a more in-depth understanding of device physics through the use of simulation tools. Technology CAD tools include Silvaco (Athena/Atlas) for device simulation. The lecture will explore the various models that are used for device simulation, emphasizing the importance of complex interactions and 2-D effects as devices are scaled deep-submicron. Laboratory work involves the simulation of various device structures. Investigations will explore how changes in the device structure can influence device operation. (Permission of instructor) **Class 3, Lab 2, Credit 3 (F)**

MCEE-706 SiGe and SOI Devices and Technologies
This course introduces students to the fundamentals of SiGe and Silicon on Insulator (SOI) devices and fabrication technologies. The course will first discuss the band structure of the SiGe material system, and how its properties of band structure and enhanced mobility may be utilized to improve traditional Si devices. Basic heterojunciton theory is introduced to students. Some specific applications that are introduced include heterojunction bipolar transistors (HBTs), SiGe-channel MOS devices, and high-electron mobility transistors (HEMTs). Fabrication technologies for realizing SOI substrates that include SIMOX and SMART CUT technologies are described. The physics of transistors built on SOI substrates will be discussed. At the completion of the course, students will write a review paper on a topic related to the course. (Permission of instructor) **Class 3, Lab 3, Credit 3 (F)**

MCEE-713 Quantum and Solid-State Physics for Nanostructures
This course describes the key elements of quantum mechanics and solid state physics that are necessary in understanding the modern semiconductor devices. Quantum mechanical topics include solution of Schrodinger equation solution for potential wells and barriers, subsequently applied to tunneling and carrier confinement. Solid state topics include electronic structure of atoms, crystal structures, direct and reciprocal lattices. Detailed discussion is devoted to energy band theory, effective mass theory, energy-momentum relations in direct and indirect band gap semiconductors, intrinsic and extrinsic semiconductors, statistical physics applied to carriers in semiconductors, scattering and generation and recombination processes. (Graduate standing) **Class 3, Lab 0, Credit 3 (F)**

MCEE-714 Micro/Nano Characterization
This microelectronic engineering elective is taught by mechanical engineering with a weekly lab component focuses on tools and techniques for micro- and nano-characterization of materials, surfaces and thin films. The course covers the principles and applications of four experimental techniques: quantitative imaging, x ray diffraction, scanning probe microscopy, and micro- and nano-indentation. Students will learn the physics of interaction processes used for characterization, quantification and interpretation of collected signals, and fundamental detection limits for each technique. (An introductory materials science course such as: MECE-305 or MCEE-360 or MTSE-701) **Class 2, Lab 2, Credit 3 (F)**

MCEE-717 Memory Systems
This course targets the overlapping areas of device physics, VLSI Design, advanced processes, electrical characterization and circuit architecture as it applies to modern memory systems. While there are no specific set of prerequisite courses, students should be willing to work on problems involving the previously mentioned topics. Course work will trace the design, development, fabrication, packaging and testing of SRAM, DRAM and Flash Memory, and then branch off into MRAM, FRAM and PRAM technology. The course wraps up with an exploration of future memory system candidates such as quantum, molecular and optical memory systems. Students will write a term paper on an aspect of memory systems of particular interest to them (Proposed topic must still be approved by the instructor.) Graduate standing or permission of instructor) **Class 3, Lab 0, Credit 3 (F)**

MCEE-720 Photovoltaic Science and Engineering
This course focuses on the principle and engineering fundamentals of photovoltaic (PV) energy conversion. The course will cover modern silicon PV devices, including the basic physics, ideal and non-ideal models, device parameters and design, and device fabrication. The course will discuss crystalline, multi-crystalline, amorphous thin films solar cells and their manufacturing. Students will be made familiar on how basic semiconductor processes are employed in solar cells manufacturing. The course will further introduce third generation advanced photovoltaic concepts including compound semiconductors, spectral conversion, and organic and polymeric devices. PV applications, environmental, sustainability and economic issues will also be discussed. Evaluation will include in addition to assignments and exams, a research/term paper on a current PV topic. (Permission of instructor) **Class 3, Lab 3, Credit 3 (S)**

MCEE-730 Metrology for Failure Analysis and Yield of ICs
Successful IC manufacturing must detect defects (the non-idealities) that occur in a process), eliminate those defects that preclude functional devices (yield enhancement), and functionality for up to ten years of use in the field (reliability). Course surveys current CMOS manufacturing to compile a list of critical parameters and steps to monitor during manufacturing. This survey is followed with an in depth look at the theory and instrumentation of the tools utilized to monitor these parameters. Tool set includes optical instrumentation, electron microscopy, surface analysis techniques, and electrical measurements. Case studies from industry and prior students are reviewed. Students are required to perform a project either exploring a technique not covered in class, or to apply their course knowledge to a practical problem. (MCEE-201 or equivalent MCEE-360, or equivalent; permission of instructor) **Class 3, Lab, Credit 3 (F)**

MCEE-732 Evaluation of Microelectronic Manufacturing
This course focuses on CMOS manufacturing. Topics include CMOS process technology, work in progress tracking, CMOS calculations, process technology, long channel and short channel MOSFET, isolation technologies, back-end processing and packaging. Associated is a lab for on-campus section (01) and a graduate paper/case study for distance learning section (90). The laboratory for this course is the student-run factory. Topics include Lot tracking, query processing, data collection, lot history, cycle time, turns, CPK and statistical process control, measuring factory performance, factory modeling and scheduling, cycle time management, cost of ownership, defect reduction and yield enhancement, reliability, process modeling and RIT's advanced CMOS process. Silicon wafers are processed through an entire CMOS process and tested. Students design unit processes and integrate them into a complete process. Students evaluate the process steps with calculations, simulations and lot history, and test completed devices. (MCEE-701) **Class 3, Lab 3, Credit 3 (S)**

MCEE-770 Microelectromechanical Systems
This course will provide an opportunity for the student to become familiar with the design, fabrication technology and applications of Microelectromechanical systems. This is one of the fastest growing areas in the semiconductor business. Today's MEMS devices include accelerometers, pressure sensors, flow sensors, chemical sensors, energy harvesting and more. These devices have wide variety of applications including automotive, consumer, military, scientific, and biomedical. Students will select a MEMS device/project to be made and then design, fabricate, test, prepare a project presentation and final paper. (Senior/graduate level engineering student or permission of the instructor) **Class 3, Lab 3, Credit 3 (F)**

MCEE-777 Master of Engineering Internship
This course number is used to fulfill the internship requirement for the master of engineering degree program. The student must obtain the approval of the department head before registering for this course. (Adviser approval) **Class 0, Lab 0, Credit 4 (F, S, S)**

MCEE-789 Special Topics
This is a variable credit, variable special topics course that can be in the form of a course that is not offered on a regular basis. (Adviser approval) **Class 1–3, Lab 0, Credit 1–3 (F, S, S)**

MCEE-790 MS Thesis
The master's thesis in microelectronic engineering requires the student to prepare a written thesis proposal for approval by the faculty; select a thesis topic, adviser and committee; present and defend thesis before a thesis committee; submit a bound copy of the thesis to the library and to the department; prepare a written paper in a short format suitable for submission for publication in a journal; complete course work and thesis within a seven-year period; register for one credit of Continuation of Thesis each school term (except summer) after the 30 credits required for the master's degree until the thesis is completed. (Graduate standing in MS in microelectronic engineering, adviser approval) **Class 1, Credit 1–6 (F, S)**

MCEE-795 **Microelectronics Research Methods**
Weekly seminar series intended to present the state of the art in microelectronics research. Other research-related topics will be presented such as library search techniques, contemporary issues, ethics, patent considerations, small business opportunities, technical writing, technical reviews, effective presentations, etc. Required of all MS microelectronic engineering students for one credit up to a total 3 credits. **Class 1, Lab 0, Credit 1 (F, S)**

MCEE-799 **Graduate Independent Study**
This course number should be used by students who plan to study a topic on an independent basis under the guidance of a faculty member. A written proposal with an independent study form is to be submitted to the sponsoring faculty member and approved by the department head prior to the commencement of work. (Adviser approval) **Credit 1–3 (F, S, S)**

Computer Engineering

CMPE-630 **Digital Integrated Circuit Design**
This course will cover the basic theory and techniques of Digital Integrated Circuit Design in CMOS technology. Topics include CMOS transistor theory and operation, design and implementation of CMOS circuits, fabrication process, layout and physical design, delay and power models, static and dynamic logic families, testing and verification, memory and nanoscale technologies. Laboratory assignments and project facilitate in hands-on learning of circuit-level design and simulation, layout and parasitic extractions, pre- and post-layout verification and validation, full-custom flow and Synthesis based flow, using industry standard CAD tools. (CMPE-260 Digital System Design II; EEEE-381 Electronics I or equivalent) **Class 3, Lab 2, Credit 3 (F, S)**

CMPE-651 **High Performance Architectures**
This course will focus on learning and understanding the available hardware options to satisfy the needs of high performance and computational intensive applications. Special attention will be paid to single platform massively parallel devices, their programming and efficient use of the hardware resources. The course will include hands on work with the actual device, lab work, and technical reports and conference paper reading as a relevant source of information. (CMPE 380 and CMPE-551) **Class 3, Lab 0, Credit 3 (F, S)**

CMPE-660 **Reconfigurable Computing**
The objective of this course is to present the foundations of reconfigurable computing methodologies from both hardware and software perspectives. Topics covered are: architectures of modern field programmable gate arrays (FPGAs), digital system design methodologies using FPGAs, hardware-software co-design with embedded processors, hardware optimization techniques, system level integration under operating system, dynamic reconfiguration. Laboratory projects in which students will acquire a solid capability of Xilinx CAD tools and FPGA devices are required. The projects include the whole design flow: design of the system, VHDL modeling, software and hardware development, FPGA verification. (CMPE-260, CMPE-350) **Class 2, Lab 2, Credit 3 (F, S)**

CMPE-663 **Real-time and Embedded Systems**
This first course in a graduate elective sequence will begin by presenting a general road map of real-time and embedded systems. The course will be conducted in a studio class/lab format with lecture material interspersed with laboratory work. This course will introduce a representative family of microcontrollers that will exemplify unique positive features as well as limitations of microcontrollers in embedded and real-time systems. These microcontrollers will then be used as external, independent performance monitors of more complex real-time systems. The majority of the course will present material on a commercial real-time operating system and using it for programming projects on development systems and embedded target systems. Some fundamental material on real-time operating systems and multiprocessor considerations for real-time systems will also be presented. Examples include scheduling algorithms, priority inversion, and hardware-software co-design. (CMPE-380, or SWEN-461) **Class 4, Credit 3 (F)**

CMPE-670 **Data and Communication Networks**
This course will give an overview of the technologies, architectures and protocols used to build various types of computer and communication networks—wired or wireless. The emphasis will be placed on discussions of various network design problems and solution approaches. Specific issues covered in this course include: framing and coding, error detection, multiple access control, addressing, routing, flow and congestion control, scheduling and switching. (MATH-251) **Class 3, Lab 0, Credit 3 (F, S)**

CMPE-684 **Wireless Networks**
This course will give an overview of the technologies, architectures and protocols used to build various types of computer and communication networks—wired or wireless. The emphasis will be placed on discussions of various network design problems and solution approaches. Specific issues covered in this course include: framing and coding, error detection, multiple access control, addressing, routing, flow and congestion control, scheduling and switching. (CMPE-570 or CMPE-670) **Class 3, Lab 0, Credit 3 (F, S)**

CMPE-685 **Computer Vision**
This course covers both fundamental concepts and the more advanced topics in Computer Vision. Topics include image formation, color, texture and shape analysis, linear filtering, edge detection and segmentation. In addition, students are introduced to more advanced topics, such as model based vision, object recognition, digital image libraries and applications. Homework, literature reviews and programming projects are integrated with lectures to provide a comprehensive learning experience. (Graduate student or BS/MS student) **Class 3, Credit 3 (S)**

CMPE-699 **Graduate Co-op**
Graduate co-op aims to enhance the educational experience of graduate students through full-time paid employment during an academic quarter at positions in the Computer Engineering field. Registration is optional and is recommended for summer term only after the completion of all course work. (Department approval required) **Credit 0**

CMPE-730 **Advanced Digital Integrated Circuit Design**
This course covers techniques for high-performance, low power and reliability in digital integrated circuit design from a systems perspective. Emphasis will be on the most important design challenges, being the impact of scaling, interconnect, signal integrity, power and timing. Presentation and term paper based on current research articles is required. Laboratory assignments are based on real time applications. Design process starting from logic synthesis down to layout synthesis will be covered in the laboratory, with industry standard CAD tools. (CMPE-530 or CMPE-630) **Class 3, Lab 2, Credit 3**

CMPE-740 **Analytical Topics in Computer Engineering**
This course begins by reviewing signal and system analysis techniques for analyzing linear systems. It includes Fourier techniques and moves on to present fundamental computational techniques appropriate for a number of applications areas of computer engineering. Other topics include symbolic logic and optimization techniques. (CMPE-480, MATH-231, MATH-241, MATH-251) **Class 3, Lab 0, Credit 3 (F, S)**

CMPE-756 **Multiple Processor Systems**
The course introduces basic concepts of parallel and high-performance computing and current methodologies and trends in the design and programming of multiprocessor systems. Theoretical models of parallel computing and performance metrics are studied and contrasted with practical parallel system architectures, programming environments, and benchmarking techniques. Parallel architectures are classified according to mode and degree of parallelism, memory organization, and type and typology of interconnection networks used in the design. The suitability of various architectures in meeting demands is studied in depth including the study of representative examples of current commercial machines. Students will complete programming assignments on a parallel computer illustrating practical issues. A review and analysis of a commercial parallel processor system or an active research area is required; written review presented in class. (CMPE-551 Computer Architecture) **Class 3, Lab 0, Credit 3 (F, S)**

CMPE-789 **Special Topics**
Graduate level topics and subject areas that are not among the courses typically offered are provided under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate status) **Class 3, Credit 3 (F, S)**

CMPE-790 **Thesis**
Thesis research investigates an independent problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty adviser to guide the thesis before registering. (Department approval required) **Credit 1-6**

CMPE-795 **Graduate Seminar**
The graduate seminar prepares graduate students to effectively conduct their thesis research and expose them to current research in various areas of computer engineering. Current literature topics are reviewed through interactive presentations and discussions. (Graduate status or permission of instructor) **Class 1, Credit 0 (F, S)**

Center for Quality and Applied Statistics

CQAS-611 Statistical Software
This course is an introduction to two statistical-software packages, SAS and R, which are often used in professional practice. Some comparisons with other statistical-software packages will also be made. Topics include: data structures; reading and writing data; data manipulation, subsetting, reshaping, sorting, and merging; conditional execution and looping; built-in functions; creation of new functions or macros; graphics; matrices and arrays; simulations; select statistical applications. (One course in basic statistics) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-621 Statistical Quality Control
A practical course designed to provide in-depth understanding of the principles and practices of statistical process control, process capability, and acceptance sampling. Topics include: statistical concepts relating to processes, Shewhart charts for attribute and variables data, CUSUM charts, EWMA charts, process capability studies, attribute and variables acceptance sampling techniques. (One course in basic statistics) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-670 Designing Experiments for Process Improvement
How to design and analyze experiments, with an emphasis on applications in engineering and the physical sciences. Topics include the role of statistics in scientific experimentation; general principles of design, including randomization, replication, and blocking; replicated and un-replicated two-level factorial designs; two-level fractional-factorial designs; response surface designs. (One semester basic statistics, CQAS-621 recommended) **Class 3, Credit 3 (F, S)**

CQAS-672 Survey Design and Analysis
This course is an introduction to sample survey design with emphasis on practical aspects of survey methodology. Topics include: survey planning, sample design and selection, survey instrument design, data collection methods, and analysis and reporting. Application areas discussed will include program evaluation, opinion polling, customer satisfaction, product and service design, and evaluating marketing effectiveness. Data collection methods to be discussed will include face-to-face, mail, Internet and telephone. (One course in basic statistics) **Class 3, Lab 0, Credit 3 (Su)**

CQAS-682 Lean Six Sigma Fundamentals
This course presents the philosophy and tools that will enable participants to develop quality strategies and drive process improvements that are linked to and integrated with business plans. The principles of Lean Six Sigma are presented, making the course a prerequisite for Lean Six Sigma Black Belt certification. **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-683 Lean Six Sigma Project
Students in this course will work on a process improvement opportunity at an organization utilizing the DMAIC (Define, Measure, Analyze, Improve, and Control) approach to problem solving as well as the Lean Six Sigma tools. (CQAS-682; corequisite(s): CQAS-621, CQAS-670) **Credit 3 (F, S)**

CQAS-699 Graduate Co-op
Up to six months of full-time, paid employment in the mechanical engineering field. See the graduate program coordinator or RIT's Office of Cooperative Education for further details. (Department permission) **Credit 0 (F, S, Su)**

CQAS-701 Foundations of Experimental Design
This course is an introduction to experimental design with emphases on both foundational and practical aspects. Topics include the role of statistics in scientific experimentation, completely randomized designs, randomized complete block designs, nested designs, Latin square designs, incomplete block designs, general factorial designs, split-plot designs, random vs. fixed effects, and mixed models. (One course in basic statistics) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-721 Theory of Statistics I
This course introduces the student to the fundamental principles of statistical theory while laying the groundwork for study in the course sequel and future reading. Topics include classical probability, probability mass/density functions, mathematical expectation (including moment-generating functions), special discrete and continuous distributions, and distributions of functions of random variables. (Two semesters of university-level calculus and a basic statistics course) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-722 Theory of Statistics II
Building on foundations laid in the first course, this second course in statistical theory answers some of the "How?" and "Why?" questions of statistics. Topics include the sampling distributions and the theory and application of point and interval estimation and hypothesis testing. (CQAS-721 or equivalent) **Class 3, Credit 3 (F, S)**

CQAS-741 Regression Analysis
A course that studies how a response variable is related to a set of predictor variables. Regression techniques provide a foundation for the analysis of observational data and provide insight into the analysis of data from designed experiments. Topics include happenstance data versus designed experiments, simple linear regression, the matrix approach to simple and multiple linear regression, analysis of residuals, transformations, weighted least squares, polynomial models, influence diagnostics, dummy variables, selection of best linear models, nonlinear estimation, and model building. (CQAS-701 is useful) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-747 Principles of Statistical Data Mining I
This course covers topics such as clustering, classification and regression trees, multiple linear regression under various conditions, logistic regression, PCA and kernel PCA, model-based clustering via mixture of gaussians, spectral clustering, text mining, neural networks, support vector machines, multidimensional scaling, variable selection, model selection, k-means clustering, k-nearest neighbors classifiers, statistical tools for modern machine learning and data mining, naïve Bayes classifiers, variance reduction methods (bagging) and ensemble methods for predictive optimality.(one course in basic statistics) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-751 Nonparametric Statistics
The emphasis of this course is how to analyze certain designs when the normality assumption cannot be made, with an emphasis on applications. This includes certain analyses of ranked data and ordinal data. The course provides a review of hypothesis testing and confidence-interval construction. Topics include: sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, runs tests, chi-square tests, rank correlation, rank order tests; and Kolmogorov-Smirnov statistics. (CQAS-701 or equivalent) **Credit 3 (Su)**

CQAS-756 Multivariate Analysis
Multivariate data are characterized by multiple responses. This course concentrates on the mathematical and statistical theory that underlies the analysis of multivariate data. Some important applied methods are covered. Topics include matrix algebra, the multivariate normal model, multivariate t-tests, repeated measures, MANOVA and principal components. (Basic matrix algebra; CQAS-701 is useful; CQAS-721 is recommended; CQAS-611 is suggested) **Class 3, Credit 3 (F, S)**

CQAS-762 SAS Database Programming
This course focuses on the SAS programming language used to read data, create and manipulate SAS data sets, and create SAS macros. This course covers the material required for "SAS Base Programming."

CQAS-773 Time Series Analysis and Forecasting
TThis course is designed to provide the student with a solid practical hands-on introduction to the fundamentals of time series analysis and forecasting. Topics include stationarity, filtering, differencing, time series decomposition, time series regression, exponential smoothing, and Box-Jenkins techniques. Within each of these we will discuss seasonal and non-seasonal models. Many real-world examples will be covered and demonstrated using modern statistical software. (CQAS-741) **Class 3, Credit 3 (F, S)**

CQAS-775 Design and Analysis of Clinical Trials
This course is an introduction to the statistical design and the analysis of clinical trials. Topics include: study objectives and population; randomization, blinding, and sample size; data collection and quality control; participant adherence; survival curves and their comparisons; parametric and non-parametric modeling; Cox's proportional-hazards model and extensions; covariates, prognostics indicators, multi-center trials; ANOVA, ANCOVA, logistic regression; and sequential methods. (CQAS-701, CQAS-611, CQAS-741) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-784 Categorical Data Analysis
The course develops statistical methods for modeling and analysis of data for which the response variable is categorical. Topics include: contingency tables, matched pair analysis, Fisher's exact test, logistic regression, analysis of odds ratios, log linear models, multi-categorical logit models, ordinal and paired response analysis. (CQAS-741) **Class 3, Lab 0, Credit 3 (F, S)**

CQAS-789 Special Topics
Topics and subject areas that are not regularly offered are provided under this course. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate status) **Credit 3**

CQAS-790 Thesis
For students working for the MS degree who are writing a research thesis. (Department approval) **Credit 6**

CQAS-792 **Capstone**
This course is designed to provide a capstone experience for MS students at the end of the graduate studies, and will require a synthesis of knowledge obtained from earlier coursework. (CQAS-611, CQAS-701, CQAS-722, CQAS-741) **Class 3, Credit 3 (F, S)**

CQAS-795 **Graduate Seminar**
This course, required for full-time students, offers opportunities for additional learning through formal seminars, informal presentations, and special projects. **Credit 0 (F, S)**

CQAS-799 **Independent Study**
This course, required for full-time students, offers opportunities for additional learning through formal seminars, informal presentations, and special projects. (Department approval required) **Credit variable 1-6 (F, S)**

Microsystems Engineering

MCSE-702 **Introduction to Nanotechnology and Microsystems**
This course will introduce first year Microsystems Engineering students to microsystems and nanotechnology. Topics include, micro and nano systems; MEMS, bioMEMS, MOEMS, and NEMS; nanomaterials; nanopatterning; characterization and analytical techniques; self-assembly approaches; nanoelectronics and nanophotonics; nanomagnetics; organic electronics; and microfluidics. The course will be taught by faculty in the individual fields of nanotechnology and microsystems. (Graduate [Ph.D.] standing or permission of instructor) **Class 3, Credit 3 (F)**

MCSE-703 **Material Science for Microsystems Engineering**
The intent of this course is to provide a comprehensive review of the fundamental concepts of materials science and engineering with applications to nano- and microsystems. Topics include crystallography, diffusion, phase diagrams, fluids, and thermal, elastic, electrical, optical and magnetic properties. This course provides students in the engineering or science fields of nano- and microsystems with the background for future course work and research in materials. (Graduate [Ph.D.] standing or permission of instructor) **Class 3, Credit 3 (S)**

MCSE-712 **Nonlinear Optics**
This course introduces nonlinear concepts applied to the field of optics. Students learn how materials respond to high intensity electric fields and how the materials response: enables the generation of other frequencies, can focus light to the point of breakdown or create waves that do not disperse in time or space solitons, and how atoms can be cooled to absolute zero using a laser. Students will be exposed to many applications of nonlinear concepts and to some current research subjects, especially at the nanoscale. Students will also observe several nonlinear-optical experiments in a state-of-the-art photonics laboratory. (EEEE-374 or equivalent) **Class 3, Credit 3 (S)**

MCSE-713 **Lasers**
This course introduces students to the design, operation and applications of lasers (Light Amplification by Stimulated Emission of Radiation). Topics: ray tracing, Gaussian beams, optical cavities, atomic radiation, laser oscillation and amplification, mode locking and Q switching, and applications of lasers. (EEEE-374 or equivalent) **Class 3, Credit 3 (F)**

MCSE-714 **Quantum Mechanics for Engineers**
This course will give students comprehensive understanding of the foundations of quantum mechanics. The course will also provide practical solution techniques which can be applied to a variety of nanoscale problems. Topics include: waves and Schrodinger's equation; time-dependent Schrodinger equation; operator approach to quantum mechanics; Dirac Notation; solution approaches and approximation methods; time-dependent perturbation theory with applications to absorption and Fermi's golden rule; angular momentum and the hydrogen atom; If time allows: spin; identical particles. (EEEE-353, MATH-231) **Class 3, Credit 3 (F)**

MCSE-731 **Integrated Optical Devices and Systems**
This course discusses basic goals, principles and techniques of integrated optical devices and systems, and explains how the various optoelectronic devices of an integrated optical system operate and how they are integrated into a system. Emphasis in this course will be on planar passive optical devices. Topics include optical waveguides, optical couplers, micro-optical resonators, surface plasmons, photonic crystals, modulators, design tools and fabrication techniques, and the applications of optical integrated circuits. Some of the current state-of-the-art devices and systems will be investigated by reference to journal articles. (Graduate [Ph.D.] standing or permission of instructor) **Class 3, Credit 3 (F)**

MCSE-771 **Optoelectronics**
To provide an introduction to the operating principles of optoelectronic devices used in various current and future information processing and transmission systems. Emphasis in this course will be on the active optoelectronic devices used in optical fiber communication systems. Topics include pulse propagation in dispersive media, polarization devices, optical fiber, quantum states of light, fundamental of lasers, semiconductor optics, light-emitting diodes, laser diodes, semiconductor photon detectors, optical modulators, quantum wells, and optical fiber communication systems (Graduate [Ph.D.] standing or permission of instructor) **Class 3, Credit 3 (S)**

MCSE-889 **Special Topics**
Topics and subject areas that are not regularly offered are provided under this course. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (Graduate status) **Class 3, Credit 3 (F, S)**

MCSE-890 **Dissertation**
Research in an appropriate topic as arranged by doctoral candidate and dissertation adviser in fulfillment of the dissertation requirement. A minimum of 18 research credits is required for graduation (maximum is 27). **Credit variable 1-27 (F, S, Su)**

College of Health Sciences and Technology

Daniel Ornt, Dean

Programs of study

Online learning option available

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters.Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The United States faces a looming shortage of many types of health care professionals, including nurses, physicians, dentists, pharmacists, and allied health workers. The college, housed in the Institute of Health Sciences and Technology, serves as an independent academic and research entity designed to provide a focused, interdisciplinary, and systems approach to innovative health care education, applied/translational research, and community outreach. The institute incorporates three major thrusts: the College of Health Sciences and Technology, a Health Science Research Center, and a Health Science Community Collaboration and Outreach Center.

The college offers clinically related and biomedical research-based programs to meet both the present and future needs of the health care system. The college's faculty and staff are committed to delivering high quality educational programs. Building on a foundation of liberal arts and basic sciences, students will gain advanced knowledge in theoretical science and practical applications in experiential learning environments. These experiences prepare students to serve as practitioners, scientists, and leaders through their contribution to, and the provision of, high-quality patient care, health care service, and/or applied, translational biomedical research.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

Faculty members in the college have considerable experience in their respective fields of discipline. Basic science and clinical faculty work side-by-side to provide students with a comprehensive learning experience to prepare them for their chosen health care related career.

Facilities and resources

In addition to facilities shared with the College the Science and the College of Imaging Arts and Sciences, the Center for Bioscience Education and Technology (CBET) provides a comprehensive environment to support academic, community, and career-training programs in the emerging life and medical sciences. The facility consists of multi-purpose, high-tech laboratories and classrooms for work-force development, academic programs, continuing education programs, research, K-12 student workshops, and secondary school training programs.

Clinical Chemistry, MS

http://www.rit.edu/healthsciences/graduate-programs/clinical-chemistry/

James C. Aumer, Interim Director

(585) 475-2526, jcascl@rit.edu

Program deactivated

Effective fall 2013, the program in clinical chemistry will no longer admit new students. This change will not affect currently matriculated students.

The clinical chemistry program is designed for full- or part-time study. Required courses are offered regularly during the late afternoon or evening in order to accommodate the work schedules of part-time students.

The program is designed to provide a focused educational experience for individuals preparing for careers in clinical chemistry. The design of the program provides technical and managerial proficiencies in either the diagnostic laboratory or a related industry.

Curriculum

The program includes a core curriculum and electives that are chosen to reflect the student's background and career goals. A minimum of 50 quarter credit hours beyond the bachelor's degree is required.

Required courses

1009-702 Biochemistry: Biomolecular Conformation and Dynamics
1009-703 Biochemistry: Metabolism
1008-711, 621 Instrumental Analysis and Lab
1016-719 Biostatistics
1023-705 Mechanisms of Disease
1023-820, 821, 822 Advanced Clinical Chemistry I, II, III
0102-740 Organizational Behavior and Leadership
Plus one of the following courses:
1023-877 External Clinical Chemistry Research
1023-879 Internal Clinical Chemistry Research

All students are required to carry out and defend original research as part of the program requirements. Research is conducted under the direction of a faculty member and is reviewed and defended before a graduate committee appointed by the program director.

The program focuses on the activities of the diagnostic clinical laboratory, developmental research in pathology, and diagnostic testing, as well as industrial activities related to clinical laboratory products and instruments.

Admission requirements

To be considered for admission to the MS program in clinical chemistry, candidates must fulfill the following requirements:

- Hold a bachelor's degree in chemistry, biology, medical technology, nuclear medicine technology, or a related field from an accredited college or university,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit a statement outlining the candidate's research/project interests, career goals, and suitability to the program,
- Have an undergraduate cumulative GPA of 3.0 or higher,
- Submit two letters of recommendation, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 575 (paper-based) or 90-91 (Internet-based) is required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information, please visit www.ielts.org.

All students whose native language is not English are required (upon arrival) to take the Michigan Test of English Proficiency, administered by the English Language Center. If a student's score is below standard, the center will make recommendations for additional course work. Successful completion of this work is a program requirement for the degree. This may mean students will need additional time and financial resources to complete the degree program.

Health Systems Administration, MS

http://www.rit.edu/cast/servicesystems/hsa/

Linda Underhill, Graduate Program Chair
(585) 475-7359, lmuism@rit.edu

Program overview

The MS in health systems administration is designed to provide strategic skills for today's health care management. Now, as never before, health care is rapidly transforming. The pace of technology and innovation are changing how, when, and where health care is provided, and who is providing it. Concurrently, health care customers have high expectations for quality and responsiveness to their needs—delivered in a cost-effective manner.

To provide these strategic skills to health care management, the MS in health systems administration builds on a foundation of courses in policy and law formation, health care economics, innovation, and leadership. Additional options are provided through course selections, building an integrated program that meets the individual challenges of participating students.

The program is available online, allowing students to pursue their degree while maintaining full-time employment in locations around the world. Another distinct advantage is the diversity of our student population, allowing for creative discussion and comprehension of global health care issues and how these relate to the standards and practices of the American health care system. The ability to share information and ideas, and to contrast and compare strategies, allows students a level of creativity and scope of practice not found in the traditional classroom.

RIT provides excellent online learning support that leads the student through registration and use of distance learning tools. In addition, for select subject areas, the health systems administration program plans special learning sessions that blend presentation styles. This could be through attendance at seminars in locations throughout the country or on the RIT campus. These formats provide a combination of both distance learning and interaction with presenters who provide a strategic view of health care delivery models.

Curriculum

The program requires 48 quarter credit hours at the graduate level and can be completed in approximately two years by taking two courses per quarter. Students may take longer to complete the course work by reducing their workload to one course per quarter. However, students must complete their degree requirements within seven years of the date of the oldest course identified on their RIT course records. Students must maintain a 3.0 average throughout their academic career. Toward the end of their program of study, students will complete a capstone course focusing on a business plan/case for an innovative topic related to their work environment. The paper is developed and written within a course that is taken during the last year of study for the degree. Upon matriculation, each student works with the program chair for advice and direction to develop a plan of study.

Electives

Students must also complete a total of 12 quarter credit hours of electives. Students may fulfill electives from other concentrations or from other graduate courses offered in the School of International Hospitality and Service Innovation with permission of their adviser and program chairs.

Thesis/Capstone/Comprehensive exam options

All students must complete a thesis, a capstone project, or a comprehensive exam to complete their degree program. In conferring with their academic adviser, students may choose a thesis or capstone project topic that complements the candidate's undergraduate training, career experiences, and graduate interests. Both the thesis and capstone project are formal documents that reflect the candidate's professional preparation and should be of an applied research genre. Graduate faculty will assist the student in selecting a relevant thesis/project topic.

The comprehensive exam focuses on knowledge of the core competencies, theory and foundation principles, and application of this knowledge to a variety of scenarios.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Health systems administration, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0626-714	Data Analysis/Metrics	2
0625-844	Breakthrough Thinking, Creativity and Innovation	4
0635-840	Health Systems Policy and Law	4
0635-820	Health Systems Economics and Finance	4
0624-770	Service Leadership	4
0635-712	Library Research	1
0635-718	Research Writing	4
	Electives	12
	Thesis/Capstone/ Comprehensive Exam	8
Total Quarter Credit Hours		**48**

Concentrations

COURSE	
Elements of Heath Care Leadership	
0635-830	Health Systems Planning
0635-882	Bioethics
0625-842	Customer Relationship Management
0625-750	Elements of Service
Health Systems Finance	
0635-815	Finance for Operations
0635-798	Risk Management
0635-797	Strategies for Health Care Accountability
0635-881	Health Insurance Reimbursement

Health systems administration (leadership in health care concentration), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
HLTH-700	Research Methods	3
HLTH-702	Graduate Writing Strategies	3
HLTH-710	Health Governance and Economics	3
HLTH-715	Reinventing Health	3
HLTH-717	Bioethics	3
SERQ-730	Service Leadership	3
HRDE-731	Team Process and Facilitation skills	3
HLTH-720	Health Systems Planning	3
Second Year		
HLTH 725	Marketing Within Health	3
HLTH 795	Comprehensive Exam	0
	HLTH Elective	3
HLTH 794	Integrative problem solving	3
Total Semester Credit Hours		**36**

Health systems administration (healing hospitality concentration), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
HLTH-700	Research Methods	3
HLTH-702	Graduate Writing Strategies	3
HLTH-710	Health Governance and Economics	3
HLTH-715	Reinventing Health	3
HLTH-717	Bioethics	3
HLTH-740	CRM in Health	3
SERQ-740	Context in Service	3
HLTH-745	Healing Cultures	3
Second Year		
HLTH-747	Healing Environments	3
HLTH-795	Comprehensive Exam	0
SERQ-712	Breakthrough Thinking	3
	HLTH Elective	3
HLTH-794	Integrative Problem Solving	3
Total Semester Credit Hours		**36**

Health systems administration (health care operations concentration), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
HLTH-700	Research Methods	3
HLTH-702	Graduate Writing Strategies	3
HLTH-710	Health Governance and Economics	3
HLTH-715	Reinventing Health	3
HLTH-717	Bioethics	3
HLTH-730	Finance for Health Care Professionals	3
HLTH-732	Health Insurance and Reimbursement	3
HLTH-735	Management of Risk in Health Care	3
Second Year		
HLTH-737	Lean Sigma in Health	3
HLTH-795	Comprehensive Exam	0
SERQ-712	Breakthrough thinking	3
	HLTH Elective	3
HLTH-794	Integrative Problem Solving	3
Total Semester Credit Hours		**36**

Admission requirements

To be considered for admission to the MS program in health systems administration, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at a regionally accredited college or university,
- Have a cumulative GPA of 3.0 or above (or superior endorsement),
- Submit two letters of reference from individuals who have the opportunity to observe the applicant's work output,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Complete an interview with the program chair (for those without health care experience), and
- Complete a graduate application.

It is recommended that applicants have a minimum of three years of experience in a health care or health-related organization as either a practitioner or manager. Applicants who do not meet this requirement may be asked to complete certain undergraduate courses as a bridge for the content knowledge required for the graduate program. They may also be required to complete a graduate level internship in health care prior to graduation.

All credentials must be submitted and reviewed by faculty prior to the completion of 12 quarter credit hours of graduate work in the program.

Medical Illustration, MFA

http://www.rit.edu/healthsciences/graduate-programs/medical-illustration/

Program overview

The MFA program in medical illustration enables students to exhibit critical and creative thinking and problem solving through the accurate translation of medical and scientific concepts into effective visual support for instruction or advertisement. Students utilize effective research techniques and demonstrate efficient use of time and resources during concept and development of projects to satisfy course assignments.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Medical illustration, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2020-781	Medical Illustration Topics I	3
2020-784	Medical Illustration Topics II	3
2020-731	Human Gross Anatomy I	4
2020-732	Human Gross Anatomy II	4
2014-701	Survey: Computer Graphics	2
2020-782	Medical Illustration Graphics	3
2020-783	Anatomical Studies	3
Choose one of the following:		3
2020-753	Medical Legal Illustration	
2020-767	Molecular Illustration	
2020-890	Medical Illustration Thesis	1
	Science Elective	4
	Humanities	8
	Open/Studio Electives	12
Second Year		
2020-785	Surgical Procedures	3
2020-780	Surgical Procedures II	3
2020-751	Computer Animation and Interactivity I	3
2020-890	Medical Illustration Thesis	13
	Open/Studio Electives	18
Total Quarter Credit Hours		**90**

Medical illustration, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ILLM-601	Human Gross Anatomy	6
ILLM-602	Anatomic Studies	3
ILLM-603	3D Modeling of Biomedical Forms	3
Choose one of the following electives:		3
HCIN-660	Fundamentals of Instructional Technology	
HCIN-610	Foundations of Human Computer Interactivity	
VCDE-711	Design Theory and Methods	
ILLM-606	3D Animation of Biomedical Forms	3
ILLM-607	Computer Applications in Medical Illustration	3
ILLM-608	Scientific Visualization	3
ILLM-890	Thesis	1
	Studio Elective	3
	Science Elective	3
Second Year		
ILLM-615	Interactive Media I	3
ILLM-612	Surgical Illustration	3
	Studio Electives	6
ILLM-616	Interactive Media II	3
ILLM-617	Portfolio and Business Practices	3
ILLM-890	Thesis	9
	Graduate Elective	3
Total Semester Credit Hours		**61**

Admission requirements

To be considered for admission to the MFA in medical illustration, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in a field of the arts, sciences, or education from a regionally accredited college. The undergraduate degree should include studio art courses, one year of general or introductory biology (for biology majors), and a minimum of three advanced biology courses, such as vertibrate anatomy, physiology, neurobiology, cell biology, molecular biology, immunology, microbiology, genetics, developmental biology, or pathology.
- Demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential.
- Demonstrate, through the submission of a portfolio, outstanding drawing skills, particularly the ability to draw subjects from direct observation.
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work.
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required. Scores from the International

English Language Testing System may be submitted in place of the TOEFL. A minimum score of 6.5 is required. Those applicants coming from countries where the baccalaureate degree is not awarded for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and if their academic records and portfolios indicate an ability to meet graduate standards.

Elements of Health Care Leadership, Adv. Cert.

Program overview

RIT offers three advanced certificates in health administration:

- Elements of health care leadership
- Health systems finance
- Senior living management

These certificate programs strive to meet the changing needs of health care professionals.

Each certificate can be completed individually to prepare professionals in a particular areas of expertise, update a set of skills, or assist in a career change. They may serve as stand-alone certificates or, at a later date, if a student decides to pursue the MS program in health systems administration, three of the four courses may be applied toward the program's requirements. To meet the needs of working professionals, courses required in all three of the advanced certificates are taught online.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program modification
Effective fall 2013, the program in elements of health care leadership will be modified and renamed leadership in healthcare. This change will not affect currently matriculated students.

Elements of health care leadership, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0635-882	Bioethics	4
0635-830	Health Systems Planning	4
0625-842	Customer Relationship Management	4
0625-750	Elements of Service	4
Total Quarter Credit Hours		**16**

Leadership in health care, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HLTH-710	Health Governance and Economics	3
HLTH-715	Reinventing Health Care	3
HLTH-717	Bioethics	3
HRDE-731	Group Dynamics and Facilitation Skills	3
HLTH-725	Marketing Within Health Care	3
Second Year		
SERQ-730	Service Leadership	3
HLTH-720	Health Systems Planning	3
Total Semester Credit Hours		**21**

Health Systems Finance, Adv. Cert.

Program overview

RIT offers three advanced certificates in health administration:

- Elements of health care leadership
- Health systems finance
- Senior living management

These certificate programs strive to meet the changing needs of health care professionals.

Each certificate can be completed individually to prepare professionals in a particular areas of expertise, update a set of skills, or assist in a career change. They may serve as stand-alone certificates or, at a later date, if a student decides to pursue the MS program in health systems administration, three of the four courses may be applied toward the program's requirements. To meet the needs of working professionals, courses required in all three of the advanced certificates are taught online.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program modification
Effective fall 2013, the program in health systems finance will be modified and renamed finance in health care. This change will not affect currently matriculated students.

Health systems finance, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0635-815	Finance for Operations	4
0635-723	Lean Sigma Appications in Health	4
0635-881	Health Insurance and Reimbursement	4
0635-798	Risk Management	4
Total Quarter Credit Hours		**16**

Finance in health care, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
HLTH-710	Health Governance and Economics	3
HLTH-715	Reinventing Health Care	3
HLTH-717	Bioethics	3
HRDE-735	Management of Risk in Health Care	3
HLTH-737	Lean Six Sigma in Health Care	3
Second Year		
HLTH-730	Finance for Health Care Professionals	3
HLTH-732	Health Insurance and Reimbursement	3
Total Semester Credit Hours		**21**

Senior Living Management, Adv. Cert.

Program overview

RIT offers three advanced certificates in health administration:

- Elements of health care leadership
- Health systems finance
- Senior living management

These certificate programs strive to meet the changing needs of health care professionals.

Each certificate can be completed individually to prepare professionals in a particular areas of expertise, update a set of skills, or assist in a career change. They may serve as stand-alone certificates or, at a later date, if a student decides to pursue the MS program in health systems administration, three of the four courses may be applied toward the program's requirements. To meet the needs of working professionals, courses required in all three of the advanced certificates are taught online.

Curriculum

Program deactivated
Effective fall 2013, the advanced certificate in senior living management will no longer admit new students. This change will not affect currently matriculated students.

Senior living management, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0635-716	Law and Policy in Senior Living	4
0635-798	Aging in America	4
0625-842	Customer Relationship Management	4
0626-735	Human Capital Strategies	4
Total Quarter Credit Hours		**16**

College of Health Sciences and Technology

Health Systems Administration

Linda Underhill, RD, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Graduate Program Chair; Associate Professor

Medical Illustration

Glen Hintz, BA, Lafayette College; MS, The Medical College of Georgia—Associate Professor

James Perkins, BA, Cornell University; MFA, Rochester Institute of Technology; ABD, University of Rochester—Associate Professor

Quarter Courses
2012–2013 Academic Year

Clinical Chemistry

1023-725 Product Development in the Pharmaceutica
This course is designed as an overview of the product development process. The course will describe activities used to bring these different types of products from concept through testing to product approval. Regulatory requirements for product approval in the USA as well as international requirements will be discussed. Overall product development will be outlined with an emphasis on clinical research activities toward market approval. Students will learn the activities and requirements to get products through clinical research to FDA approval. (Permission of instructor) **Class 4, Credit 4 (W)**

1023-726 Good Clinical Practices
This course is designed to provide the student with an understanding of the regulatory framework that governs clinical research activities. The general principles of good clinical practice and the responsibilities of the key figures involved in a clinical research study will be discussed. The history of the regulations and significant milestones in U.S. Food and Drug Law will also be presented. (Permission of instructor) **Class 4, Credit 4 (S)**

1023-727 Ethical Found/Issues Human Subject Reseach
The history of ethical issues in research involving human subjects and the resulting development of regulatory requirements globally. Critical processes such as informed consent and institutional review boards will be reviewed extensively. Current issues such as conflict of interest and research involving genetic material will also be discussed and understanding the role of good science as good ethics will be included. **Class 4, Credit 4 (F)**

1023-728 Clinical Trial Design
This course provides students with the basic principles behind the design of clinical research trials to effectively test medical hypotheses. The critical components of a well designed clinical research protocol will be explored. Students will be exposed to the different types of clinical trials used in the industrial, government and academic sectors for pharmaceutical, medical device, or biologic interventions. (1023-724 and 1023-725) **Class 4, Credit 4**

1023-870 Clinical Chemistry Seminar
For graduate students presenting research outcomes to graduate committees. **Credit 1**

1023-877 External Clinical Chemistry Research
Research carried out in a laboratory outside of the College of Science. Prior to the initiation of external research, a proposal from the student as well as a commitment of support and direction from the laboratory are evaluated. **Credit variable**

1023-879 Clinical Chemistry Research
Research carried out in the College of Science laboratories under the direction of RIT faculty members. The amount of credit awarded for such projects is determined after evaluation of a research proposal. **Credit variable**

Health Systems Administration

0635-700 Health Systems Administration Elective

0635-712 Library Research Methods
This course is to instruct the learner how to conduct research using the tools the RIT library can provide. Fundamentals include use of online search engines and databases. **Credit 1**

0635-714 Data Analysis
This course will allow the learner to read and evaluate statistical information presented in evaluation reports used in health care management. **Credit 2**

0635-716 Law Policy Senior Retirement Living Opt
Retirement living in the United States has evolved to be a significant industry. Legislation and regulations govern the continuum of care for the independent as well as corporate organizations that provide senior living. The purpose of this course is to review the federal and state regulations governing senior retirement living, discussion of senior living models and the leadership requirements to operate and manage such facilities. **Credit 4**

0635-718 Research Writing
In preparation for writing a capstone project this course provides guidelines and practice in producing researched writing for analysis, definition, comparison and/or benchmarking. (Required for HSA students, available for HSM graduate students) **Credit 1**

0635-720 Preventive Epidemiology
Examination and use of the statistical processes employed in the evaluation and assessment of disease, morbidity and mortality of populations served by health systems in the United States. Compares and contrasts health systems status within the United States and with other industrialized countries. Appraisal of health systems research from a managerial perspective with emphasis on prevention, access, distribution, cost, efficiency, and effectiveness of health care. (Statistical Concepts or Introduction to Statistics) **Credit 4**

0635-723 Lean Sigma Appl in Health Care
This course teaches the principles of Lean-Sigma and the application of its process improvement methodologies (and tools) in a health care environment. The history of lean and key principles of six sigma will be discussed. The merging of these two powerful process improvement methodologies will be examined in the context of health care. The Toyota Production System (TPS) and its key leadership principles will be analyzed. The curriculum examines the current challenges encountered in the health care industry and the application of Lean Sigma to improve overall performance specifically in the clinical, administrative and service segments. (Elective for HSA graduate students) **Credit 4**

0635-754 EHealth
This course will give students a broad overview of essential concepts in, and applications of, web based technologies in health care. EHealth topics covered will include review, discuss and analyze industry trends explore emerging ECare solutions and investigate EHealth ethical guidelines and governmental regulations established to ensure privacy, standardization and health content reputability. **Credit 4**

0635-777 Health Systems Administration Internship
This is a health systems administration internship. Consists of a professional placement in an appropriate health care organization of at least 240 hours. Required for students without health care work experience. Can be taken in place of electives. Students will arrange with their program chair or assigned adviser, negotiate any arrangement necessary for on-site supervision and develop a written proposal. Students will present an oral evaluation of their experiences at the final course seminar. **Variable credit 2–8**

0635-796 Risk Management in Health Systems
This course identifies the risk inherent within health care institutions, organizations, agencies and for individual providers. The management of risk is explored as part of a strategic response of an organization or individual within health care. Specifically the risk inherent within health care organizations; in communications and sharing of data; in the embracing of new technologies and drug treatment therapies; and the expectations of corporate compliance will be discussed. The role of quality assurance will be reviewed as a strategy to control risk. **Credit 4**

0635-798 Special Topics
Experimental courses are offered under this number. **Credit 1–5**

0635-815 Finance for Operations
This course is an introductory course that examines the responsibilities of the finance function in health care entities and its relations to the operating responsible centers (or departments). Subject matter is broad enough to include both not-for-profit and for profit organizations in the allied health field. While this is a distance learning course, students are invited to participate in the first two on-campus lectures (attendance is optional, and those not attending will receive a videotape of the campus sessions). Topics include terminology and measurement, cost finding and allocation, budgeting and the budgeting process, report, reimbursement, interpretation of financial statements, and facilities and materials management. Students must be matriculated in the health systems master's program or have permission of the department chairperson. **Credit 4**

0635-820 Health Systems Economics and Finance
Investigation of the efficiency, effectiveness and equity of the economics of health care and a conceptual and practical knowledge of health care finance. Reviews sources of funding, the accounting and reporting process, and the influence of third-party payers on the provision of health care through applied exercises. Provides an integrated overview of managerial economics, financial management, and product management for distinct health care organizations composing the overall health care system. (Accounting Concepts for Managers) **Credit 4**

0635-830 Health Systems Planning
A review of the methodology of planning effectively for health care systems. The use of data systems, forecasting, and identifying and analyzing problems is explored, along with the process of strategic planning, setting priorities, developing projects, and allocating resources. Students will prepare actual business plans and applications for new health care programs to regulatory agencies. (Permission of program chair) **Credit 4**

0635-840 Health Systems Policy and Law
An examination of the roles and responsibilities of policy makers on the health care system. Compares and contrasts the regulatory functions of varying levels of government and the political process as it relates to health care systems. Examination of control issues and regulatory dynamics, the legislative process, and regulatory trends in the United States. Assessment of health systems' strategies and responses to regulatory oversight. An overview of legislation as it applies to health facilities and administrative law using case studies. **Credit 4**

0635-881 Health Insurance Reimbursement
An in-depth look at characteristics of successful managed care plans. The course will familiarize the student with all essential elements of managed care, using the tools needed to model and compare various managed care structures. **Credit 4**

0635-882 Bioethics
An overview of what ethics means, the principal ethical theories, and their application to specific bioethical issues. The course will familiarize students with ethics and ethical principles, the role of ethics in professional life, what is bioethics and an appreciation of ethical issues and arguments surrounding contemporary bioethical issues such as death, rationing health care and managed care. **Credit 4**

0635-890 Health Systems Administration Independent Study
Provides for independent study or research activity in subject areas not included in any existing course in the degree program, but having special value to students. Proposals approved by a supervising faculty member and the program chair are required prior to registration. This course may be taken more than once. **Variable credit 4–8**

0635-891 Special Topics

0635-893 Comp Review and Examination
A written comprehensive exam is one of the non-thesis options available to complete the MS degree. Students will take a written examination and must receive a passing grade of at least 80% to be successful. Students failing the course will receive an incomplete and have one opportunity to retake the exam. Students have access during the quarter they are registered for the exam to self-directed learning resources covering the fundamental theories, foundation principles, and applications of each of the core subjects. Policy details and further information about the Comprehensive Examination is available from the Department of Hospitality and Service Management. (GPA of 3.0 or higher; faculty adviser approval) **Credit 4**

Medical Illustration

2020-707 Contemporary Media for Interactive Portfolio
Students will create an interactive portfolio of their artwork and/or animations designed to attract potential clients and employers. The portfolio will be available for viewing on the World Wide Web and as a CD or DVD. It will include interactive navigation and be able to download vitae and promotional materials to site visitors. (2020-711) **Credit 3**

2020-710 Anatomic Illustration Mixed Media
Students will learn to use raster painting software to modify scanned artwork and create new images from scratch. Students will also use page layout applications to combine digital images with text and other graphic elements. Course work emphasizes creation of illustrations to support medical education, for advertising, and to editorialize health and medical concepts. **Credit 3**

2020-711 Computer Animation and Interactivity I
This course continues advancement of animation skills used in Medical Illustration Topics II (2020-784). Students will create an interactive lesson using computer illustrations and two-dimensional computer animations designed for delivery via the World Wide Web. Course work will also require students to create "puzzles" and other games requiring interactive learner participation. (2020-784) **Credit 3**

2020-712 Computer Animation and Interactivity II
This course introduces variables as a tool in constructing tests designed to measure learner comprehension. Students will create interactive lessons that use animation and interactive teaching strategies to deliver instructional objectives to a specific audience. Learner interaction with the symbols and control of animation remains a prime focus of the course. (2020-784) **Credit 3**

2020-731 Human Gross Anatomy I
A two-quarter sequence devoted to the study of the human body. Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. Dissection focuses on the muscles of the torso, the contents of the thorax and abdomen, and the upper limb. **Credit 4**

2020-732 Human Gross Anatomy II
The second half of a two-quarter sequence devoted to the study of the human body. Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems; with a detailed dissection of the head and neck and moves on to the pelvis, perineum, and lower limb. (2020-731) **Credit 4**

2020-750, 751, 752, 753 Medical Illustration Special Topic

2020-761 3-D Modeling of Organic Forms
This course introduces students to NURBS, Polygon, and Subdivision modeling techniques for creating virtual three-dimensional organic subjects. Accurate portrayal of the subject, including form, texture, and color are emphasized. Developing models from student drawings is required. **Credit 3**

2020-762 3-D Animation of Organic Forms I
Course work focuses on accurate animation of organic and/or biomedical subjects using three-dimensional computer modeling. All animations are intended for display on the Web. Projects are three-dimensional animations that teach or portray an assigned topic. (2020-761 recommended) **Credit 3**

2020-763 3-D Animation of Organic Forms II
Students are introduced to three-dimensional computer animation using character rigging. Assignments focus on creating joint skeletons and binding three-dimensional surfaces to these "joints." Course work introduces manipulating surface deformations in response to movements and surface material. All animations are intended for display on the Web. Projects are "applied animations" that teach or portray an assigned topic. (2020-762 or permission of instructor) **Credit 3**

2020-767 Molecular Illustration
Accurate representations of molecular structures are essential to illustrate recent advances in biotechnology, medical genetics, and pharmacology. This course provides a basic overview of molecular biology and introduces the principles of molecular illustration. Students will locate three-dimensional molecular model files on the Internet and manipulate these models to create two- and three-dimensional, and animated representations of molecules and biochemical processes. **Credit 3**

2020-777 Medical Illustration Grad Internship

2020-781 Medical Illustration Topics I
A introductory course; designed to acquaint the illustration student with art techniques commonly used in medical illustration and with the medical library and audio-visual television supporting milieu in which the medical illustrator works. **Credit 3**

2020-782 Medical Illustration Graphics
A course emphasizing the use of computer software and hardware as a resource for generating titles, charts and graphs, schematics, and illustrations as vehicles to meeting instructional and communicative needs. Students will learn the various techniques available and will apply those techniques while designing pamphlets, in-house publications and poster exhibits. **Credit 3**

2020-783 Anatomical Studies
Sketches drawn from human dissection are translated into instructional illustrations using watercolor wash, pen, and ink. Emphasis will be on rapid but accurate sketching and observation in the laboratory, with a representation of form and structure in living tissue for publication. **Credit 3**

2020-784 Medical Illustration Topics II
A introduction to two-dimensional computer animation as it applies to contemporary methods of instruction in medicine and allied health. Students will research current topics in health care and develop an interactive lesson that matches the instructional objectives of their topic. **Credit 3**

2020-785 Surgical Procedures I
The application of creating instructional aids designed to increase learner understanding of surgical procedures and concepts. Sketches are to be drawn while observing the surgery, consulting with the surgeon for accuracy of detail and development. The final preparation of the artwork will match its intended use (publication, slide graphic, computer graphic, etc.) **Credit 3**

2020-786 Surgical Procedures II
A continuation of the concepts begun in Surgical Procedures I (2020 785); specifically, combining anatomical knowledge with surgical observation to construct a concise and accurate surgical series. Students will concentrate on communicating essential surgical concepts to a specific audience, as well as ensuring that their artwork will meet the demands of reproduction. **Credit 3**

2020-787 **Computer Anim Med Inst Gra**

2020-799 **Medical Illustration Independent Study Grad**
Students who wish to register for an independent study must complete an "independent study form" available from office #7A-2512. Independent studies require department approval.

2020-890 **Research and Thesis-Medical Illustration**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. (Approval required) **Credit 0-14** (offered every quarter)

2020-999 **Medical Illustration Co-Op**

Semester Courses

Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Health Systems Administration

HLTH-700 **Research Methods**
For a topic relevant to the field of study of the student this course will provide an exercise to learn the process used to design research through the use of specialized methods. These methods include the principles and techniques of research design, sampling, data collection, data analysis and interpretation and reporting on results. Data analysis will include the use of statistical methods to use to research and interpret data found in the research surveys and reports generated as well as reading and interpreting professional material. **Credit 3**

HLTH-702 **Graduate Writing Strategies**
Taught in conjunction with Research methods student will become articulate in using a variety of business and research communication methods. These methods will include writing a research proposal, a white paper, the elements of a business plan and a grant proposal. The search of the literature for the research proposal will include an annotated bibliography to support the references used in the research proposal. In addition students will research the requirements for submission of a professional journal in their field and develop a research article which could be submitted for publication to the identified journal. **Credit 3**

HLTH-710 **Governance of Health Care: Law, Policy, and Economics**
This course will review how health care law is created and promulgated from policy to regulations. Examination of specific laws that govern all health care in the USA will be reviewed as well as discussion of regulatory dynamics, the legislative process and regulatory trends in the United States. Emphasis will be placed on strategy development to respond to regulations including advocacy as a response to regulation interpretation and enforcement. Health economics overview will include an explanation of how health care economics are unique in the world of economics and who the major stakeholders are within health care economics including their motivation and reward systems. Given this knowledge strategies will be developed to deal with real and hypothetical challenges facing health care today from a legal and economic perspective. **Credit 3**

HLTH-720 **Health Systems Planning**
Forecasting and projecting into the future for a health organization is one of the most critical elements of health care. There are three goals for this course: the development and planning of a strategic plan; the consideration of alliance and partnerships that can facilitate achieving the strategic plan; and board governance issues which relate to building and maintaining a board which contributes to the success of the strategic plan and the organization. **Credit 3**

HLTH 725 **Marketing within Health Care**
The ability to differentiate a health care facility within the market place provides a challenge to leadership. The government is pursing publication of quality results as the venue to differentiate quality providers for consumers. Health care facilities compete with each other yet lack the ability to focus on what differentiates their products and services from competitors. This course will provide the framework of how to maximize differentiator points about health facilities in messages used to promote the facility. The goal of this course is to teach the health administrator the elements of marketing and adapt those elements to marketing of health care facilities and systems. Outcome of this course is two fold; to develop required statistical data into an informative presentation for consumers that stress the importance of understanding all the information about data collected and presented. Secondly, application of a variety of strategies for dissemination of the differentiation data including e-health venues as well as traditional methods of marketing dissemination. **Credit 3**

HLTH-730 **Finance in Operations**
This course examines the duties and responsibilities of the finance function in health care entities and its relations to the operating responsible centers (or departments). The methodology of the course provides a systematic process to learn the financial components of a health care facility and how the finance department manages and maintains the health facilities assets and liabilities which impact on management's decisions for the organization. The subject matter is broad enough to include both not-for-profit and for-profit organizations in the allied health field. **Credit 3**

HLTH-732 **Health Insurance and Reimbursement**
This course looks at characteristics of successful health insurance plans with emphasis on cost containment and premium control techniques. The primary goal of this course is to familiarize the student with all of the essential elements of health insurance, and provide the student with the foundation needed to model and compare various managed care structures. Emphasis is placed on learning the various funding arrangements and reimbursement methodologies available to manage unit cost and utilization, along with programs to engage consumers in their health care. Basic concepts of health insurance underwriting are covered, as well the essential elements of a successful provider payer partnership. **Credit 3**

HLTH-735 **Management of Risk in Health**
This course identifies the risk inherent within health care- institutions, organizations, agencies and for individual providers. The management of risk is explored as part of a strategic response of an organization or individual within health care. Specifically the risk inherent within health care organizations; in communications and sharing of data; in the embracing of new technologies and drug treatment therapies; and the expectations of corporate compliance will be discussed. The role of quality assurance will be reviewed as a strategy to control risk. **Credit 3**

HLTH-737 **Lean Sigma Applications in Health Care**
This course teaches the principles Lean-Sigma and the application of its process improvement methodologies (and tools) in a health care environment. The curriculum examines the current challenges encountered in the health care industry and the application of Lean-Sigma to improve overall performance specifically in the clinical, administrative, and service segments. The methods and roadmap for deploying Lean-Sigma to obtain desired results of streamlining operations processes and the improvement of administration effectiveness will be studied and practiced. **Credit 3**

HLTH-740 **Customer Relationship Management in Health**
This course provides a review of foundation principles of CRM and definitions as well as a discussion of customer centric service. These concepts serve as a framework for the next service evolution; transforming "your staff to your brand" to add value to the health care system through positive customer experiences. In addition, discussion and related assignments will focus on how these experiences create an environment to allow a healing hospitality culture to flourish within the organization. **Credit 3**

HLTH-745 **Healing Cultures within Health Organizations**
This course centers on the leadership's responsibilities and behaviors necessary to re-design the organizational culture to provide "healing hospitality" throughout the workforce within health care. A key to providing hospitable service is to develop the infrastructure or culture to support what the front line staff is expected to deliver. Hospitality is a belief that goes well beyond a mission. This is the lens that all decisions, policies, procedures must be centered on for the hospitality mindset to be woven into every aspect of the entire organization. This healing orientation helps reduce patient's stress and reinforce comfort care and will become an integral mission of each employee. The goal of this course is twofold: first, to identify what leadership behaviors are necessary to redesign the health culture to incorporate healing hospitality. Second, to develop strategies to change or strengthen the overall culture of the organization to attain success in providing a healing hospitable environment. **Credit 3**

HLTH-747 **Healing Environments/the Design of Facilities and Service**
A service philosophy permeates every aspect of a facility design. The design of service in health care often revolves around function of the providers and not from the perspective of the customer of health service. This course will discuss how to incorporate a hospitality orientation in the design and function of the building structure and all the service entities who serve the health customer. The goal of this course is to incorporate healing hospitality into innovative designs of facilities and services within existing health care structures and the plans of new facilities and systems. Students will have the opportunity to benchmark design and function with leading architectural firms as well as local design innovation in health facilities. The outcome of the course is to design a facility for patient service that reflects these healing hospitality design elements. **Credit 3**

HLTH-750 Ethics in Human Subjects Research
This course provides a comprehensive course in clinical research ethics. The course will present the history of ethical issues in research involving human subjects and the resulting development of regulatory requirements globally. Critical processes such as informed consent and institutional review boards will be reviewed extensively. Current issues such as conflict of interest and research involving genetic material will also be discussed and understanding the role of good science as good ethics will be included. **Class 3, Credit 3 (S)**

HLTH-753 Clinical Trial Design
This course is designed to provide graduate and upper-level undergraduate students with the basic principles behind the design of clinical research trials to effectively test medical hypotheses. The critical components of a well-designed clinical research protocol will be explored. Students will be introduced to the different types of clinical trials used in the industrial, government and academic sectors or pharmaceutical, medical device, or biologic interventions. (Clinical research; MEDS-420 Histology) **Class 3, Credit 3 (F)**

HLTH-754 Regulations and Clinical Practices
This course is designed to provide the student with knowledge of the regulatory framework that governs clinical research activities. The principles that govern good clinical practice and the responsibilities of the administrators involved in a clinical research study will be discussed. The history of the regulations and significant milestones in U.S. food and drug law will also be presented. (Permission of instructor) **Class 3, Credit 3 (S)**

HLTH-755 Product Development: Pharmaceutical, Device, and Biologics Industries
This course is designed as an overview of the product development process. It will describe activities used to bring these different types of products from concept through testing to product approval. Domestic and international regulatory requirements for product approval will be discussed. Overall product development will be outlined with an emphasis on clinical research activities toward market approval. Students will learn the activities and requirements to get products through clinical research to FDA approval. (Permission of instructor) **Class 3, Credit 3 (F)**

HLTH-760 Health Care Informatics
This course is intended to explore current challenges in the health care system, and how the ability to understand and apply health data can improve the quality and cost of health care services. The course will include a review of current and future data collection, storage and exchange practices; and utilize applied case studies allowing students to demonstrate their ability to use health care information technology systems and data analytics to improve patient and provider outcomes. **Class 3, Credit 3 (S)**

HLTH-795 Comp Review and Examination
A written comprehensive exam is one of the non-thesis options available to complete the MS degree. Students will take a written examination and must receive a passing grade of at least 80% to be successful. Students failing the course will receive an incomplete and have one opportunity to retake the exam. Students have access during the quarter they are registered for the exam to self-directed learning resources covering the fundamental theories, foundation principles, and applications of each of the core subjects. Policy details and further information about the Comprehensive Examination is available from the department of Hospitality and Service Management. (GPA of 3.0 or higher; faculty adviser approval) **Credit 0**

HLTH-796 Integrated Problem Solving
Students will demonstrate synthesis and integration of the theories and foundation principles of their discipline. This will be achieved through application of core knowledge in a series of progressive problem situations culminating in a comprehensive examination. To be successful, students must receive a passing grade of at least 80% in the course. Students will have one additional opportunity to register for and pass the Integrative Problem Solving course if their initial attempt result in a failing grade. **Credit 3**

HRDE-731 Group Dynamics and Facilitation Skills
The dynamics of working with teams and groups of people is explored using this orientation to provide principles and practice in facilitation skills for organizational meetings, planning and conflict resolution. The outcome of this course is to provide practitioners the skills necessary to plan and facilitate events to reach the goals of the organization. **Credit 3**

SERQ-710 Evolving Context in Service
Service systems to create the experience of healing hospitality include analysis of systems based on their purpose, design, and value added components to address the needs of changing markets in health. Included is an overview of how learning organizations are developed and operate as well as designing systems to allow for co-creation with customers. This overview of service systems is the foundation for understanding how the three components of healing hospitality interact and are interdependent to provide a healing hospitality environment within health care. **Credit 3**

SERQ 712 Breakthrough Thinking: Creativity and Innovation
Innovation in today's business world is the norm for those businesses that continuously reinvent themselves. Leaders who are not innovative themselves seek to create an environment which allows and fosters innovation. In the service industry it is critical to facilitate innovation and modify and change systems to remain competitive. The educational goal/outcome for this course is twofold. First, to discuss, conceptualize and seek to foster innovation strategies from an individual perspective. Second, to develop a framework of reference, to be superimposed on organizations that allow and actually promote innovation occurring in the workplace. **Credit 3**

SERQ-730 Service Leadership
This course has four outcomes: (1) to understand how the best service organizations design, implement, operate and evaluate their specified purpose/vision (2) to explore the limiting factors that derail service organization change, (3) to examine current leadership thought—the leader in service organizations, (4) to explore the rapidly changing role of leadership, management, and organizations in current and future environments. The interdependence and integration of various conceptual paradigms are discussed with the goal of enhancing organizations and each individual's leadership ability, both as a leader and as a change agent. Determining how to utilize these abilities to interact in rapidly changing service environments is the outcome of the course. **Credit 3**

Medical Illustration

HMIL-601 Human Gross Anatomy
An in-depth study of the structure of the human body. Emphasis is on understanding the relationships between anatomical structures as well as their form, texture, and color. Dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. **Credit 6 (F)**

HMIL-602 Anatomical Studies
Through independent research and acquired understanding of human gross anatomy, students create illustrations designed to support medical or graduate level instruction of Human Gross Anatomy. Course requires students to cognitively illustrate their subjects, rather than creating literal interpretations of their observations. Work is intended for full-color print media. **Credit 3 (F)**

HMIL-603 3-D Modeling of Biomedical Forms
This course introduces strategies to create polygonal models of biomedical subjects in a three-dimensional environment. Students will be asked to research contemporary theory defining their subjects' anatomy and create models consistent with their findings. Instruction will also focus on creating lighting and "shader" systems that emphasize form and are consistent with tissue characteristics. **Credit 3 (F)**

HMIL-606 3-D Animation of Biomedical Forms
This course explores animating biomedical subjects and processes in their native environment. Students will be asked to research contemporary theory defining their subjects' anatomy and create animations consistent with their findings. Frame by frame animation, blend shapes, nonlinear deformers and "rigging" systems will be introduced to permit students to choose the most effective method for creating motion and transformation. (HMIL 603) **Credit 3 (S)**

HMIL-607 Computer Applications in Medical Illustration
Students will learn to use industry-standard raster and vector illustration software to create images based on independent research of medical topics. Students will also use page layout applications to combine digital images with text and other graphic elements. Course work emphasizes creation of illustrations to support medical education and publishing. **Credit 3 (S)**

HMIL 608 Scientific Visualization
Emerging technologies enable scientists to visualize structures that are otherwise invisible to the naked eye. For example, molecular visualization software allows us to construct highly accurate molecular models from X-ray crystallography and other structural data. Cryo-EM and confocal microscopy are revealing the previously unknown structure of cellular organelles. Medical imaging systems allow us to reconstruct the human body in three dimensions from actual patient data (CT scans, MRI, etc.). This course explores the use of these technologies to provide references for traditional artwork and to export models for digital rendering and animation. (HMIL 601) **Credit 3 (S)**

HMIL-612 Surgical Illustration
Students observe and sketch live surgical procedures at a local hospital. After further background research, students translate their sketches into finished illustrations that are used in medical training, patient education, and litigation. Demonstrations of sketching and rendering techniques are supplemented with lectures on general surgical principles and common procedures. (HMIL-601 and HMIL-607) **Credit 3 F**

HMIL-615 **Interactive Media I**
This course is an introduction to two dimensional computer illustration, animation, and interactive media as they apply to contemporary methods of instruction in medicine and allied health. Students will research a current topic in health care and develop interactive lessons that match the instructional objectives of their topic. Students will organize these lessons as a web site. (HMIL-607) **Credit 3 (F)**

HMIL-616 **Interactive Media II**
This course continues the development of a student-created website designed to teach those studying allied health. Advanced topics in two dimensional computer illustration, animation, and interactive media will be presented. Students will research current topics in health care and continue the development of the interactive lesson begun in the previous class. (HMIL-615) **Credit 3 (S)**

HMIL-617 **Portfolio and Business Practices**
This course helps prepare students to enter the workforce in fulltime positions or as freelance illustrators. Students create a traditional portfolio, personal identity package, and marketing materials. The course also introduces important business concepts such as copyright, licensing, pricing, contracts, taxation, and formation of a proper business. (HMIL-612) **Credit 3 (S)**

HMIL-890 **Thesis**
Students conduct background research and create a body of artwork on a contemporary medical topic. The artwork is exhibited during one of several graduate thesis shows or during a screening of digital animation and interactive works. The thesis culminates with the production of a written thesis paper that documents the process of creating the work. (Approval required) **Credit 0–14** (offered every quarter)

Physician Assistant

PHYA-710 **Graduate Project I**
This is the first of a two-course sequence that will provide the physician assistant student with opportunities to prepare a formal graduate capstone project/paper. Projects may be in the form of: clinical practice essay, PA curriculum development, medically related community service project, in-depth medical case review, meta-analysis of specific disease syndrome, or original medical research. This capstone project/paper will build on clinical training and enable students to build skills for lifelong learning as problem solvers and critical evaluators of medical and scientific literature. (PHYA-520 Clinical Integration, PHYA-550 Procedural Clinical Skills) **Class 2, Credit 2 (Su)**

PHYA-720 **Graduate Project II**
This course will provide the physician assistant student with continued preparation of a formal graduate project for the PA program. Projects may be in the form of: clinical practice essay, PA curriculum development, medically related community service project, in-depth medical case review, meta-analysis of specific disease/syndrome, or original medical research. This course will culminate with the completion of the capstone project/paper, which is founded in clinical experience and enables students to build skills for lifelong learning as problem solvers and critical evaluators of medical and scientific literature. (PHYA-710 Graduate Project I) **Class 2, Credit 2 (F)**

PHYA-729 **Clinical Epidemiology**
This course provides students with a foundation in epidemiological concepts from which infectious and noninfectious diseases manifest in acute and chronic settings. Course focuses on descriptive and analytical research designs, conditions associated with their use, and subsequent strengths and weaknesses. Principles of clinical epidemiology are applied to real-world clinical applications in addressing acute and chronic disease characteristics. (Matriculation into the fourth year of the PA Program and PHYA-424 Clinical Medicine III) **Class 3, Credit 3 (S)**

PHYA-730 **Research Methods**
This course will build on the knowledge of statistics and epidemiology and provide the student with an introduction to research methodology and design. The course design will enable the PA student to read and interpret medical literature and evaluate the findings. The course will introduce different research methods and outcomes assessment of Evidence-Based Medicine (EBM). The course will require the physician assistant student to create a formal graduate research project, which will culminate in a project to be completed in the fifth year of the PA program. Projects may be in the form of: clinical practice essay, PA curriculum development, medically related community service project, in-depth medical case review, meta-analysis of specific disease/syndrome, or original medical research. (Matriculation into the fourth year of the PA program) **Class 2, Credit 2 (S)**

1032-750 **Pediatric Clinical Rotation**
This mandatory rotation in the field of pediatric medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical coursework. (1032-720) **Credit 4 (Su)**

1032-751 **General Medicine Clinical Rotation**
This mandatory rotation in the field of general medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (Su)**

1032-752 **Obstetrics /Gynecology Clinical Rotation**
This mandatory rotation in the field of obstetrics and gynecologic medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720.) **Credit 4 (F)**

1032-753 **Emergency Medicine Clinical Rotation**
This mandatory rotation in the field of emergency medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (F)**

1032-754 **Surgery Clinical Rotation**
This mandatory rotation in the field of surgery provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (F)**

1032-755 **Orthopedic Clinical Rotation**
This mandatory rotation in the field of orthopedic medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (W)**

1032-756
Geriatric Clinical Rotation
This mandatory rotation in the field of geriatric medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (W)**

1032-757 **Psychiatry Clinical Rotation**
This mandatory rotation in the field of psychiatric medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (S)**

1032-758
Family Medicine Clinical Rotation
This mandatory rotation in the field of family medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (S)**

1032-759 **Elective Clinical Rotation**
This mandatory rotation in an elective field of medicine provides "hands-on" clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (1032-720) **Credit 4 (S)**

PHYA-761 **Professional Practice I**
This is the first in a sequence of courses designed for the physician assistant student, in the clinical setting. The course will cover discipline specific areas including an orthopedic workshop and overview of professionalism in general and rehabilitative medicine. The course will also include an ongoing Evidence-Based Medicine (EBM) series. (PHYA-520 Clinical Integration, PHYA-550 Procedural Clinical Skills) **Class 3, Credit 2 (Su)**

PHYA-762 **Professional Practice II**
This is the second in a sequence of courses designed for the physician assistant student in the clinical setting. The course will cover discipline specific areas including a pulmonary workshop, topics on death and dying, an overview of social work services, referrals, and the socioeconomic aspects of health care. The course will also include an ongoing Evidence-Based Medicine (EBM) series (PHYA-761 Professional Practice I) **Class 3, Credit 2 (F)**

PHYS-763 **Professional Practice III**
This is the last in a sequence of courses designed for the physician assistant, in the clinical setting. The course will cover areas including professional development; résumé writing and interviewing workshop; topics on interacting with pharmaceutical representatives; complementary medicine; and the socioeconomic aspects of health care, coding, billing, reimbursement, personal investment and finance management; and Physician Assistant National Certifying Examination (PANCE) board preparation. The course also includes an ongoing Evidence-Based Medicine (EBM) series. (PHYA-762) **Class 3, Credit 2 (S)**

The College of Imaging Arts and Sciences

Lorraine Justice, Dean
http://cias.rit.edu

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Programs of study

The College of Imaging Arts and Sciences offers the most comprehensive graduate imaging programs in the world, encompassing design, science, technology, engineering, management, crafts, and fine arts. Six of our visual arts programs are among the top 12 in the nation. The college is a diverse, world-class collaboration of six schools: School for American Crafts, School of Art, School of Design, School of Photographic Arts and Sciences, School of Film and Animation, and School of Print Media. Its scope gives students a perspective that can be found nowhere else—a place where some students create fine art using centuries-old methods while others push the edges of digital creativity. At no other university can students explore so many different aspects of the imaging fields to a high level of professional excellence. In addition, the college offers expertise in the professional operations of running a studio or gallery.

Both graduate students and our alumni have received numerous prestigious awards:

- Our photojournalism alumni have won 11 Pulitzer Prizes.
- Students have won the Graduate Film Honorarium of the Princess Grace Award.
- A computer graphics design alumnus was awarded a Golden Globe.
- An emerging filmmaker received the overall grand prize in the Adobe Flash Point Student Design Contest for multimedia projects.
- Computer graphics design students have won awards in the Macromedia Student Web Design Contest.
- Graphics design alumni have received awards of excellence from the Society of Technical Communications, both locally and internationally.
- Students have received "finalist" designations in the People's Choice Awards at the Macromedia International User Conference and Exhibition.
- A computer graphics design graduate received honors from *Communication Arts* and *I.D.* magazines for her interactive thesis project.
- An industrial design student received an award from Volvo of North America for his winning child car seat in the Design for Automobile Safety Competition at the World Traffic Safety Symposium.
- Students from the School of Print Media have won the best paper award from Technical Association of the Graphic Arts.
- Current students and alumni have been peer-selected speakers at the Society for Photographic Education's national conference.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Portfolio guidelines: All of the graduate programs in the schools of American Crafts, Art, Design, and the MFA program in imaging arts-photography (in the School of Photographic Arts and Sciences), require the submission of a portfolio that is used to assess applicants' performance and academic capabilities. Please refer to each individual program for specific information regarding portfolio guidelines and requirements.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

The college's world-class faculty are noted for their excellence, from creating award-winning sculptures and visual communications to receiving international recognition as innovators in their fields. They excel in the practice of their profession, using state-of-the-art equipment and studio facilities supporting both course work and research. Their role as mentors is evidenced in the national awards won by their students.

Policy regarding student work

The School for American Crafts, School of Art, and School of Design, reserve the right to retain student work for educational use or exhibition for a period of time not to exceed one and a half quarters beyond the year the object has been made.

Facilities

The college has extensive facilities and resources:

- Thirty fully equipped photographic studios.
- More than twenty fully ventilated darkrooms.
- Extensive professional 16mm film and digital video field production equipment, including newly renovated film and animation facilities, 60 digital film editing stations, three animation labs, three stop-motion studios, two sound stages, and prop shop.
- More than $40 million worth of printing and publishing equipment in 17 laboratories.
- Wallace Library, rich in photography, graphic arts publications, and contemporary periodicals in design, arts, crafts for study, and research; ARTstor, an online image collection; and electronic reserve course materials.
- Cooperative efforts with George Eastman House International Museum of Photography and Film, with access its collections of photography, rare books, motion pictures, and technology.
- Cutting-edge print media labs include:
  - Prepress and Publishing Lab, featuring 25 fully configured and networked dual-processor Macintosh G5 workstations, the latest graphics and imaging software, scanners, and a complete selection of output devices.
  - Design and Color Lab, containing 25 fully configured and networked flat-screen "superdrive" Macintosh G5 computers loaded with the latest design, imaging, and multimedia software.
  - Advanced Publishing Lab, containing 14 fully configured and networked Macintosh G5 computers loaded with cutting-edge graphics, imaging, and database publishing software.
  - Color Proofing Lab, featuring the Kodak Approval digital color proofing system in addition to other state-of-the-art color proofing systems.
  - Desktop Scanning Lab, a facility that reflects the growing range of image-capture tools available to professionals, including high-end flatbed and drum scanners.
  - Color Measurement Lab, addressing the growing industry focus on managing color and containing spectrophotometers, colorimeters and color profiling, and color analysis software.
  - Digital Printing Lab, one of the few educational facilities in the world that houses a full array of digital color printing equipment.
  - Print Science Laboratory, a materials research and teaching laboratory housed in the Gannett Building; home to the materials and process course, among other print science courses, and the activity center for materials research in the field of printing.
  - Printing Applications Laboratory, a state-of-the-art research laboratory that serves both the School of Print Media and the industry. It houses the Printing Materials Application Laboratory, a Heidelberg Speedmaster six-color press, a Creo Trendsetter, and a Goss 2000 Sunday Production press.
- Library of the Kodak Research Laboratories.
- The Melbert B. Cary Jr. Graphic Arts Collection, containing more than 20,000 volumes of rare books, with resources that illustrate fine printing, the history of printing, book design and illustration, papermaking, binding, and other aspects of the graphic arts.
- Bevier Gallery and the School of Photographic Arts and Sciences (SPAS) Gallery, the college's on-campus exhibition spaces.
- Gallery r, the university's off-campus, student-managed contemporary art gallery, is overseen by the School of Art. The gallery actively educates and encourages viewers to examine the relevance of art and cultural exposure in their own lives. Gallery r is an educational laboratory presenting art to the widest possible audience and maintaining a select collection of student and alumni artwork for on-site consignment and sales.
- The college houses archives, as well as exhibition and display spaces. Exhibitions regularly feature the work of contemporary painters, designers, photographers, illustrators, graphic artists, filmmakers, and faculty and student work.
- A comprehensive art library and a variety of educational resources are available in RIT's library.

Study options

Nonmatriculated students:
Students who have a baccalaureate degree and who wish to take particular courses may be admitted as nonmatriculated students to courses for which they are qualified. They may receive graduate credit, but it may not be submitted toward degree requirements. Students deficient in admission requirements or competence may take undergraduate courses, as advised, to qualify for admission.

Ceramics and Ceramic Sculpture, MFA

Program overview

The MFA is a professional degree for practicing artists, craftspeople, or designers who desire to leave a lasting impression on their fields by devotion to their work and high standards of discipline and artistic ideals. The MFA is generally a two-year, full-time program that involves the presentation of a thesis. The thesis includes written documentation and the formal exhibition of a body of work.

The ceramics studio embraces the contemporary spectra of aesthetic ideas and innovative techniques to educate and train professional artists/craftspeople. It strives to support students' career goals with pragmatic information and suitable facilities and equipment.

Our structured courses address specific issues inherent to utilitarian pottery, vessel aesthetics, ceramics sculpture, and mixed media. The ceramics program also receives substantial reinforcement from the other craft studios because they, too, explore similar formats and concerns that face artists and craftspeople in the 21st century.

Curriculum

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Ceramics and ceramic sculpture, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2044-781	Graduate Ceramics I	9
2044-782	Graduate Ceramics II	9
2044-783	Graduate Ceramics III	9
2039-715	Thinking About Making	3
2037-785	Forms of Inquiry	2
2045-753	Graduate Crafts Seminar	2
	Humanities	12
	Electives/Minor	9
Second Year		
2044-784	Graduate Ceramics IV	9
2045-751	Thesis Implementation	2
2045-752	Thesis Review	2
2044-890	Graduate Thesis	18
	Electives/Minor	9
Total Quarter Credit Hours		**91**

Ceramics, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CCER-701	Ceramics Graduate Studio I	6
ARTH-601	Forms of Inquiry	3
	Graduate Elective	3
	Humanities Elective	3
CCER-702	Ceramics Graduate Studio II	6
ARTH-605	Thinking About Making: The Practice of Art in a Global Society	3
	Graduate Elective	3
CGEN-702	Crafts Graduate Seminar	3
Second Year		
CCER-790	Ceramics Thesis Initiation	6
CGEN-703	Thesis Implementation	3
	CIAS Studio Elective	3
	Humanities Elective	3
CCER-890	Ceramics Thesis Resolution	9
	Graduate Elective	3
	CIAS Studio Elective	3
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in ceramics and ceramic sculpture, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in a field of arts, sciences, or education from a regionally accredited institution in the United States,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work (the undergraduate degree should include 75 quarter credit hours [50 semester hours] in studio courses),
- Demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential, and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required. Scores from the International English Language Testing System are accepted in place of the TOEFL. A minimum score of 6.5 is required. Applicants coming from countries where the baccalaureate degree is not awarded for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and if their academic records and portfolios indicate an ability to meet graduate standards.

Additional information

Studio residence program

The School for American Crafts offers a craft residence program. Participants are accepted in the ceramics, glass, metals, and wood studios.

Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted studio residents are required to register for at least two quarter credit hours of independent study during every quarter of residence. These two quarter credit hours can be taken as an audit, thus reducing the tuition cost to the resident.

Accepted residents are expected to be present in their assigned studio during class hours and to contribute up to 10 hours of work per week in the main studio. These work hours will be coordinated and overseen by the major faculty in the area. In exchange, the school will provide workspace, access to facilities, and supportive instruction. The resident is invited to participate in the full range of studio activities.

Participants may be those seeking additional studio experience prior to undergraduate or graduate study, early career professionals, or teachers on leave who wish to work again in an academic studio environment. The major faculty in the area will make decisions concerning appropriate candidates.

Inquiries should be made to the Residence Program, College of Imaging Arts and Sciences, School for American Crafts, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Glass, MFA

Program overview

The MFA is a professional degree for practicing artists, craftspeople, or designers who desire to leave a lasting impression on their fields by devotion to their work and high standards of discipline and artistic ideals. The MFA is generally a two-year, full-time program that involves the presentation of a thesis. The thesis includes written documentation and the formal exhibition of a body of work.

This two-year program is structured on the basis of individual needs, interests, and professional preparation, as may be determined through individual/group discussions. A rapid series of exploratory works is developed during the first year, with emphasis on broadening technical and aesthetic understanding. The second year's focus is on developing a body of work based on a sustained interest from the first year's investigation. The final work must be supported by a written thesis, a high-quality portfolio, and an exhibition.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Glass, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2044-781	Graduate Glass I	9
2044-782	Graduate Glass II	9
2044-783	Graduate Glass III	9
2039-715	Thinking About Making	3
2037-785	Forms of Inquiry	2
2045-753	Crafts Graduate Seminar	2
	Humanities	12
	Electives/Minor	9
Second Year		
2044-784	Graduate Glass IV	9
2045-751	Thesis Implementation	2
2044-890	Graduate Thesis	18
2045-752	Thesis Review	2
	Electives/Minor	9
Total Quarter Credit Hours		**91**

Glass, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CGLS-701	Glass Graduate Studio I	6
CGLS-702	Glass Graduate Studio II	6
ARTH-601	Forms of Inquiry	3
ARTH-605	Thinking About Making: The Practice of Art In A Global Society	3
CGEN-702	Crafts Graduate Seminar	3
	Open Electives	6
	Humanities	3
Second Year		
CGLS-790	Glass Studio Thesis Initiation	6
CGLS-890	Glass Studio Thesis Resolution	9
CGEN-703	Research Implementation	3
	Studio Electives	6
	Open Electives	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in glass, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in a field of arts, sciences, or education from a regionally accredited institution in the United States,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work (the undergraduate degree should include 75 quarter credit hours [50 semester hours] in studio courses),
- Demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential, and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required. Scores from the International English Language Testing System are accepted in place of the TOEFL. A minimum score of 6.5 is required. Applicants coming from countries where the baccalaureate degree is not awarded for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and if their academic records and portfolios indicate an ability to meet graduate standards.

Additional information

Studio residence program

The School for American Crafts offers a craft residence program. Participants are accepted in the ceramics, glass, metals, and wood studios.

Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted studio residents are required to register for at least two quarter credit hours of independent study during every quarter of residence. These two quarter credit hours can be taken as an audit, thus reducing the tuition cost to the resident.

Accepted residents are expected to be present in their assigned studio during class hours and to contribute up to 10 hours of work per week in the main studio. These work hours will be coordinated and overseen by the major faculty in the area. In exchange, the school will provide workspace, access to facilities, and supportive instruction. The resident is invited to participate in the full range of studio activities.

Participants may be those seeking additional studio experience prior to undergraduate or graduate study, early career professionals, or teachers on leave who wish to work again in an academic studio environment. The major faculty in the area will make decisions concerning appropriate candidates.

Inquiries should be made to the Residence Program, College of Imaging Arts and Sciences, School for American Crafts, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Metalcrafts and Jewelry, MFA

Program overview

The MFA is a professional degree for practicing artists, craftspeople, or designers who desire to leave a lasting impression on their fields by devotion to their work and high standards of discipline and artistic ideals. The MFA is generally a two-year, full-time program that involves the presentation of a thesis. The thesis includes written documentation and the formal exhibition of a body of work.

Curriculum

The program gives the student a broad exposure to metal working techniques, expands the student's knowledge of applied design, strengthens perceptual and philosophical concepts, and develops an individual mode of expression. This sequence leads to the master's thesis, inaugurated by the student and overseen by the faculty. This program is structured on the basis of individual needs, interests, and background preparation, as may be determined through faculty counseling.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in metalcrafts and jewelry will be renamed metals and jewelry design. This change will not affect currently matriculated students.

Metalcrafts and jewelry, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2044-781	Graduate Metals I	9
2044-782	Graduate Metals II	9
2044-783	Graduate Metals III	9
2039-715	Thinking About Making	3
2037-785	Form of Inquiry	2
2045-753	Crafts Graduate Seminar	2
	Humanities	12
	Electives	9
Second Year		
2044-784	Graduate Metals IV	9
2045-751	Thesis Implementation	2
2044-890	Graduate Thesis	18
2045-752	Thesis Review	2
	Electives	9
Total Quarter Credit Hours		**91**

Metals and jewelry design, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CMTJ-701	Metals and Jewelry Design Graduate Studio I	6
ARTH-601	Forms Of Inquiry	3
	Humanities Elective	3
CMTJ-702	Metals and Jewelry Design Graduate Studio II	6
ARTH-605	Thinking About Making: The Practice of Art in a Global Society	3
	Graduate Elective	6
CGEN-702	Crafts Graduate Seminar	3
Second Year		
CMTJ-790	Metals and Jewelry Design Thesis Initiation	6
CGEN-703	Thesis Implementation	3
	Humanities Elective	3
CMTJ-890	Metals and Jewelry Design Thesis Resolution	9
	Graduate Elective	3
	Studio Elective	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for the MFA program in metalcrafts and jewelry, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in a field of art, science, or education from a regionally accredited institution in the United States,
- Demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work (undergraduate degree should include 75 quarter credit hours [50 semester hours] in studio courses), and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required. Scores from the International English Language Testing System are accepted in place of the TOEFL. A minimum score of 6.5 is required. For those applicants applying from countries where the baccalaureate degree is not awarded for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and if their academic records and portfolios indicate an ability to meet graduate standards.

Additional information

Studio residence program

The School for American Crafts offers a craft residence program. Participants are accepted in the ceramics, glass, metals, and wood studios.

Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted studio residents are required to register for at least two quarter credit hours of independent study during every quarter of residence. These two quarter credit hours can be taken as an audit, thus reducing the tuition cost to the resident.

Accepted residents are expected to be present in their assigned studio during class hours and to contribute up to 10 hours of work per week in the main studio. These work hours will be coordinated and overseen by the major faculty in the area. In exchange, the school will provide workspace, access to facilities, and supportive instruction. The resident is invited to participate in the full range of studio activities.

Participants may be those seeking additional studio experience prior to undergraduate or graduate study, early career professionals, or teachers on leave who wish to work again in an academic studio environment. The major faculty in the area will make decisions concerning appropriate candidates.

Inquiries should be made to the Residence Program, College of Imaging Arts and Sciences, School for American Crafts, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Woodworking and Furniture Design, MFA

Program overview

The MFA is a professional degree for practicing artists, craftspeople, or designers who desire to leave a lasting impression on their fields by devotion to their work and high standards of discipline and artistic ideals. The MFA is generally a two-year, full-time program that involves the presentation of a thesis. The thesis includes written documentation and the formal exhibition of a body of work.

Curriculum

Applicants to this program come from diverse backgrounds such as architecture, interior design, industrial design, art history, law, and teaching, as well as undergraduate wood programs. In the first year, students identify issues in their technical and aesthetic background and, along with faculty, create a program of study to address these areas. Simultaneously, they discover directions in their work that are promising for further exploration. Based upon this experience, students develop a thesis proposal and, in the second year, create a comprehensive body of work. This work culminates in the end-of-the-year graduate thesis exhibition in the college gallery and a written thesis in support of the work.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in woodworking and furniture design will be renamed furniture design. This change will not affect currently matriculated students.

Woodworking and furniture design, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2044-781	Graduate Wood I	9
2044-782	Graduate Wood II	9
2044-783	Graduate Wood III	9
2039-715	Thinking About Making	3
2037-785	Forms of Inquiry	2
2045-753	Crafts Graduate Seminar	2
	Humanities	12
	Elective/Minor	9
Second Year		
2044-784	Wood IV	9
2044-890	Graduate Thesis	18
2045-751	Thesis Implementation	2
2045-752	Thesis Review	2
	Electives	9
Total Quarter Credit Hours		**91**

Furniture design, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CWFD-701	Furniture Design Graduate Studio I	6
ARTH-601	Forms Of Inquiry	3
	Humanities Elective	3
CWFD-702	Furniture Design Graduate Studio II	6
ARTH-605	Thinking About Making: The Practice of Art in a Global Society	3
	Open Graduate Electives	6
CGEN-702	Crafts Graduate Seminar	3
Second Year		
CWFD-790	Furniture Design Thesis Initiation	6
CGEN-703	Thesis Implementation	3
	Humanities Elective	3
CWFD-890	Furniture Design Thesis Resolution	9
	Open Grad Elective	3
	CIAS Studio Electives	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in woodworking and furniture design, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in a field of arts, sciences, or education from a regionally accredited institution in the United States,
- Demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work (undergraduate degree should include 75 quarter credit hours [50 semester hours] of studio courses), and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required. Scores from the International English Language Testing System are accepted in place of the TOEFL. An IELTS score of 6.5 is required. For international students coming from countries where the baccalaureate degree is not given for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and if their academic records and portfolios indicate an ability to meet graduate standards.

Additional information

Studio residence program

The School for American Crafts offers a craft residence program. Participants are accepted in the ceramics, glass, metals, and wood studios.

Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted studio residents are required to register for at least two quarter credit hours of independent study during every quarter of residence. These two quarter credit hours can be taken as an audit, thus reducing the tuition cost to the resident.

Accepted residents are expected to be present in their assigned studio during class hours and to contribute up to 10 hours of work per week in the main studio. These work hours will be coordinated and overseen by the major faculty in the area. In exchange, the school will provide workspace, access to facilities, and supportive instruction. The resident is invited to participate in the full range of studio activities.

Participants may be those seeking additional studio experience prior to undergraduate or graduate study, early career professionals, or teachers on leave who wish to work again in an academic studio environment. The major faculty in the area will make decisions concerning appropriate candidates.

Inquiries should be made to the Residence Program, College of Imaging Arts and Sciences, School for American Crafts, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Fine Arts Studio, MFA

http://cias.rit.edu/art/

Program overview

The MFA program in fine arts studio offers intensive study in painting, printmaking, sculpture, new forms, and related media, leading to mastery in the fine arts field on a professional level. Students will explore advanced techniques in painting, sculpture, new forms, and non-toxic printmaking. These may be pursued singly and combined, or brought together with nontraditional media to create new forms. Faculty guidance focuses upon research strategies that support sequential studio production, leading to individual solutions.

Critical discussion is developed from the traditions of fine art and contemporary directions in our culture. These contemporary and historical concepts stimulate and provoke the development of an individual approach to expression. Along with engaging in critical dialogues, students progress toward the production of a body of work and a report for the master's thesis.

Gallery r, an art gallery in downtown Rochester operated by School of Art students, helps solidify the learning experience by bringing the work of students to the greater Rochester community.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Fine arts studio, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2039-715	Thinking About Making	3
2021-872	Business Practices	3
2037-790	Forms of Inquiry	2
2021-780	Fine Art Studio Graduate I: Painting, Printmaking Sculpture, or New Forms	18
2021-890	Fine Art Studio Thesis	3
	Studio/Open Electives	12
	Humanities	8
Second Year		
	Fine Art Studio Graduate II: Painting, Printmaking Sculpture, or New Forms	12
2021-890	Fine Art Studio Thesis	11
	Studio/Open Electives	18
Total Quarter Credit Hours		**90**

Fine arts studio, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
	Fine Art Studio Major Courses	15
ARTH-601	Forms of Inquiry	3
	Art History Course	3
FNAS-702	Fine Art Research	3
ARTH-605	Thinking About Making	3
	Open Elective	3
	Studio Elective	3
Second Year		
	Fine Art Studio Major Courses	9
FNAS-606	Business Practices	3
	Studio Elective	3
FNAS-890	Research and Thesis	10
	Open Elective	3
Total Semester Credit Hours		**61**

Art Education (Visual Art–All Grades), MST

Program overview

The MST in visual art, a graduate program in the field of art education, leads to initial/professional New York state certification in visual arts for grades K through 12. This certification allows applicants to teach in any state across the nation. The program features pedagogical studies, studio inquiry, and student teaching. The purpose of the MST is to offer a unique graduate experience that prepares students to meet the national, state, and regional need for teachers of the visual arts. The program designed for accomplished art educators and advocates for art and learning in all grades. The program is nationally accredited and is for teachers in art education who hold a BFA or BA (art major) degree. Classes begin each September and conclude in May. Graduates of teacher education programs at RIT have a 96-percent pass rate on the NY State Teacher Certification examinations.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Art education (visual art-all grades), MST degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
	Psychology	4
	Education	16
	Methods and Materials in Art Education, Seminar in Art Education, Practice Teaching Studio Electives	28
Total Quarter Credit Hours		**48**

Art education (visual art-all grades, MST degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ARED-701	Child Development in Art	3
ARED-702	Inclusive Art Education	3
ARED-703	Multicultural Issues	3
ARED-704	Methods in Teaching and Learning	3
ARED-705	Methods II Studio Thinking	3
	Graduate Studio Elective	3
ARED-890	Graduate Seminar in Art Education	6
ARED-711	Professional Practices	3
ARED-790	Student Teaching	9
Total Semester Credit Hours		**36**

Admission requirements

To be considered for admission to the MST program in art education (visual art–all grades), candidates must fulfill the following requirements:

- Hold a baccalaureate degree in an art field from a regionally accredited college or university in the United States, with a major concentration in art, art education, or industrial arts education,
- Have a minimum of 54 quarter credit hours (36 semester credit hours) in drawing, painting, design, or the crafts. If the applicant holds a BA or BFA degree and seeks the MST degree in visual arts, the undergraduate program must have adhered to the studio course distribution required by the New York State Department of Education.

Non-toxic Intaglio Printmaking, Adv. Cert.

Program overview

This advanced certificate offers technical training and retraining for artists and printmaking professionals seeking a comprehensive working knowledge of non-toxic intaglio printmaking techniques, including a study of methodology and aesthetic applications.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in non-toxic printmaking will be renamed non-toxic printmaking. This change will not affect currently matriculated students.

Non-toxic intaglio printmaking, advanced certificate, typical course sequence (quarters)

COURSE	QUARTER CREDIT HOURS	
2021-741	Non-Toxic Intaglio Printmaking I	4
2021-742	Non-Toxic Intaglio Printmaking II	4
2021-743	Non-Toxic Intaglio Printmaking II	4
Total Quarter Credit Hours		**12**

Non-toxic printmaking, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE	SEMESTER CREDIT HOURS	
First Year		
FNAS-606	Non-Toxic Printmaking I	6
FNAS-606	Non-Toxic Printmaking II	6
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate in non-toxic intaglio printmaking, candidates must fulfill the following requirements:

- Hold a BFA, MFA, or be recognized as a master printer or professional printmaker,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a letter of intent,
- Submit a current resume,
- Submit a slide portfolio (between 10–20 slides),
- Submit three references with contact information, and
- Complete a graduate application.

Computer Graphics Design, MFA

Chris Jackson, Graduate Program Director
(585) 475-5823, cbjpgd@rit.edu

Program overview

This internationally recognized program offers concentrations in interactive design for Web, DVD, and mobile devices; three-dimensional digital graphics; motion graphics; game art and design; and information visualization. The curriculum combines knowledge of design theory, methodology, and aesthetics with skills in two- and three-dimensional computer graphics, interactive techniques, and interface design. Students utilize cutting-edge technology to produce a vast array of dynamic work for the screen (computer, broadcast, mobile).

The program focuses on practical and experimental approaches to the expression of unique visions. Students create interactive websites, applications for mobile devices (tangible interfaces and iPhone), opening title credits for movies and television broadcast, interactive graphic novels, immersive three-dimensional environments, and computer games realized from their imaginations. Resources in the Digital Studio are accessible 24 hours a day, seven days a week, and include three-dimensional digitizers, physical computer interfaces, motion capture systems, three-dimensional printers, monitor tablets, and a wide variety of software applications.

As part of the entrance requirements, applicants must demonstrate an understanding of basic design principles and visual computer skills. Software skills must include Adobe Photoshop and Illustrator. A portfolio of the applicant's best work is submitted in the form of a CD-ROM or DVD (in Macintosh or Windows platforms). A portfolio of 15-20 examples must demonstrate a good sense of design, typography, and illustration in a stand-alone format, and/or video, or a combination of these. Images saved in PDF format are preferred. Use the QuickTime movie format (.mov) for videos. Flash SWF files and HTML websites are accepted and encouraged.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

New program
Effective fall 2013, the MFA programs in computer graphics design and graphic design will merge to form one program in visual communication design. This change will not affect currently matriculated students.

Computer graphics design, MFA degree, typical course sequence (quarters)

COURSE	QUARTER CREDIT HOURS	
First Year		
2014-701	Survey of Computer Graphics	2
2010-713	Design History Seminar	3
4085-715	Programming for Designers	4
2014-798	Production Pipeline	4
	Major Studio Courses	24
	Elective	3
	Liberal Arts	6-8
Second Year		
2014-831	Thesis Planning	2
2014-890	Research and Thesis	12
	Major Studio Courses	12
	Electives	9-12
Total Quarter Credit Hours		**90**

Visual communication design (communication design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE	SEMESTER CREDIT HOURS	
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-717	Design Systems	3
VCDE-723	Interaction Design	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-742	Information Design	3
VCDE-741	Environmental Graphic Design	3
VCDE-732	Branding and Identity Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Elective	9
Total Semester Credit Hours		**60**

Visual communication design (interaction design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-723	Interaction Design	3
IGME-601	Programming for Designers	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-733	Digital Video and Audio	3
VCDE-742	Information Design	3
VCDE-741	Environmental Graphic Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Elective	9
Total Semester Credit Hours		**60**

Visual communication design (motion and 3D digital design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-728	Motion Graphics	3
VCDE-716	3D Particles and Dynamics	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-731	3D Visual Design	3
VCDE-733	Digital Video and Audio	3
VCDE-741	Environmental Graphic Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Elective	9
Total Semester Credit Hours		**60**

Graphic Design, MFA

Chris Jackson, Graduate Program Director
(585) 475-5823, cbjpgd@rit.edu

Program overview

Graphic design is a professional major that addresses a range of advanced visual communication problems, with an emphasis on meaning, form, and function. In a professional studio setting, students work with faculty on the understanding and implementation of theories, principles, and methods related to concept development, design process, context, history and criticism, research, evaluation, visual aesthetics, typography, systems thinking, information design, inter- and cross-disciplinary collaboration, as well as social and ethical responsibility.

Course assignments and thesis projects incorporate both theory and application in the solution of hypothetical and actual graphic design problems. Courses offer a balanced approach toward the integration of digital media and traditional processes. Final design outcomes focus on small- and large-scale, two- or three-dimensional printed artifacts and environmental graphic design solutions, with opportunities to develop relevant for time-based and/or interactive digital applications as well. Special lectures, guest speakers, exhibitions, and workshops complement studio and seminar goals. Students have ongoing access to resources such as the Graphic Design Archive and the Cary Graphic Arts Collection, the Artists' Books Collection, and the collections of the Vignelli Center for Design Studies.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

New program
Effective fall 2013, the MFA programs in computer graphics design and graphic design will merge to form one program in visual communication design. This change will not affect currently matriculated students.

Graphic Design, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2010-713	Design History Seminar	3
2010-716	Image Forms	4
2010-711	Design Theory and Methods Seminar	3
2010-712	Graduate Typography Design	4
2010-726	Design Issues Seminar	3
2010-717	Graduate Systems Design	4
2010-722	Design Applications I	4
	Minor Courses	6
	Electives	10
	Liberal Arts	8
Second Year		
2010-861	Graphic Design Thesis Planning	4
2010-718	Graduate Information Design	4
2010-862	Graduate Design Thesis Development	4
2010-724	Graduate Design Topics	4
2010-722	Design Applications II	4
2010-863	Graphic Design Thesis Implementation	4
	Minor Courses	9
	Elective	4
	Liberal Arts	4
Total Quarter Credit Hours		**90**

Visual communication design (communication design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-717	Design Systems	3
VCDE-723	Interaction Design	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-742	Information Design	3
VCDE-741	Environmental Graphic Design	3
VCDE-732	Branding and Identity Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Electives	9
Total Semester Credit Hours		**60**

Visual communication design (interaction design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-723	Interaction Design	3
IGME-601	Programming for Designers	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-733	Digital Video and Audio	3
VCDE-742	Information Design	3
VCDE-741	Environmental Graphic Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Elective	9
Total Semester Credit Hours		**60**

Visual communication design (motion and 3D digital design option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-708	Typography	3
VCDE-707	Web and UI Design	3
VCDE-709	Digital Design in Motion	3
VCDE-706	3D Modeling and Motion	3
VCDE-701	Design History Seminar	3
VCDE-728	Motion Graphics	3
VCDE-716	3D Particles and Dynamics	3
VCDE-718	Project Design and Implementation	3
VCDE-711	Design Theory and Methods Seminar	3
	Open Elective	3
Second Year		
VCDE-790	Thesis Research and Planning	3
VCDE-731	3D Visual Design	3
VCDE-733	Digital Video and Audio	3
VCDE-741	Environmental Graphic Design	3
VCDE-890	Thesis Implementation and Evaluation	6
VCDE-746	Professional Practices	3
	Open Elective	9
Total Semester Credit Hours		**60**

Industrial and Interior Design, MFA

Josh Owen, Graduate Program Director
(585) 475-5257, josh.owen@rit.edu

Program overview

The master of fine arts degree in industrial and interior design is for career enhancement or redirection. The educational experience is project-oriented, requiring research into design methods and technologies. Cross-disciplinary collaboratives provide an experiential dimension.

The first year of study includes seminar courses in design history, issues, research, theory, and methods, which are common to all graduate students in the School of Design. In addition, studio courses involve extensive design work with respect to environmental issues, the meaning of artifacts, and critical analysis. Extensive course work using three-dimensional software for product modeling and animation fills out the program.

In the second year students conduct research and develop a thesis project, which is presented in a graduate thesis exhibition or presentation, and is documented in a written thesis report.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in industrial and interior design will be renamed industrial design. This change will not affect currently matriculated students.

Industrial and interior design, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2035-711	Advanced Computer Modeling I	3
2035-721	Advanced Computer Modeling II	3
2035-731	Advanced Computer Modeling III	3
2035-736	Industrial Design Problems I	6
2035-737	Industrial Design Problems II	6
2035-738	Industrial Design Problems III	6
2035-716	Industrial Design Presentation	3
2010-713	Design History Seminar	3
2035-732	Interaction Design	3
2010-711	Design Theory and Methods Seminar	3
2010-726	Design Issues Seminar	3
2035-840	Thesis Research I	3
	Elective/Minor	3
Second Year		
	Special Topics: Thesis Research II	3
2035-890	Thesis	14
	Electives/Minor	21
	Liberal Arts	4
Total Quarter Credit Hours		**90**

Industrial design, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IDDE-701	Design Laboratory I	6
IDDE-703	Function of Form	3
IDDE-705	2D Ideation and Visualization	3
VCDE-701	Design History Seminar	3
IDDE-702	Design Laboratory II	6
IDDE-704	Form of Function	3
IDDE-706	Integrated Design Visualization	3
	Open Grad Elective	3
Second Year		
IDDE-790	Thesis: Research and Planning	6
VCDE-711	Design Theory and Methods Seminar	3
	CIAS Design Elective	3
IDDE-890	Thesis: Implementation and Evaluation	6
	CIAS Design Elective	3
	Open Grad Elective	9
Total Semester Credit Hours		**60**

Print Media, MS

Patricia Sorce, Graduate Director
(585) 475-2313, psorce@mail.rit.edu

Program overview

The MS program in print media offers an unparalleled opportunity to work at the intersection of art, science, and technology. Students learn how to develop solutions and deliver content through print, Web, mobile, and social media. With an overview of the fundamentals of the graphic communication industry, the program allows students to tailor their studies through electives and a concentration. Recent students have pursued concentrations in information technology, imaging science, typography, digital asset management, business, and marketing. Some of the program's graduates are employed in advertising, publishing, and corporate communications.

Curriculum

The program requires 48 quarter credit hours of study, which includes five core courses, a concentration, and electives.

Concentrations and electives

Concentration courses are selected by the student to develop an additional expertise in a particular area of interest. The degree offers flexibility in terms of tailoring the program to meet individual needs. The electives and minor concentration courses are comprised of selected courses offered by the College of Imaging Arts and Sciences or other RIT colleges. All courses must be pre-approved by the graduate program chair.

Thesis

All students are required to complete a research thesis that demonstrates original thinking and creativity in the search for new knowledge in the graphic communication industry. Students select projects that align with their research adviser's area of research expertise. Graduate assistantships often are available to help fund research.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Print media, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0106-782	Statistical Analysis Decision Making	4
2081-711	Tone and Color Analysis	4
2081-716	Materials and Processes in Print Media	4
2081-701	Research Methods and Trends in Graphic Media	4
2081-747	Cross Media Workflow	4
	Elective	4
	Minor Concentration 1, 2, 3	12
	Graduate Research Assistantship	
Second Year		
2081-890	Thesis	8
	Concentration	4
Total Quarter Credit Hours		**48**

Print media, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
PPRT-601	Materials and Processes in Printing	3
PPRT-602	Tone and Color Analysis	3
PPRT-701	Operations Management in Graphic Arts	3
PPRT-703	Cross Media Workflow	3
PPRT-704	Research Methods and Trends in Graphic Media	3
	Graduate Elective	3
Second Year		
PPRT-790	Thesis	6
DECS-782	Statistical Analysis and Decision Making	3
	Graduate Electives	9
Total Semester Credit Hours		**36**

Film and Animation, MFA

http://cias.rit.edu/schools/film-animation/graduate-film-and-animation

Program overview

The MFA program enjoys state-of-the-art facilities. Students can create computer animation that is unique. It is the only such program housed in a School of Film and Animation with full production facilities, as well as the additional support of highly specialized faculty in photography, imaging science, computer science and information technology, and printing.

Goals

The program's goals provide students with the opportunity to use animation, filmmaking, and other imaging arts as a means to:

- pursue a career and earn a livelihood,
- enrich their personal lives and society as a whole, and
- encourage a sense of community, creativity, scholarship, and purpose.

Curriculum

Degree requirements

The MFA degree in film and animation provides students with four options:

(1) The live action (film production) option allows students to develop and refine their creative approach to fictional narrative, documentary, and experimental work.

(2) Scriptwriting is an opportunity for students to complete short films with a concentration in creating feature length screenplays.

(3) 2D animation concentrates on traditional forms drawn by hand, a mixture of both traditional and digital, or all digital origination. There is also the possibility of concentrating on stop motion puppet animation.

(4) 3D computer animation focuses on advanced 3D modeling, lighting, texturing, and animating in a 3D space.

All four options require two years of course work and a thesis project. A complete film is required of all the first-year students, a complete film or script is required in the second year, and a more ambitious thesis film or feature length script is required of the third year.

A minimum of 90 quarter credit hours of graduate work is outlined below. The 90 hours do not include undergraduate work required by action of the MFA admission committee in accepting a particular applicant, nor do they include undergraduate prerequisites for graduate courses.

Distribution of work within the following course sequences is subject to modification based upon the candidate's background, abilities, and interests. An individualized course of study will be prepared with the advice of the graduate faculty and made a matter of record. Modifications in this prescribed program thereafter must be approved and recorded.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Film and animation (2D animation option), MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2065-222	Film Language	4
2065-611	Graduate Production	4
2065-711	Film and Animation Core	4
2065-721	Animation and Graphic Film	4
2065-727	Scriptwriting for Animation	4
2065-732	Basic Sound Recording	3
2065-737	2D Computer Animation I	4
2065-738	2D Computer Animation II	4
2065-741	Graduate Drawing for Animators: Dynamics	3
2065-742	Graduate Drawing for Animators: Sequence	3
2065-747	Introduction to Computer Animation	4
2065-751	Introduction to 3D Drawn Animation	3
2065-771	Graduate Seminar I	2
2065-783	Acting for Animation	4
Second Year		
2065-701	History and Aesthetics: Animation	4
2065-712	Film and Animation Core	4
2065-743	Graduate Drawing for Animators: Characters	3
2065-744	Business of Animation	2
2065-762	Stop Motion Animation	4
2065-796	Programming for Animators	4
2065-813	Career Preparation	2
2065-818	Advanced Storyboard and Layout	4
2065-841	Research Seminar	2
2065-843	Research Seminar Thesis Preparation	2
	Electives	8
Third Year		
2065-890	Thesis and Research	12
Total Quarter Credit Hours		**93**

Film and animation (2D animation option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-610	Graduate Seminar	2
SOFA-601	Graduate Production	3
Choose one of the following:		3
SOFA-603	2D Animation I: Fundamentals	
SOFA-617	Stop Motion Puppet Fundamentals	
SOFA-627	Pre-Production for Animators	3
SOFA-630	Animation Film Language Seminar	2
SOFA-605	Basic Sound Recording	3
SOFA-611	History and Aesthetics of Animation	3
SOFA-622	30-Second Film	3
Choose one of the following:		3
SOFA-604	2D Animation II: Mechanics	
SOFA-623	Stop Motion Master Class	
SOFA-625	Animated Acting Principles	3
SOFA-628	Animation Writing and Visual Storytelling	3
Second Year		
Choose one of the following:		3
SOFA-704	2D Animation III: Camera and Sequence	
SOFA-772	Frame by Frame Techniques	
SOFA-717	Animation Workshop	4
SOFA-780	Thesis Preparation Seminar	
SOFA-725	Business Careers and Animation	
	SOFA Electives	15
Third Year		
SOFA-790	Research and Thesis I	4
SOFA-890	Research and Thesis II	4
Total Semester Credit Hours		**65**

Film and animation (3D animation option), MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2065-222	Film Language	4
2065-611	Graduate Production	4
2065-702	History and Aesthetics: Film and Animation	4
2065-711	Film and Animation Core	4
2065-721	Animation and Graphic Film	4
2065-727	Scriptwriting for Animation	4
2065-732	Basic Sound Recording	3
2065-737	2D Computer Animation I	4
2065-748	Intermediate 3D Computer Animation	4
2065-747	Introduction to 3D Computer Animation	4
2065-751	Introduction to Drawn Animation	3
2065-771	Graduate Seminar I	2
Choose one of the following:		4
2065-783	Acting for Animation	
2065-745	Acting for Film and Animation	
2065-746	Directing the Actor	
	Elective	3-4
Second Year		
2065-712	Film and Animation Core	4
2065-744	Business of Animation	2
2065-762	Stop Motion Animation	4
2065-796	Programming for Animators	4
Choose one of the following:		4
2065-791	Particle Effects	
2065-766	Advanced Modeling for Animation	
2065-841	Research Seminar	2
2065-843	Research Seminar Thesis Preparation	2
	Electives	16
Third Year		
2065-890	Thesis and Research	12
Total Quarter Credit Hours		**93**

Film and animation (3D animation option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-610	Graduate Seminar	2
SOFA-601	Graduate Production	3
SOFA-615	3D Animation Fundamentals	3
SOFA-627	Pre-Production for Animators	3
SOFA-630	Animation Film Language Seminar	2
SOFA-605	Basic Sound Recording	3
SOFA-611	History and Aesthetics of Animation	3
SOFA-622	30-Second Film	3
SOFA-616	Intermediate 3D Animation	3
SOFA-625	Animated Acting Principles	3
SOFA-628	Animation Writing and Visual Storytelling	3
Second Year		
SOFA-716	Advanced 3D Animation	3
SOFA-717	Animation Workshop	4
	SOFA Electives	15
SOFA-780	Thesis Preparation Seminar	1
SOFA-725	Business Careers and Animation	3
Third Year		
SOFA-790	Research and Thesis I	4
SOFA-890	Research and Thesis II	4
Total Semester Credit Hours		**65**

Film and animation (live action production option), MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2065-222	Film Language	4
2065-611	Graduate Production	4
2065-701	History and Aesthetics of Film	4
2065-711	Film and Animation Core	4
2065-717	Production Processes	6
2065-724	Live-Action Pre-Production	3
2065-732	Basic Sound Recording	3
2065-733	Graduate Screen Writing	3
2065-746	Directing the Actor	4
2065-771	Graduate Seminar I	2
2065-774	Post Production Processes	4
2065-776	Dramatic Structure of Film and Television	4
	Elective	4
Second Year		
2065-713	Film and Animation Core	4
2065-726	Live Action Seminar	2
2065-734	Graduate Screen Writing II	4
2065-736	Theory Via Short Narrative Film	4
2065-764	Business of Film/Video	3
2065-768	Lighting for Film/Video Production	3
2065-843	Research Seminar (Thesis Preparation)	2
	Electives	17-20
Third Year		
2065-890	Research and Thesis	12
Total Quarter Credit Hours		**92**

Film and animation (production option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-613	Graduate Screenwriting I	3
SOFA-606	Directing the Actor for F & V	3
SOFA-608	Dramatic Structure	3
SOFA-610	Graduate Seminar	2
SOFA-602	Production Processes	4
SOFA-605	Basic Sound Recording	3
SOFA-621	Spring Film	3
	History and Aesthetics Elective	3
	SOFA Production Elective	3
Second Year		
SOFA-721	Fall Film	3
SOFA-763	Cinematography and Lighting	3
SOFA-711	Theory Via Short Narrative Film	3
SOFA-735	Business and Careers in Film	3
SOFA-780	Thesis Preparation Seminar	1
	History and Aesthetics Elective	3
	SOFA Electives	6
	Free Electives	6
Third Year		
SOFA-790	Research and Thesis I	4
SOFA-890	Research and Thesis II	4
Total Semester Credit Hours		**66**

Film and animation (scriptwriting option), MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2065-222	Film Language	4
2065-611	Graduate Production	4
2065-701	History and Aesthetics of Film	4
2065-711	Film and Animation Core	4
2065-717	Special Topics: Production Processes	6
2065-724	Special Topics: Live-Action Pre-Production	3
2065-733	Graduate Screen Writing	3
2065-734	Graduate Screen Writing II	4
2065-746	Directing the Actor	4
2065-771	Graduate Seminar I	2
2065-774	Post Production Processes	4
2065-776	Dramatic Structure of Film and Television	4
Second Year		
2065-726	Special Topics: Live Action Seminar	2
2065-754	Writing The Feature I	4
2065-755	Writing The Feature II	4
2065-736	Theory Via Short Narrative Film	4
2065-764	Business of Film/Video	3
2065-843	Research Seminar (Thesis Preparation)	2
	Writing Elective	4
	Electives	18-24
Third Year		
2065-890	Research and Thesis	12
Total Quarter Credit Hours		**92**

Film and animation (scriptwriting option), MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-613	Graduate Screenwriting I	3
SOFA-606	Directing the Actor for F & V	3
SOFA-608	Dramatic Structure	3
SOFA-610	Graduate Seminar	2
SOFA-602	Production Processes	4
SOFA-626	Writing the Short Film	3
SOFA-621	Spring Film	3
	History and Aesthetics Elective	3
	SOFA Production Elective	3
Second Year		
SOFA-721	Fall Film	3
SOFA-663	Writing the Feature I	3
SOFA-711	Theory Via Short Narrative Film	3
SOFA-735	Business and Careers in Film	3
SOFA-664	Writing the Feature II	3
	History and Aesthetics Elective	3
SOFA-735	SOFA Elective	3
	Free Electives	6
Third Year		
SOFA-790	Research and Thesis I	4
SOFA-890	Research and Thesis II	4
Total Semester Credit Hours		**66**

Electives
Elective courses are available in animation, film, video, multimedia, screenwriting, printmaking, painting, sculpture, communication design, museum studies, crafts, bookmaking, typography, color photography, new media, studio photography, advertising photography, perception, sensitometry, computer graphics, art history, and archival preservation and conservation. There are also opportunities for independent studies, internships, and concentrations.

Thesis
Specific instructions pertaining to the thesis are available in the "MFA Guide for Students and Faculty: Policy Regarding Student Work." The School of Film and Animation reserves the right to retain copies of student-produced films to be used for educational purposes, to show to prospective students, and as examples of student productions.

Admission requirements
To be considered for admission to the MFA in film and animation, candidates must fulfill the following requirements:
- Hold a baccalaureate degree from an accredited college or university,
- Submit a portfolio of work that demonstrates the applicant's skills, visual sophistication, and aesthetic awareness,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation,
- Submit a personal statement of purpose detailing why the candidate wants to attend graduate school and what they will bring to the program, and
- Complete a graduate application.

Scores from the Graduate Record Exam (GRE) are not required for admission. Applicants who are capable of good academic work as well as artistic visual expression, and who demonstrate an interest in the exploration of new artistic ideas and experiences, will be favored. The graduate faculty makes recommendations based on the above interlocking criteria.

Students who are evaluated to have MFA potential but need additional study in preparation for graduate courses will be advised to take such courses either prior to entrance or during their first year of study. The graduate faculty will make recommendations.

All correspondence concerning applications or catalogs should be addressed to the Office of Graduate Enrollment Services. Students interested in the program should have their application process completed by January 15. Applications received later than January 15 are considered on a space-available basis.

Portfolio
The review committee is looking for work that is original in concept and content. It does not need to necessarily be motion media, but should be visual or aural. Examples include films/videos, photos, drawing, paintings, sculpture, stop motion puppets, script, storyboards, and original music.

The applicant must present what they consider to be the best of their work, not all their work. Therefore links to websites and or multiple film reels tapes, DVDs, or CDs will not be reviewed. The film or videos should total 15 minutes or less. A complete work is preferable to a "demo reel." If there are no short works, then a 15-minute excerpt of a longer piece is acceptable.

Please provide an inventory sheet or table of contents. Videos should be on mini-DV, DVDCAM, DVD, or DVDROM. The movie files on a DVDRM must be in QuickTime, MPEG2, MPEG4, or HG.264 format. No AVI or other digital video architecture files, NTSC or ATSC(HD) only. Still images should be on DVDROM or DCROM and be .jpeg or .tiff format; 35mm slides are acceptable but must be in sleeves. No boxes or carousel trays. No more than 30 images. Sound design should be no longer than 10 minutes and on CD format.

Additional information

Faculty
The program is supported by a staff of 18 full-time faculty members and a variety of adjunct faculty members. The program may also borrow faculty and utilize courses from the schools of Photographic Arts and Sciences, Print Media, Art, Design, American Crafts, and the College of Liberal Arts.

Transfer credit
Graduate-level course work taken prior to admission should be submitted for approval upon entrance into the program. Up to 12 quarter credit hours (8 semester credit hours) of graduate work with a grade of B or better is transferable and may be counted toward the MFA degree, with the approval of the graduate faculty.

Grades and time limit
The average of all grades for graduate credit taken at the university must be at least a B (3.0) to qualify for the MFA degree. Thesis hours are usually completed over several quarters. Acceptance or rejection of the thesis is made by the candidate's thesis board and the graduate faculty. All course work, including an accepted thesis, must be completed within seven years of entrance into the program.

Screenings
Screenings are required for all student-produced films and are coordinated through the professor or the thesis chair.

Imaging Arts, MFA

Therese Mulligan, Chair, School of Photographic Arts and Sciences
(585) 475-2884, mtmpph@rit.edu

Program overview
The master of fine arts program in imaging arts emphasizes a broad interpretation of photography as a conceptual art form, with the intention of inspiring and nurturing the individuality of each student as a creative, productive artist. The program encourages graduate study in photography and related media as a means to personal, aesthetic, intellectual, and career development.

The MFA curriculum provides a flexible pattern of study that is continually sensitive to the needs of each student, building upon the strengths each individual brings to the program. Successful completion of the program enables a student to seek careers in education, museum or gallery work, or as a self-employed professional.

Program goals
The program's goals provide students with the opportunity to use the still and moving image as a means to
- pursue a professional career and earn a livelihood.
- enrich their personal lives and society as a whole.
- encourage a sense of community, creativity, scholarship, and purpose.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Imaging arts, MFA degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
2039-415	Thinking About Making	3
2066-701	History and Aesthetics I	3
2066-702	History and Aesthetics II	3
2066-703	History and Aesthetics III	3
2066-711	Photography Core	4
2066-712	Photography Core	4
2066-713	Photography Core	4
2066-771	Graduate Seminar	2
	History and Criticism	3
	Electives	20
Second Year		
2066-752	Special Topics: Photography Core II	4
	Electives	21
	History and Criticism	3
2066-842	Research Seminar	2
2066-753	Graduate Thesis Seminar	2
	Research and Thesis	12
Total Quarter Credit Hours		**90**

Imaging arts, MFA degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
PHGR-701	Histories and Aesthetics of Photography I	3
PHGR-703	Imaging Core I	3
PHGR-711	Graduate Seminar	3
ARTH-605	Thinking about Making: The Practice of Art in a Global Society	3
PHGR-702	Histories and Aesthetics of Photography II	3
PHGR-704	Imaging Core II	3
PHGR-722	Contemporary Issues	3
	Professional Electives	9
Second Year		
PHGR-721	Research Core	3
PHGR-890	Thesis	6
PHGR-724	Professional Development for the Emerging Artist	3
	Professional Electives	18
Total Semester Credit Hours		**60**

Distribution of work within these guidelines is subject to modification based upon the candidate's background, abilities, and interests. An individualized course of study will be prepared with the advice of the graduate faculty and made a matter of record. Modifications in this prescribed program thereafter must be approved and recorded.

Art electives
Elective courses are available in animation, video, multimedia, film, printmaking, painting, sculpture, communication design, crafts, bookmaking, typography, color photography, new media, studio photography, advertising photography, computer graphics, art history, and archival preservation and conservation. There also are opportunities for independent studies and internships.

Thesis
The thesis exhibition/project must be an original body of work appropriate to the major commitment of the degree candidate. A written thesis will be prepared for inclusion in Wallace Library. Specific guidelines are available in the "MFA Guide for Students and Faculty: Policy Regarding Student Work."

Admission requirements

To be considered for admission to the MFA program in imaging arts-photography, candidates must fulfill the following requirements:

- Hold a baccalaureate degree (or equivalent) from an accredited college or university,
- Present a portfolio of work that demonstrates skill, visual sophistication, and aesthetic awareness,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit three letters of recommendation,
- Submit a personal statement of purpose detailing the attributes a candidate brings to graduate study, including expectations and professional goals they wish to achieve,
- Particiate in a personal interview (optional), and
- Complete a graduate application.

Applicants who are capable of graduate level academic work, as well as artistic visual expression, and who demonstrate an interest in the exploration of new artistic ideas and experiences will be recommended.

Portfolio
The portfolio, along with written records of achievements and recommendations, serves to inform the faculty of the applicant's readiness for advanced graduate study. It provides a visual statement of the applicant's performance to date in terms of his or her skills, aesthetic development, and maturity.

Applicants should send 20 images on a CD and/or DVD, representing a cohesive body or bodies of recent work. An artist's statement accompanies the portfolio, addressing the work being presented and its creative process.

Admission selection for the fall quarter is made in the spring from among all portfolios and completed applications received. Applicants should be certain that portfolios are postmarked no later than January 15 to ensure review of the application. Acceptance occurs only once a year for a fall admission.

Portfolio instructions include the following:

- Submit no more than 20 images on CDs and/or DVDs. (Size each digital file to no more than a maximum of 1400 pixels at its longest side, at 72ppi.)
- Number images 1 to 20 in the order the applicant wishes them to be projected.
- Include a numbered page detailing the CD and/or DVD image information.
- Include the title of the work, date, size, and medium.
- Include a one-page artist statement discussing submitted work and applicant's creative process.
- Include a self-addressed, stamped envelope for return of the portfolio. (The school cannot return portfolios lacking sufficient postage or inadequate packaging. The school will retain the work of admitted applicants.)
- Submit the portfolio with the application material to the Office of Graduate Enrollment Services.

Additional information

Faculty
Ten full-time faculty members, all critically regarded for their artistic work in exhibition and publication, contribute to the MFA program. The faculty brings individual expertise and dedication to their work with graduate students, encouraging intellectual inquiry of contemporary art-making practices and aesthetics. The MFA program is also supported by a staff of 40 full-time faculty members from the schools of Photographic Arts and Sciences, Print Media, Art, and adjunct faculty members from George Eastman House International Museum of Photography and Film, as well as noted regional, national, and international practitioners, critics, and historians.

Transfer credit
Graduate-level course work taken prior to admission should be submitted for approval upon entrance into the program. Up to 12 quarter credit hours (8 semester hours) of graduate work with a minimum grade of a B or higher is transferable toward the degree, with the approval of the graduate coordinator.

Grades and maximum time limit
The average of all grades for graduate credit taken at the university must be at least a B (3.0) to qualify for the MFA imaging arts degree. Thesis hours are usually taken over several quarters. All course work, including an accepted thesis, must be completed within seven years of entrance into the program.

Policy regarding student work
The School of Photographic Arts and Sciences reserves the right to retain at least one original piece of work from a student's MFA thesis show for inclusion in the MFA Collection, to be used for educational, promotional, and exhibition purposes. Graduates must also leave the school a CD containing 20 images of thesis work completed for the master's degree.

School of Photographic Arts and Sciences (SPAS) Gallery
The SPAS Gallery supports the exhibition of graduate thesis work, student work, and the works of contemporary imagemakers. It maintains an academic year calendar of exhibitions, public lectures and receptions. Importantly, it also provides real world experience for interested graduate students, where they learn firsthand about gallery operations, installation, and communications.

Graduate Faculty

Lorraine Justice, BFA, Edinboro University; MFA, Ph.D., The Ohio State University—Dean

Graduate Studies

Michael Amy, BA, Vrige Universiteit Brussel; MA, Ph.D., New York University—Associate Professor

Roberley Bell, BFA, University of Massachusetts at Amherst; MFA, State University of New York College of Ceramics at Alfred University—Professor

Heidi Nickisher, BA, University of California at Santa Barbara; MA, California State University, Fullerton—Lecturer

Clarence Burton Sheffield Jr., BS, University of Utah; MA, University of Colorado at Boulder; Ph.D., Bryn Mawr College—Associate Professor

Sarah Sutton, BA, John Carroll University; MFA, Kent State University—Visiting Assistant Professor

Sarah Thompson, BA, University of California at San Diego; MA, Ph.D., University of California at Santa Barbara—Assistant Professor

School of Art

Donald Arday, BFA, Cleveland Institute of Art; MFA, Syracuse University—Professor

Bob Cole, BA, MS, University of Maryland—Professor

Robert Dorsey, BFA, Rochester Institute of Technology; MFA, Syracuse University—Associate Professor

William Finewood, BA, State University College at Geneseo; MFA, Syracuse University—Associate Professor

Robert Heischman, BFA, Miami University; UCFA, Ruskin School of Art—Professor

Glen R. Hintz, BA, Lafayette College; MS, The Medical College of Georgia—Associate Professor

Keith Howard, Painting Diploma, National Art School (Australia); MA, New York University—Associate Professor

Elizabeth Kronfield, BFA, Bowling Green State University; MFA, University of Georgia—Associate Professor

Thomas R. Lightfoot, BA, BFA, University of Connecticut; MFA, Institute Allend; MA, Ed.D., Columbia University Teachers College—Associate Professor

James Perkins, BA, Cornell University; ABD, University of Rochester; MFA, Rochester Institute of Technology—Professor

Luvon Sheppard, BFA, MST, Rochester Institute of Technology—Professor

Alan D. Singer, BFA, The Cooper Union; MFA, Cornell University—Professor

Carole Woodlock, BFA, Alberta College of Art; MFA, Concordia University—Administrative Chair, School of Art; Coordinator, Art Education (Visual Arts-All Grades); Associate Professor

School of Design

Deborah Beardslee, BFA, Syracuse University; MFA, Virginia Commonwealth University—Associate Professor

Peter Byrne, BFA, Alberta College of Art and Design; MFA, York University—Associate Professor; Graphic Design

Nancy A. Ciolek, BFA, MFA, Indiana State University—Associate Professor

Daniel DeLuna, BFA, Ball State University; MFA, Pratt Institute—Associate Professor, Computer Graphics Design

Lorrie Frear, BFA, MFA, Rochester Institute of Technology—Assistant Professor, Graphic Design

Joyce Hertzson, BFA, Rhode Island School of Design; MFA, Indiana University—Professor

Chris B. Jackson, BFA, Alfred University; MFA, Rochester Institute of Technology—Associate Professor; MFA Coordinator, Computer Graphics Design

Patti J. Lachance, BFA, Herron School of Art at Indiana and Purdue Universities at Indianapolis; MFA, Rochester Institute of Technology—Associate Professor; Administrative Chairperson, School of Design

Alex Lobos, BA, Universidad Rafael Landivar; MFA, University of Notre Dame—Assistant Professor, Industrial Design

Bruce I. Meader, BFA, MFA, Carnegie Mellon University—Associate Professor, Graphic Design

josh Owen, BA, BFA, Cornell University—Program Chair, Industrial Design; Associate Professor

R. Roger Remington, BFA, Rochester Institute of Technology; MS, University of Wisconsin—Professor, Graphic Design

Stan Rickel, BID, Pratt Institute; MID, Syracuse University—Program Chair, Industrial Design; Associate Professor

Marla Schweppe, BA, University of Kansas; MA, The Ohio State University—Professor; Director of Visualization; Computer Graphics Design

Kim Sherman, BS, State University College at Cortland; MFA, Rochester Institute of Technology—Lecturer, Industrial Design

School for American Crafts

Andy Buck, BA, Virginia Commonwealth University; MFA, Rhode Island School of Design—Professor, Wood

Juan Carlos Caballero-Perez, BFA, MFA, Rochester Institute of Technology—Professor, Metals

Robin Cass, BFA, Rhode Island School of Design; MFA, State University of New York at Alfred—Professor, Glass

Wendell Castle, BFA, MFA, University of Kansas—Professor; Artist-in-Residence, Chair in Contemporary Crafts

Richard Hirsch, BS, State University College at New Paltz; MFA, Rochester Institute of Technology—Professor, Ceramics

Albert Paley, BFA, MFA, Temple University; Ph.D. (honorary), University of Rochester—Artist-in-Residence, Charlotte Fredericks Mowris Chair in Contemporary Crafts

Michael Rogers, BA, MA, Western Illinois University; MFA, University of Illinois—Professor, Glass

Richard Tannen, BS, Cornell University; Certificate of Mastery, Boston University—Professor, Wood

Leonard A. Urso, BFA, MFA, State University College at New Paltz—Professor, Metals

School of Film and Animation

Cat Ashworth, MA, State University of New York at Buffalo—Associate Professor

Charles Bandla, BA, State University College at Fredonia; MFA, Rochester Institute of Technology—Visiting Assistant Professor

Carl (Skip) Battaglia, BA, Boston College; MS, Syracuse University—Professor

Jack Beck, BA, Denison University; MFA, University of Iowa—Associate Professor; Live Action Production Program Chair

Adrianne Carageorge, BA, Florida State University; MFA, Ohio University—Associate Professor

Richardo Figueroa, BS, MS, University of Puerto Rico-Mayaguez—Assistant Professor

Mark Foggetti, BFA, Rochester Institute of Technology—Senior Lecturer

Tom Gasek, BFA, Rochester Institute of Technology; MFA, Art Institute of Boston at Lesley University—Assistant Professor

Brian Larson, BFA, Colorado State University; MFA, Miami International University—Assistant Professor

Howard Lester, BA, Cornell University; MFA, University of California at Los Angeles—Professor; MFA Coordinator

David Long, BS, University of Texas; MS, University of Rochester—Assistant Professor; Program Chair, Digital Cinema

Stephanie Maxwell, BA, University of California at Los Angeles; MFA, San Francisco Art Institute—Professor; Program Chair, Animation

Mark Reisch, BFA, Savannah College of Art and Design; Certificate in Advanced Studies of Animation, Emeryville-AnimationMentor.com—Visiting Assistant Professor

David Sluberski, BA, State University College at Fredonia—Visiting Assistant Professor

Malcolm Spaull, BS, St. Lawrence University; MFA, Rochester Institute of Technology—Professor; Administrative Chair

School of Photographic Arts and Sciences

Patti Ambrogi, MFA, Visual Studies Workshop—Associate Professor

Gregory Halpren, BA, Harvard University; MFA, California College of the Arts—Assistant Professor

Angela M. Kelly, MA, Columbia College—Associate Professor

Susan Lakin, BFA, Art Center of Design; MFA, University of California—Associate Professor

Dan Larkin, BFA, Rochester Institute of Technology; MFA, Bard College—Associate Professor

Therese Mulligan, BA, University of Missouri; MA, Michigan State University; Ph.D., University of New Mexico—Professor; Administrative Chair

Oscar Palacio, MFA, Massachusetts College of Art and Design; MA, University of Miami—Assistant Professor

Willie Osterman, MFA, University of Oregon—Professor

Christine Shank, MFA, Miami University; MFA, Texas Woman's University—Assistant Professor

Carla Williams, BA, Princeton University; MFA, University of New Mexico—Assistant Professor

Ken White, BA, Princeton University; MA, MFA, University of New Mexico—Associate Professor

School of Print Media

Barbara Birkett, BA, Aquinas College; MBA, Rochester Institute of Technology; CPA, Maryland—Associate Processor, Print Media Management

Christopher Bondi, BS, New York Institute of Technology; MS, Rochester Institute of Technology—Interim Administrative Chair; Gannet Distinquished Professor

Robert Y. Chung, BS, Eastern Washington State University; MS, Rochester Institute of Technology—Gravure Research Professor, Color Management

Christine Heusner, BA, Elmira College; MFA, Rochester Institute of Technology—Lecturer

Myrtle Jones, BA, University of Illinois; MS, New York University—Assistant Professor

Bruce Myers, BFA, Montclair State University; MA, New York University—Assistant Professor

Frank J. Romano, BA, City University of New York—Emeritus Professor, Electronic Publishing

Patricia Sorce, BA, Kent State University; MS, Ph.D., University of Massachusetts—Associate Professor, Roger K. Fawcett Professor, Administrative Chair; Print Media Management

Quarter Courses

2012–2013 Academic Year

2001-723 The College Teacher

A graduate level course for students who are thinking about entering teaching at the college level. Students will learn about the teacher's role and responsibilities within the college structure; course development, course presentation, and course evaluation. Students will have the chance to develop and present instruction. (Course is limited to graduate students in CIAS or by permission of instructor) **Credit 3**

Art History

2039-713 Displaying Gender

This course brings together two of the most significant strains of recent art historical scholarship: the study of gender in representation and the critical examination of exhibitions and museums with particular focus given to key examples of curatorial practice from the late 19th century to the present day. Through readings, possible museum visit(s), class discussions, and guided individual research, questions of gender in exhibitions will be considered in relation to other aspects of identity including sexuality, race, and class. **Credit 3**

2039-714 Art and Architecture of Ancient Rome

In this course, students will examine the visual culture of ancient Roman civilization from the foundations of Roman culture through the Late Imperial era. Roman culture was heavily reliant on images as a means of transmitting concepts of lineage, status, power, and politics; students will learn how these images may have been perceived in the context of Roman social and political history, and how style may have been used as an ideological tool. **Credit 3**

2039-716 Florence and Rome: 1400– 1470

Significant commissions for painting, sculpture and architecture in Florence and Rome from 1400–1470 will be studied. Artists studied will include Filippo Brunelleschi, Lorenzo Ghiberti, Donatello, Luca della Robbia, Michelozzo, Leon Battista Alberti, Masaccio, Fra Angelico, Fra Filippo Lippi and Paolo Uccello. Questions for consideration will include: the nature and meaning of the Early Renaissance, developments in artistic theory and practice, the importance of Antique and Medieval precedents, the increasing attention to the effects of nature, the role of the patron, and the relevance of documents, literary sources and visual precedents for our interpretation of images. **Credit 3**

2039-717 Florence and Rome: 1470– 1520

Significant commissions for painting, sculpture and architecture in Florence and Rome from 1470–1520 will be studied. Artists studied will include Sandro Botticelli, Antonio and Piero del Pollaiuolo, Leonardo da Vinci, Domenico del Ghirlandaio, Bernardo Pinturicchio, Bramante, Michelangelo and Raphael. Patrons studied will include Lorenzo the Magnificent, the Florentine Republic, Popes Sixtus IV, Alexander VI, Julius II, and Leo X. Questions for consideration will include: the nature and meaning of the High Renaissance, developments in artistic theory and practice, the importance of Antique and Medieval precedents, the increasing attention to the effects of nature, the role of the patron, and the relevance of documents, literary sources, and visual precedents for our interpretation of images. **Credit 3**

2039-718 Florence and Rome: 1520–1590

Significant commissions for painting, sculpture and architecture in Florence and Rome from 1520–1590 will be studied. Artists studied will include Michelangelo, Jacopo Sansovino, Jacopo Pontormo, Agnolo Bronzino, Baccio Bandinelli, Benvenuto Cellini, Giorgio Vasari, Bartolommeo Ammannati and Giambologna. Patrons will include Grand Dukes Cosimo and Francesco de'Medici of Florence, and Popes Clement VII, Paul III, Julius III, and Sixtus V. Questions for consideration will include: the nature and meaning of the Late Renaissance in Italy, developments in artistic theory and practice, the importance of Antique, Medieval, Early Renaissance and High Renaissance precedents, the rising status of the artists, the role of the patron, and the relevance of documents, literary sources and visual precedents for our interpretation of images. **Credit 3**

2039-725 Art in 15th Century Venice

The subject of this course is 15th century painting, sculpture and architecture in Venice and the Veneto. As we examine different types of paintings, sculptures, and architecture works we will understand how these types evolved and they were used in Venice and the Veneto over the course of the 15th century. Questions for consideration will also include: the myth of Venice, the importance of Antique, Byzantine, Islamic, and western medieval precedents for developments in Venetian art and architecture, the introduction of Florentine Gothic and Renaissance art and ideas into Venice, the impact Venice had upon the art and architecture of the Veneto, and vice versa, and the cultural exchange between Venice and the north. **Credit 3**

2039-731 Dada and Surrealism

This course examines the widely influential Dada and Surrealist movements in Europe and the United States from 1916 through the post-World War II period as well as their relevance to contemporary concerns. Emphasis is on identifying the major works of artists involved in these movements as well as their philosophical foundations, critical implications, and ideological contexts (e.g., Freud, Breton, Leiris, and Bataille). A broad range of works and practices (paintings, performance, installations, literary texts, photography, film, and ephemeral objects) will be studied, and the work of certain key artists (Höch, Heartfield, Schwitters, Duchamp, Picabia, Picasso, Dali, Ernst, Giacometti, Man Ray, Bellmer, Cornell, Magritte, Miro, Picasso) will be analyzed in depth. **Credit 3**

2039-733 The Image

The image remains a ubiquitous, controversial, ambiguous, and deeply problematic issue in contemporary critical discourse. Yet, it is also a key concern of visual culture, and a connecting problem across the entirety of the College of Imaging Arts and Sciences here at RIT where the production and consumption of images is paramount. This course will examine recent scholarship devoted to the image and the ideological implications of the image in contemporary culture. Topics will include: the modern debate over word vs. image, the mythic origins of images, subversive, traumatic, monstrous, banned and destroyed images (idolatry and iconoclasm), the votive and effigy, the mental image, the limits of visuality, the moving and projected image, the virtual image, image fetishism, the valence of the image, as well as criteria by which to assess their success or failure (their intelligibility) and their alleged redemptive and poetic. **Credit 3**

2039-734 Gothic Art

This course will examine architecture, sculpture, painting, and decorative arts in Europe from the mid-twelfth century to the Renaissance. Students will analyze the visual culture of the period in relation to the historical, social, and political contexts of its production. Primary issues to be considered include the design and construction of Gothic buildings, the format, function, and creation of manuscripts, art and religious practice, the status and organization of artists, artistic patronage, regional styles, and cross-media influences. **Credit 3**

2039-738 Body in Art

This course is an inquiry into the artistic investigation of the literal human body and the texts that give them meaning. The class will focus on the history, theory, and problems of performance art in the latter part of the 20th century. **Credit 3**

2039-739 The Gothic Cathedral

This course will examine the Gothic cathedral and related art production (stained glass, sculpture, and metalwork) from the twelfth through the fifteenth century. The cathedrals of the late middle ages represent the greatest efforts of medieval art production; students will study these buildings within their cultural contexts and examine the meanings such buildings conveyed to their intended audiences. The class will explore the design, structure, and construction of Gothic churches throughout Europe, and will also examine the decorative programs of sculpture, stained glass, and liturgical objects integral to the meaning and function of these structures. Issues to be considered include the production of cathedrals; the stylistic variations of Gothic; the relationship between function and form; and the urban context of Gothic cathedrals. **Credit 3**

2039-740 Symbols and Symbol Making

This course explores the links between psychoanalytic theory and art history with special focus on the work of Sigmund Freud, Carl Jung, and their successors. A central aim is to examine the way in which psychoanalytic theory has been employed by art historians and theorists as a mode of interpretation, as well as to study how, why, and what several of the most notable psychoanalysts have written about art. Topics include the interpretation of dreams, transference, the Oedipal myth, melancholia, narcissism, abjection, the structure of the unconscious, the fetish, Archetypes and the Collective Unconscious, as well as outsider art: the art of the insane. Key theorists to be discussed include: Freud, Jung, D.W. Winnicott, Melanie Klein, Jacques Lacan, Otto Rank, and Julia Kristeva; individual artists such as: Albrecht Dürer, Leonardo da Vinci, Edvard Munch, Max Ernst, Jackson Pollock, Louise Bourgeois, and Mary Kelly. **Credit 3**

2039-743 Edvard Munch

The Norwegian artist Edvard Munch (1863-1944) continues to generate a great deal of popular interest, critical scholarship, and reflection. A painter, printmaker, photographer, and filmmaker, Munch was also a prolific writer, well acquainted with the symbolist poets and playwrights, as well as the broad intellectual drift of the fin-de-Siécle. He is the one Scandinavian artist included within the Modernist canon and his image, The Scream (1893), is an icon of the modern age. Munch traveled widely throughout Europe and his work was exhibited in North America. This course will examine recent scholarship devoted to Munch and the critical issues that his work addresses. It will also place him within the broader cultural context of Scandinavian and European modernism, while examining his impact on subsequent generations.) **Credit 3**

2039-744 The Gothic Revival
This class covers the Gothic Revival of the eighteenth, nineteenth centuries, and twentieth centuries. Issues to be examined include the question of stylistic revival vs. stylistic survival; the origin and meanings of Gothic as a stylistic category; the impact of antiquarianism on the Gothic Revival in the eighteenth century; Gothic and eighteenth-century modes of vision; Gothic in the private and public spheres; Gothic s associations with science, gender, nationalism, and morality; the Gothic Revival and the Pre-Raphaelites, and major figures within the movement such as A.W.N. Pugin and John Ruskin. **Credit 3**

2039-755 Latin American Art
This is a survey course of the historical development of the art of Latin America from colonial times to the present. Included will be a consideration of painting, sculpture, architecture, graphic, and photographic arts. Potential themes to be addressed include the dependence on the European neo-classical academic model; indigenism; nationalism and the resurgence of popular art; the role of the visual arts in the construction of history; and the conflicts and tensions involved in the search for a cultural identity. **Credit 3**

2039-763 The Russian Avant-Garde
The radical move away from classical forms of representation in the late 19th and early 20th centuries is how one understands the avant-garde. Russian art from mid-1890 through 1922 showed extreme departures from art practices of the earlier 19th century. We will examine the avant-garde social and political underpinnings. In Russia, Peredvizhniki artists painted images that represented the social world; a group of realist painters who are misunderstood and seen as the forerunners of Soviet Social Realism. We will try to amend this misunderstanding and connect this group of artists to the Russian formal and political avant-garde of the early 20th century and to the latter non-conformist artists of the second half of the 20th century that coincides with Perestroika and the eventual demise of the Soviet Union. **Credit 3**

2039-764 Romanesque Art
This class will examine medieval European artistic production including architecture, architectural and free-standing sculpture, metalwork, painting, and manuscript illumination in the eleventh and twelfth centuries. The visual culture of the period will be analyzed in relation to the historical, social, and political context of its production. Primary issues to be considered include architectural structure, art and religious practice, the status and organization of artists and builders, art as an expression or enforcer of identity, the question of regional styles, contact with other cultures, and the relationship between Romanesque art and the past. **Credit 3**

2039-768 Scandinavian Modernism
This course examines the decorative arts and visual culture of modern Scandinavia from 1860 to the present, with special emphasis on the social, economic, and political impulses that have shaped them. Scandinavian Modern design plays a significant role in the postwar epoch; it is equated with such leading brands as Volvo, Saab, Ericsson, Nokia, H&M, Electrolux Orrefors, Georg Jensen, ARTEK, and IKEA and the idea of progressive, social democracy. The myths and realities of its success will be examined, as well as its impact on contemporary design. **Credit 3**

2039-772 Passion for Porcelain
This course offers an examination of techniques and materials together with a historical overview of European ceramics, with particular attention paid to porcelain. It includes study of Renaissance and early modern lead-glazed earthenware and stoneware as a prelude to the consideration of the history of porcelain, from its origins in China and the Far East to the heyday of its European development in the eighteenth century factories of Meissen and Seres. **Credit 3**

2039-776 Renaissance Painting in Flanders
Students will study the history of Renaissance painting in the Southern Netherlands from the beginning of the 15th century to the end of the 16th century. We will consider the meaning of the Renaissance in Flanders, the observation and recording of natural appearances, hidden symbolism, and sacramental themes in Early Netherlandish painting, the connections between Flemish, German, and Italian Art, the development of new genres in the 16th century, originality and artistic progress. The Master of Flemalle, Jan van Eyck, Rogier van der Weyden, Petrus Christus, Dieric Bouts, Hugh van der Goes, Hans Memling, Gerard David, Quinten Metsys, Hieronymus Bosch, Joachim Patinier, Pieter Aertsen, and Pieter Breughel the Elder are among the artists to be studied. **Credit 3**

2039-789 Medieval Craft
In this course, we will explore the history of craft production throughout the Middle Ages. While modern scholars have often divided art from craft, this distinction did not exist in medieval Europe: artists were craftspeople, producing objects that were both practically and symbolically functional. This class will focus on the decorative arts including stained glass, ivories, textiles, and metalwork to produce a more integrated picture of medieval visual culture. Students will study both practical aspects of production and the reception and meaning of these objects within medieval society. **Credit 3**

2039-794 Illuminated Manuscripts
Students in this course will examine the history of illuminated manuscripts, learning about the working methods of artists as well as the cultural significance of the illuminated book. Issues of production, style, function, and patronage will be introduced, and students will explore the relationships between images, texts, and readers. **Credit 3**

2039-833 Art and Technology: From the Machine Aesthetic to the Cyborg Age
This course explores the link between art and technology in the twentieth century with special focus on the historical, theoretical, and ideological implications. Topics include the body in the industrial revolution, utopian, dystopian, and fascist appropriations of the machine, engendering the mechanical body and machine-eroticism, humanism, the principles of scientific management and the paranoiac machine, multiples, mass production, and the art factory, industrial design and machines for living, the technological sublime, cyborgs, cyberpunk and the post human. Key theorists and artists will also be covered. **Credit 3**

2039-841 Conceptual Art
This course examines the widely influential mid-1960s art movement that questioned the fundamental nature of art itself by renunciating the material art object as well as the phenomenon of art making. The definition of art as well as its institutional framework was thereby expanded and the idea, concept, or intellectual dimension of the work was underscored. Students will be acquainted with the philosophical foundations and critical implications of this global movement across a wide spectrum of works and practices (paintings, performance, installations, books and texts, photography, film, and video) and its relevance to contemporary concerns. **Credit 3**

2039-843 What is Postmodernism?
This course will cover the art, politics, culture and the critical texts that formed the discourses, and their resulting debates, about contemporary society after World War II and especially so after the social unrest of 1968. What is Postmodernism? features the question itself. Here it is not necessarily as important to find out what postmodernism is or is not as it is to ask the question in the first place. To ask the question is to accentuate the idea that the question itself is what we are dealing with. How and why and by whom, are questions asked and answered? What is the difference when we ask the same question about Postmodernism in the historical sense rather than a stylistic one? What if the question were to be asked from within the discourse of architecture or music or biology? Would the answers be the same? Would the questions be the same? **Credit 3**

2039-852 Art and Activism
This course focuses on artists using their work for the purpose of changing society; work by artists that cause critics, art historians, other artists and the viewing public to ask if what they are doing is art. We will examine art to be a form of activism and persuade artists to be responsible for the way they represent the world. What is Art? What should Art be? What should Art do? But is it Art? are some questions asked when art proposes to make a political or social change, for example when art becomes action. Although these questions may not seem immediately answerable, it is our responsibility to ask them and then attempt to answer them as best we can. The artists we will discuss are concerned with problems in our society that affect gender, race, sexuality, poverty, labor issues, and the environment. Most of these artists can be classified as angry and confrontational or at least evoking a form of contestation. **Credit 3**

2039-859 Art and Architecture in Central Italy: 1250-1400
The subject of this course is painting, sculpture and architecture in Central Italy from the middle of the 13th century to the end of the 14th century. We will approach this material in more or less chronological order as we focus upon different types and media, including the altarpiece, the private devotional image, the pulpit, the tomb, the chapel, the monastic church, the cathedral, the town-hall, the private palace, and the urban setting. Questions for consideration will include: Franciscan devotion, the rivalry between Siena and Florence, early humanist thinking about the arts, Giotto as the paradigmatic Florentine painter, the nature and meaning of the Italian proto-Renaissance, and the impact of the Black Death upon the arts. **Credit 3**

2039-869 Baroque Rome
This course will focus upon Italian artists working in Rome from circa 1590 to circa 1660. Although we will explore painting, sculpture and architecture in this sequence and more or less chronologically, we will often have the chance to consider how these different media coalesce to create an overwhelming visual experience. We will pay particular attention to major commissions given to Annibale Carracci, Michelangelo da Caravaggio, Gianlorenzo Bernini and Francesco Borromini, as we seek to define the nature and meaning of the Roman Baroque. **Credit 3**

Graduate Study

2037-715 **Thinking About Making: The Practice of Art in a Global Society**
A discussion based art history elective for graduate students. The course seeks to bridge the gap between studio practice and contemporary art history. The course will explore very current work and ask questions about what is art, who is the audience, what is "our" art making practice and how does that fit within the larger context of the current state of the global art world. How do we measure success and artistic failure? The course emphasizes observation, critical analysis and written interpretation. **Credit 3**

2037-785 **Forms of Inquiry**
The exploration and organization of forms of inquiry is required for all MFA students. It aims to expose students to a broad range of critical issues related to the conception and production of art, to inspire and provoke critical reflection, and facilitate the development of a preliminary thesis topic. Presentations, discussions, and written assignments will examine concerns as they relate to contemporary art, crafts, and design. (Department approval required) **Credit 2**

2037-790 **Graduate Forum**
Students are exposed to a broad range of issues related to the conception and production of art. Presentations and discussions will deal with current approaches to aesthetics, criticism, creativity and perception through the work of contemporary artists and craftspeople. Weekly presentations will be given on specific issues relevant to contemporary practice. In addition, visiting faculty will participate in studio discussions, activities and critiques. The goal of this course is to place you in a position of awareness related to contemporary practice, the world that you are going to occupy, and the cultural models that influence your beliefs. **Credit 3**

School of American Crafts

Ceramics

2040-761, 762, 763, 764 **Ceramic Graduate Elective**
Basic instruction and experience in ceramic design, fabrication, and production of ceramic forms is undertaken. This study provides ceramic technology and terminology and gives experience with clays along with fundamental forming techniques. The development of design awareness is encouraged through lectures and critiques. Materials fee required. **Credit 3 per quarter**

2040-781 **Graduate Ceramics Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-782 **Graduate Ceramics Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-783 **Graduate Ceramics Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-784 **Graduate Ceramics Studio IV**
This is the fourth of a four-quarter sequential course covering the advanced aesthetics and techniques in ceramics. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-890 **Ceramics Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report that addresses the body of work. The work will be exhibited in the graduate thesis show. (2040-784 and Crafts graduate seminar) **Credit 1–18**

2040-892 **Continuation of Thesis Ceramics**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

General Craft Studies

2045-721 **Thesis Implementation**
This course, coordinated and overseen by the SAC graduate coordinator and thesis chief adviser, will monitor the progress of a graduate student in the development of the comprehensive and well-integrated body of work that constitutes their thesis. Students will review their work, both thesis and non-thesis, regularly throughout the quarter with both their major faculty and their thesis committee members. A minimum of two comprehensive thesis reviews will take place during the quarter, reviewed by thesis committee members. A final and formal thesis critique will take place at the end of the quarter. Students will receive a written evaluation of the evaluation. (Graduate Studio II and 2045-722) **Credit 2**

2045-722 **Thesis Review**
This course, coordinated and overseen by the SAC graduate coordinator and thesis chief adviser, will continue to monitor the progress of a graduate student in the development of the comprehensive and well integrated body of work that constitutes their thesis. It will determine a student's final readiness to exhibit his or her thesis work in the Spring Thesis Exhibitions. Students will review their work, both thesis and non-thesis, regularly throughout the quarter, with both their major faculty and their thesis committee members. A minimum of two comprehensive thesis reviews will take place during the quarter, reviewed by thesis committee members. A final and formal thesis critique will take place at the end of the quarter. Students will receive a written evaluation of the evaluation. (Graduate Studio IV and 2045-721) **Credit 2**

2045-723 **Graduate Crafts Seminar**
This course will examine the investigative process required for a craft artist to develop a comprehensive and well-integrated body of work. Students will review the work of known artists; and will research the themes and issues in their own work. They will work with the faculty and their thesis committee to develop strong viable themes for their thesis. This course is offered only in spring quarter. (2040-782 or 2041-782 or 2042-782 or 2044-782) **Credit 2**

Glass

2041-761, 762, 763, 764 **Glass Graduate Elective**
Collaborative work in the student's major area of study and glass fabrication is encouraged. Various techniques, both hot and cold, will be considered in different quarters: casting, slumping, fusing, blowing, engraving, sand carving, cutting, lamp working, and sculptural construction. Course emphasis on personal, independent development encouraging contemporary thought and concept. Materials fee required. **Credit 3 per quarter**

2041-781 **Graduate Glass Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This program is structured on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2041-782 **Graduate Glass Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2041-781) **Credit 9**

2041-783 **Graduate Glass Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2041-782) **Credit 9**

2041-784 **Graduate Glass Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2041-783) **Credit 9**

2041-890 **Glass Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report that addresses the body of work. The work will be exhibited in the graduate thesis show. (2041-784 and Crafts Graduate Seminar) **Credit 1–18**

2041-892 **Continuation of Thesis**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

Metals

2042-761, 762, 763, 764 **Metals Graduate Elective**
This course offers students fundamental, intermediate and advanced fabrication/forming techniques as they apply to hollow ware and jewelry design. Creative designs and innovative artistic concepts are encouraged. Individual and group instruction covers the properties of various metals, the use of the shop equipment, and safety procedures as they apply to metalsmithing. Materials fee required. **Credit 3 per quarter**

2042-781 **Graduate Metals Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This program is structured on the basis of the individual student's needs, interests and background preparation as they are determined through faculty counseling. There will be a strengthening of material knowledge and explore design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate and explore new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2042-782 **Graduate Metals Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new and innovative concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-781) **Credit 9**

2042-783 **Graduate Metals Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. The student will seriously explore issues and themes that may prove relevant to their final selection of a thesis topic. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-782) **Credit 9**

2042-784 **Graduate Metals Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-783) **Credit 9**

2042-890 **Metals Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report that addresses the body of work. The work will be exhibited in the graduate thesis show. (2042-784 and crafts graduate seminar) **Credit 1–18**

2042-892 **Continuation of Thesis**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

Textiles

2043-761, 762, 763, 764 **Textile Graduate Elective**
This is the study and appreciation of weaving and textile techniques, soft sculpture, off-loom weaving, and printing. Design approaches are stressed. Materials fee required. **Credit 3 per quarter**

Wood

2044-761, 762, 763, 764 **Wood Graduate Elective**
This is a course in woodworking techniques and procedures. It enables the student to gain design competency through wood and an individual solution to wood projects based on suggested needs. Materials fee required. Due to safety reasons, no students may, for any reason, miss the first class. Registered students who miss the first class will automatically be dropped. **Credit 3 per quarter**

2044-781 **Graduate Wood Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This program is structured on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. There will be a strengthening of wood techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2044-782 **Graduate Wood Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-781) **Credit 9**

2044-783 **Graduate Wood Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-782) **Credit 9**

2044-784 **Graduate Wood Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-783) **Credit 9**

2044-890 **Wood Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report that addresses the body of work. The work will be exhibited in the graduate thesis show. (2044-784 and crafts graduate seminar) **Credit 1–18**

2044-892 **Continuation of Thesis**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

School of Art

Art Education

2011-701 **Art Education Methods and Materials I**
The course will explore the process of teaching art in the public/private school classroom and focus on specific information and theories relevant to the teaching of visual art. Students will be encouraged to explore highly structured as well as highly experimental approaches to teaching art. Projects will include lesson planning, unit planning, investigating new technologies, urban education, action research, and other relevant topics, such as human development, students with disabilities, multiple intelligences, assessment processes, and personal inquiry as reflective practice. (Course is restricted to MST art education majors) **Credit 5**

2011-702 **Art Education Methods and Materials I**
This course is a continuation of Methods and Materials I. Students will further explore the process of teaching art in the public/private school classroom and focus on specific information and theories relevant to the teaching of visual art with the specific goals defining a teaching methodology that meets State and National Standards. Students will be encouraged to explore highly structured as well as highly experimental approaches to teaching art. Projects will include lesson-planning, unit planning, investigating new technologies, urban education, action research, and other relevant topics, such as human development, students with disabilities, multiple intelligences, assessment processes and personal MST majors) (2011-701, Restricted to art education graduate majors) **Credit 5**

2011-711 **Child Development in Art**
In this course students will investigate and study the topic of child development in art and education. Students will explore a range of perspectives on developmental theories; the creation, and understanding of children's art and meaning making; and approaches to teaching art to children in a birth–12 setting. Resources from the areas of art, psychology, sociology and art education will be investigated. Projects will include the development of a case study, relevant readings, research and studio activities, and collaborative research. Students will be expected to complete weekly reading and writing assignments. In a seminar format, the students realize the course objectives through participatory means. Students are expected to write critical essays, conduct research and field experience, and to participate in weekly small and large format discussion groups. Online technology is utilized in addition to lectures, videos, and other forms of media. This course has a field experience component of 30 hours. **Lec 3, Studio 0, Credit 3 (F)**

2011-712 **Inclusive Art Education: Teaching Students with Disabilities in the K–12 Art Classroom**
This course focuses on how to promote equity in art education K–12 for students with disabilities. Art Educators are expected to be able to understand the diverse learning needs of all students. Students in this course will discover how to adapt their own curricula and collaborate with special needs teachers to help students succeed in the art classroom. Through course work and field experience students will build a foundation of knowledge for working with children and youth with special needs. Students will develop new instructional strategies for making visual art more accessible for students with exceptionalities. Students will develop a plan to incorporate accessibility strategies into their daily teachings. In a seminar format, the students realize the course objectives through participatory means. Students are expected to write critical essays, conduct research and field experience, and to participate in weekly small and large format discussion groups. Online technology is utilized in addition to lectures, videos, and other forms of media. This course has a field experience component of 20 hours. **Class 3, Credit 3 (F)**

2011-820 **Seminar in Art Education**
This course supports the student who is currently student teaching. In this course students will explore the day-to-day issues they experience in their student teaching experiences. The focus will be on making connections with theory, state and national standards, and reflecting on student experience to address overall goals of the program. Students focus on the following areas to meet NYSED requirements: content/subject matter knowledge, pedagogical knowledge, teaching skills, curriculum development, assessment, and professional skills. The development of a teaching portfolio occurs in conjunction with a culminating project. Online technology is utilized in addition to slide lectures, videotapes, and other forms of media. (Limited to art education majors) **Credit 3**

2011-860 **Practice Teaching**
The student teaching experience is the single most important activity of the MST program. It is designed to provide the student with experiences and challenges which will help them to further develop into the art teacher they are becoming. Two student teaching placements are arranged for each student for the duration of seven weeks each. Students are assigned a collaborating teacher and a college supervisor for each setting. A student teaching handbook is provided. (Limited to art education majors) **Credit 9**

Fine Arts Studio

2021-710 **Introduction to Painting: Acrylic Graduate**
A course in the basic materials and processes of acrylic painting. Students will explore the expressive and stylistic possibilities of the medium. Subjects will include various interpretations of still life and model as well as individual projects. Discussion of work will focus on form, composition, and color. (Restricted to graduate students in the Art, Design, or Crafts programs, or permission of instructor) **Credit 3**

2021-711 **Introduction to Painting: Oils Graduate**
This course introduces students to oil painting. Along with learning about the properties and techniques of this medium, students will be encouraged to experiment and seek solutions to problems of composition and structure in painting. Preparatory sketches and studies will be encouraged for the production of finished works. Lectures, demonstrations, examples, and slide talks will complement the growth gained through the students' creation of a variety of paintings from both observation and imagination. (Restricted to graduate students in the Art, Design, or Crafts programs, or permission of instructor) **Credit 3**

2021-712 **Introduction to Painting: Figure Graduate**
The fundamentals of representational figure painting in oils or acrylics using traditional materials and process. Color-mixing and painting application techniques related to depicting the figure and its immediate environment will be explored. Observational study of form, space, and quality of light will be stressed. (Intro to Painting) **Credit 3**

2021-713 **Figure in Motion**
The Figure in Motion is a course that studies the fundamentals of drawing the human form in motion. Emphasis is given to sketching and quick studies with a variety of media. Principles of visual perception with also be explored. **Lec 1, Lab 4, Credit 3 (F)**

2021-716 **Introduction to Fine Art Drawing**
This class is devoted to building upon each student's skills in drawing with attention to use of a variety of mark making materials and surfaces. Drawing uses perceptual and conceptual approaches to creative visual art making. Students engage in issues of representation and abstraction through relationships of marks, lines and other graphic notations. Contemporary drawing can focus on direct observations or imaginative compositions among many other valid approaches. **Lec 1, Lab 4 , Credit 3 (F)**

2021-721 **Watercolor: Graduate Elective**
Use and control of the technique of water color painting. Exploring watercolor as an illustrative and painting media. (Restricted to graduate CIAS students, or permission of instructor) **Credit 3**

2021-722 **Contemporary Drawing Graduate Elective**
Emphasis is on drawing and the development of form, space and expression from a variety of sources, including the human figure. Emphasis on basic techniques, materials, and concepts for further study are explored. **Credit 3**

2021-733 **Introduction to Printmaking: Non-Toxic Graduate**
The student will explore of a wide range of non-toxic printmaking processes and techniques. In the mastery and application of these processes and techniques the student will achieve personal aesthetic goals. (Restricted to graduate CIAS majors or permission of the instructor) **Credit 3**

2021-736 **Foundry Practices**
This course is designed to introduce or develop students' skills in casting metals with an emphasis on cast iron and the use of a cupola. Advanced pattern-making, mold-making, sprueing, patination, and casting techniques will be introduced. Students will develop their concepts through cast metal sculpture. **Lec 1 Lab 4, Credit 3 (S)**

2021-739 **Digital Art Printmaking**
This class allows students to gain experience and practice using popular software and digital tools for visualization of their art. Students will use printmaking processes to complete a selection of prints that demonstrate knowledge of digital production and to analyze, extend, and improve their capacity as fine artists. **Lec 1, Lab 1, Studio 3, Credit 3 (F)**

2021-741 **Non-Toxic Intaglio Printmaking I**
The first of three graduate level non-toxic intaglio courses. The aim of this introductory level is to gain a technical understanding of basic Intaglio-Type and non-toxic alternative techniques for hand etching copper plates. Aspects of health and safety as applied to the intaglio studio along with working methodology will also be explored. (Matriculation into Non-Toxic Printmaking Certificate; instructor permission required) **Credit 4**

2021-742 **Non-Toxic Intaglio Printmaking II**
The second of three graduate level non-toxic intaglio courses. The aim of this second level is to gain a technical understanding of Intaglio-Type etch techniques and gain a greater understanding of non-toxic alternative techniques for hand etching. Introduction of computer-generated methods of making halftones. To learn about the Edinburgh Etch. (2021-741 or portfolio review) **Credit 4**

2021-743 **Non-Toxic Intaglio Printmaking III**
The last course in a series of three graduate level non-toxic intaglio courses. The aim of this third-level is to gain an advanced technical understanding of Intaglio-Type etch techniques and to either; learn how to make high quality photographic halftones, learn more advanced hand etching techniques. (2021-741 and 2021-742) **Credit 4**

2021-746 **Ideation and Series**
Creative flow, having an endless stream of ideas, alternatives, and choices for solutions, helps creative work evolve and reach more advanced levels. In this course students develop appropriate skills and strategies to generate ideas and develop them effectively. **Lec 2, Lab 3, Credit 3 (F)**

2021-761, 762, 763, 764 **Fine Arts Studio Graduate Elective**
Traditional sculptural concepts will evolve through a variety of processes and materials -- predominately clay, plaster, cement, stone, paper, and metal. The human figure is presented as a subject for study and for use as a springboard to invention. **Credit 3 per quarter**

2021-769 **Art Gallery Management**
The complex social and cultural role of a fine arts gallery will be explored through supportive gallery operations: the installation of experimental and traditional exhibits, promotion, and marketing for competitions, student initiatives and special events tailored to the RIT and community art audiences. (Metro site presentations and research plus arranged studio hours in a laboratory: gallery setting). **Credit 3**

2021-775 **Sculpture: Assemblage Graduate Elective**
One of the most basic approaches to creating Sculpture, this course involves assembling or bringing together parts/pieces to form a whole. Spontaneous and immediate contact with unique materials, creative processes and the degree of sculptural impact may all be characterized as extremely direct. This straightforward confrontation offers no flashy techniques, seductive material or process to hide behind. Instead, at the onset, basic sculptural manipulation must occur. **Credit 3**

2021-776 **Sculpture: Figure Graduate Elective**
This sculpture course investigates the study of human form through the development of sculpted clay figures working directly from living models. Emphasis is placed on exploring the following sculptural elements: the underlying three-dimensional structure of the human figure; proportions of the human figure; volume, mass and surface anatomy; gesture; support and balance; figurative spatial relationships; expressive qualities of human form; use and control of basic material; and processes related to figure sculpture. **Credit 3**

2021-780, 781, 782 **Fine Arts Studio Graduate I**
Fine Arts Studio: enter into a critical discourse and examination of ideas and relationships in the fine arts. Critiques, guest artists, lectures, and discussion along with studio production. Painting: develop painting skill in oil, acrylic, watercolor, drawing through individual studio investigation under the direction of fine art faculty. Sculpture: sculpture concepts are explored through a variety of processes and materials, including clay, plaster, cement, stone, wood, and metal. These concepts reveal themselves through separate sections devoted to the human figure, installation, public art, or other contemporary manifestations of sculpture. Printmaking: non toxic printmaking techniques and processes are the means for students to develop along independent lines and directions for contemporary fine art printmaking. (Restricted to graduate fine arts majors) **Credit 3 per quarter**

2021-790, 791, 792 **Fine Arts Studio Graduate II**
Fine Arts Studio: enter into a critical discourse and examination of ideas and relationships in the fine arts. Critiques, guest artists, lectures, and discussion along with studio production. Painting: develop painting skills in oil, acrylic, watercolor, drawing through individual studio investigation under the direction of fine art faculty. Sculpture: sculpture concepts are explored through a variety of processes and materials, including clay, plaster, cement, stone, wood, and metal. These concepts reveal themselves through separate sections devoted to the human figure, installation, public art, or other contemporary manifestations of sculpture. Printmaking: non-toxic printmaking techniques and processes are the means for students to develop along independent lines and directions for contemporary fine art printmaking. (2021-780) **Credit 3 per quarter**

2021-872 **Business Practices for Fine Arts**
This class is devoted to business issues that artists will face which include portfolio development, pricing, and marketing strategies, and public relations. Students will research exhibition venues and career support services. Professional accomplishment in the arts depends on communication skills. Artists run small creative businesses; students will study opportunities to network with others artists, review grant applications, and look at other financial supports. **Credit 3**

2021-891 **FAS Thesis Development**
This course involves the application of theory and methods to the planning of a fine arts studio project. Each student is responsible for formulating a comprehensive project development plan, including the use of evaluation method(s) during appropriate stages of the project. (2021-890) **Credit 1**

2021-890 **Research and Thesis: Fine Arts Studio**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. (Approval of instructor) **Credit 1–14 (offered every quarter)**

2021-892 **Continuation of Thesis Fine Arts Studio**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

Illustration

2019-706 **Illustrative Design I Graduate**
This course is an introduction to the principles and methods used to incorporate illustration with typography and layout. Students will conceptualize, organize, and execute illustrations within a design context, and will emphasize the use of graphic elements such as symbols, charts, and type to be incorporated into illustrations. Layout terminology and illustration production methods will be included. Projects will expose students to various examples of real world assignments what will demand the use of traditional illustration methods as well as computer-based production media; emphasizing the language of visualization and the relationship and coordination of concept, illustration, and word. **Credit 3**

2019-711 **Digital Illustration I Graduate**
Graduate students will be introduced to the principles of visualization used to create digital illustrations. Students will apply their ability to conceptualize effective solutions to digital illustration renderings. Assignments encourage a high level of creative conceptual development, with theory and practice in the use of digital techniques. The goal is to advance conceptual problem solving methodology and the language of visualization for professional illustration production. Color systems, digital terminology, and pre-press file formats will be covered. **Credit 3**

2019-723 **Digital Editorial I Graduate**
Graduate students will introduce students to editorial illustration. Importance will be placed on interpretation of editorial subject matter and preparation of digital imagery for print reproduction. Students will apply approaches to creative illustration while creatively interpreting editorial text. Students may use vector and rastor-based software applications and a variety of input and output devices. Stylistic issues, conceptual strategies, production restrictions, and color systems will also be covered. **Credit 3**

2019-726 Zoological and Botanical Illustration Graduate
This course utilizes subjects found in the natural world as resources for applied and fine art applications. Working from live and preserved subjects, students will accurately depict animal and plant images, which may be used descriptively in print and electronic media. **Lec 2, Studio 3, Credit 3 (F, S)**

2019-733 Illustration Portfolio Preparation Graduate
A final preparatory course for visual artists. Its purpose is to provide students with information, strategies, and guided instruction to organize and create their final portfolio. The course will include individual critique and analysis of work created in prior studio classes and progress to the definition of a career agenda. Projects will be individually assigned based on the quality of each student's body of work and their career intentions. Presentation methods, formatting, and stylization will also be addressed. The final culminating projects will be finished hard copy and digital portfolios. In addition to the portfolio document, students will be instructed in job-seeking strategies including interviewing dynamics, resume writing, and correspondence. **Credit 3**

2019-742 Digital Narrative II Graduate
This course expands upon the translation of verbal concepts to pictorial narrative introduced in Digital Narrative I. Particular emphasis will be placed on illustration sequences including story line illustration, and thematic series pictorials. Importance will be placed on the digital representation of narrative story telling with reference to style, content, and interpretation. Assignments will involve vector and rastor-based software applications and a variety of input and output devices. Conceptual strategies, production methodologies, narrative composition, and color systems will also be covered. **Credit 3**

2019-761, 762, 753, 764 Illustration Graduate Elective
Individual drawing projects related to graduate students' major area of study and opportunity to refine drawing skills on the graduate level. Elective offerings are Adobe PhotoShop, Personal Focus, and Figure in Motion. **Credit 3 per quarter**

Medical Illustration

2020-707 Contemporary Media for Interactive Portfolio
Students will create an interactive portfolio of their artwork and/or animations designed to attract potential clients and employers. The portfolio will be available for viewing on the Web and as a CD or DVD. It will include interactive navigation and be able to download vitae and promotional materials to site visitors. (2020-711) **Credit 3**

2020-710 Anatomic Illustration Mixed Media
Students will learn to use raster painting software to modify scanned artwork and create new images from scratch. Students will also use page layout applications to combine digital images with text and other graphic elements. Course work emphasizes creation of illustrations to support medical education, for advertising, and to editorialize health and medical concepts. **Credit 3**

2020-711 Computer Animation and Interactivity I
This course continues advancement of animation skills used in Medical Illustration Topics II (2020-784). Students will create an interactive lesson using computer illustrations and two-dimensional computer animations designed for delivery via the Web. Course work will also require students to create "puzzles" and other games requiring interactive learner participation. (2020-784) **Credit 3**

2020-712 Computer Animation and Interactivity II
This course introduces variables as a tool in constructing tests designed to measure learner comprehension. Students will create interactive lessons that use animation and interactive teaching strategies to deliver instructional objectives to a specific audience. Learner interaction with the symbols and control of animation remains a prime focus of the course. (2020-784) **Credit 3**

2020-731 Human Gross Anatomy I
A two-quarter sequence devoted to the study of the human body. Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. Dissection focuses on the muscles of the torso, the contents of the thorax and abdomen, and the upper limb. **Credit 4**

2020-732 Human Gross Anatomy II
The second half of a two-quarter sequence devoted to the study of the human body. Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems; with a detailed dissection of the head and neck and moves on to the pelvis, perineum, and lower limb. (2020 731) Credit 4

2020-761 3D Modeling of Organic Forms
This course introduces students to NURB, polygon, and subdivision modeling techniques for creating virtual three-dimensional organic subjects. Accurate portrayal of the subject, including form, texture, and color are emphasized. Developing models from student drawings is required. **Credit 3**

2020-762 3D Animation of Organic Forms I
Course work focuses on accurate animation of organic and/or biomedical subjects using three-dimensional computer modeling. All animations are intended for display on the Web. Projects are three-dimensional animations that teach or portray an assigned topic. (2020-761 recommended) **Credit 3**

2020-763 3D Animation of Organic Forms II
Students are introduced to three-dimensional computer animation using character rigging. Assignments focus on creating joint skeletons and binding three-dimensional surfaces to these "joints." Course work introduces manipulating surface deformations in response to movements and surface material. All animations are intended for display on the Web. Projects are "applied animations" that teach or portray an assigned topic. (2020-762 or permission of instructor) **Credit 3**

2020-767 Molecular Illustration
Accurate representations of molecular structures are essential to illustrate recent advances in biotechnology, medical genetics, and pharmacology. This course provides a basic overview of molecular biology and introduces the principles of molecular illustration. Students will locate three-dimensional molecular model files on the Internet and manipulate these models to create two- and three-dimensional and animated representations of molecules and biochemical processes. **Credit 3**

2020-781 Medical Illustration Topics I
A introductory course; designed to acquaint the illustration student with art techniques commonly used in medical illustration and with the medical library and audio-visual television supporting milieu in which the medical illustrator works. **Credit 3**

2020-782 Medical Illustration Graphics
A course emphasizing the use of computer software and hardware as a resource for generating titles, charts and graphs, schematics, and illustrations as vehicles to meeting instructional and communicative needs. Students will learn the various techniques available and will apply those techniques while designing pamphlets, in-house publications and poster exhibits. **Credit 3**

2020-783 Anatomical Studies
Sketches drawn from human dissection are translated into instructional illustrations using watercolor wash, pen, and ink. Emphasis will be on rapid but accurate sketching and observation in the laboratory, with a representation of form and structure in living tissue for publication. **Credit 3**

2020-784 Medical Illustration Topics II
A introduction to two-dimensional computer animation as it applies to contemporary methods of instruction in medicine and allied health. Students will research current topics in health care and develop an interactive lesson that matches the instructional objectives of their topic. **Credit 3**

2020-785 Surgical Procedures I
The application of creating instructional aids designed to increase learner understanding of surgical procedures and concepts. Sketches are to be drawn while observing the surgery, consulting with the surgeon for accuracy of detail and development. The final preparation of the artwork will match its intended use (publication, slide graphic, computer graphic, etc.) **Credit 3**

2020-786 Surgical Procedures II
A continuation of the concepts begun in Surgical Procedures I (2020-785); specifically, combining anatomical knowledge with surgical observation to construct a concise and accurate surgical series. Students will concentrate on communicating essential surgical concepts to a specific audience, as well as ensuring that their artwork will meet the demands of reproduction. **Credit 3**

2020-890 Research and Thesis-Medical Illustration
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. (Approval required) **Credit 1–14 (offered every quarter)**

School of Design

Effective fall 2013, the MFA programs in computer graphics design and graphic design will merge to form one program in visual communication design.

Computer Graphics Design

2014-701 Survey of Computer Graphics
The computer graphics profession is constantly progressing. This course will provide a conceptual framework to designing and implementing multimedia applications, game art and design, instructional multimedia, visualization, interactive animation, and Web page design. Students research ideas, concepts, uses, history, aesthetics, and design principles of computer graphics and interactive media as it relates to the ever-evolving field. The content integrates visual semiotics, information architecture, user interface guidelines, and icon design. Students will complete assigned projects and readings. (Limited to JADC, JADG, JADM or JADU graduate students) **Credit 2**

2014-711 Digital Video
Use of digital video cameras, lights and microphones for motion recording and the use of storyboarding, titling, editing, and software to create and format digital Quick Time movies of DVDs for multimedia productions or motion graphics. (Restricted to first-year Computer Graphics Design JADG, graduate majors) **Credit 4**

2014-713 Design Research
This course will focus primarily on developing students' research and graphic design skills and exposing them to a range of writing techniques. Emphasis will be placed on an exposure to a wide range of research resources including the more traditional library vehicles, newer developments on the Web, and relevant archives and special collections. This course will begin to establish each student's thesis direction in very general terms by including the development of a preliminary thesis proposal and establishing an overview of research directions. (Limited to JADC, JADG, JADM, or JADU graduate students) **Credit 3**

2014-717 Authoring Multimedia
This course explores the art and design of interactive applications for the web, mobile devices, and tangible media. Exposure to computer graphic algorithms, design heuristics, design methodology, and program structure of two-dimensional imagery for multimedia design. Projects involve programming interactive user experiences for on line and mobile technology. (Limited to the following graduate programs: JADG, JADC, JADU, JADM, or permission of instructor) **Credit 4**

2014-718 QTVR and Multimedia Design
This course is intended to provide a foundation to QTVR (QuickTime Virtual Reality) concepts. Previous multimedia experience and skills will be extended to emphasize multimedia applications that use QTVR as a design tool to interactively explore three-dimensional virtual environments. Attention will be given not only to the mechanics of creating the movies, but also to the design, relationship to other visual elements, and visual communication effectiveness of the movies. (Limited to first-year Computer Graphics Design graduate majors or permission of instructor) **Credit 4**

2014-721 3DDG Modeling
This course covers a contrast and comparison of various methods of creating geometry for use in three-dimensional environments including polygons, NURBS, and subdivision surfaces for various purposes. Skills learned can be applied to creating elements for computer and video games, creating virtual environments or in visualization. Students have the opportunity to work on projects of their own invention or with real world application. (Graduate standing) **Credit 4**

2014-722 3DDG Interactive Motion
This course covers first the use of animation in interactive environment including games, visualization, and virtual reality. Students will create animation using key frames, paths, deformation, forward, and inverse kinematics. (2014-721) **Credit 4**

2014-723 Graphical User Interface
This course provides an in-depth look at graphical user interface design. Students learn the basic components of a user interface, HCI (Human-Computer Interaction) and how to design alternative navigational solutions. (Limited to first-year computer graphics design graduate majors or permission of instructor) **Credit 4**

2014-731 3DDG Lighting
Students apply standard lighting methods to lighting three-dimensional models. The interaction of light and pigment, use of light in painting, photography, film, and computer graphics are used as examples. Students apply problem solving techniques to arrive at a lighting solution for various problems. (2014-721) **Credit 4**

2014-732 3DDG Shading
The course focuses on incorporating two- and three-dimensional groups of textures into realistic materials. Students learn to use texture maps instead of detail in models to increase interaction speeds. Textures are also used in order to incorporate simple models into diverse scenes. Displacement textures are used to create detail in models. Advanced techniques in the use of shading networks are incorporated into the process. (2014-721) **Credit 4**

2014-733 3DDG Character Design`
This course covers first the design of characters and then the creation of them using three-dimensional software, inverse kinematics, and deformers. Students create interpretant matrices, model sheets, sketches, and maquettes of characters followed by development of the character in software. (2014-721) **Credit 4**

2014-741 3DDG Poly and SubD Modeling
This course provides extensive coverage of methods for modeling with polygons and subdivision surfaced. In addition students extend their knowledge of methods for laying out UVs for placing materials on polygonal shapes. **Credit 4**

2014-747 3DDG Rendering
This course covers a contrast and comparison of various methods and resolutions of rendering and outputting information from three dimensional software. (2014-721) **Credit 4**

2014-767 3DDG Particles and Dynamics
This course is the introduction to particle systems and dynamic simulations in a three-dimensional software environment. Students will create projects incorporating these dynamic stimulations in practical computer graphic contexts. Credit 4

2014-781 Authoring Computer Graphics Design
Exposure to computer graphic algorithms, design heuristics, design methodology, and program structures of two-dimensional imagery for multimedia design. Projects involve programming in an authoring language. **Credit 4**

2014-782 3D Computer Graphics Design
This course is an introduction to desktop three-dimensional visualization. It also expands on previous visualization skills and design experiences to include fundamentals for more advanced studies in three-dimensional animation, virtual spaces, and multi-dimensional navigation spaces. (Computer graphics design major or permission of instructor) **Credit 4**

2014-784 Digital Typography in Motion
A study of digital typography and, in particular, digital type in motion as used in interactive applications and motion graphics. (2014-796 or permission of instructor) **Credit 4**

2014-785 Instructional Multimedia
Interactive and other software packages will be used to create instructional programs for different age groups. Course work will include subject matter research, developing objectives, creating graphics, sound and interactivity, and program evaluation. Each student will produce an instructional multimedia application. (Computer graphics design major or permission of instructor) (Limited to first-year computer graphics design majors or permission of instructor) **Credit 4**

2014-786 2D Computer Animation
This course will include two-dimensional computer animation techniques, linear and non-linear, and interactive storytelling methods, narrative design, character design and animation, digital sound, and both frame-based and scripting animation methods. These techniques will be used to create interactive, web, and broadcast narratives with animation. (First-year computer graphics design major or permission of instructor) (Limited to JADC, JADG, JADM, or JADU graduate students) **Credit 4**

2014-787 Advanced Computer Graphics Design I
This course extends previous multimedia experience and skills to emphasize advanced multimedia applications that use gaming concepts, delivery systems, and software as a design tool for entertaining and informing. Students will work with two- and three-dimensional visual concepts, virtual reality, interactivity, and sound to develop games of their own. (Computer graphics design major or permission of instructor) (Limited to second-year JADG majors or permission of instructor) **Credit 4**

2014-791 Advanced Computer Graphics Design II
This course provides the opportunity to expose students to the latest concepts, techniques, and skills in a quickly evolving technological and information oriented society. This course is open ended so that new information, techniques concepts, principles, software, and hardware can be introduced in a timely manner. (Computer graphics design major or permission of instructor) (Limited to JADG second-year majors or permission of instructor) **Credit 3**

2014-792 **Vector-Based Multimedia Design**
This course extends previous multimedia experience and skills to emphasize advanced multimedia applications that use vector-based concepts as a design tool for creating animation and interactive authoring while maintaining small file sizes. (Computer graphics design major or permission of instructor) (Limited to JADC, JADG, JADM, or JADU graduate students) **Credit 4**

2014-796 **Special Effects**
Exposure to the development of visual effects and motion graphics for broadcast and the web. Computer software and storyboarding are used to create visual effects in both animation and live video. Sequencing, storyboarding, digital sounds, titling, animation, video clips, and special effects are integrated. (Computer graphics design major or permission of instructor) (Limited to JADG second-year majors) **Credit 4**

2014-797 **Advanced Computer Graphics Design III**
This course provides an in-depth look at creating an effective electronic portfolio. Students create, organize and design a portfolio based upon personal strengths and interests, with professional standards, and career expectations in mind. (Computer graphics design major or permission of instructor) (Limited to JADG second-year majors) **Credit 4**

2014-798 **Production Pipeline**
The course focuses on implementing a project from the planning stage, through implementation, to completion, and presentation. (2014-721, plus at least one other three-dimensional design computer graphics design course) **Credit 4**

2014-803 **3DDG Motion Integration**
This course covers techniques and the application of three-dimensional elements with a two-dimensional motion graphics setting. There will be a review of the entire production process from sketches and storyboards to final rendering. The focus will be on the entire process with an emphasis on creating three-dimensional assets quickly and efficiently. **Credit 4**

2014-806 **Motion Graphics II**
This course expands the information presented in Motion Graphics I. The focus will be technical compositing and visual effects considerations and on the design and implementation of kinetic typography to enhance messages and how they are conveyed to an audience. **Credit 4**

2014-831 **Thesis Planning**
This course helps the student to research and develop a thesis related to a design problem. A thesis statement, review of the literature, construction of a time line, and application of organizational skills are integrated into this course. Revision and refinement of the proposal are based on critique and feedback. This course is required before development of a final thesis project. (Limited to Computer Graphics Design second-year majors) **Credit 2**

2014-840 **Thesis Project 1**
This course enables the students to research and develop their thesis projects. Research, surveys, resource investigation, time management, project organization, dialogue and meetings with thesis advisers are part of the course content.) (2014-831; restricted to JADG second- year students. Instructor approval required) **Credit 3**

2014-841 **Thesis Project 2**
This course is the culmination of the final thesis project. Usability testing, project refinement, time management, project documentation, dialogue and meetings with thesis advisers are part of the course content. Participation in a thesis defense, final thesis documentation, and presentation are required. (Thesis Research, 2014-831, 2014-840) **Credit 3**

2014-890 **Thesis: Computer Graphics Design**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a project report and participation in a graduate thesis show. (Computer graphic design majors only) **Credit 1–14**

2014-892 **Continuation of Thesis Computer Graphics Design**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

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Graphic Design

2010-711 **Design Theory and Methods Seminar**
Graphic design, computer graphics design, and industrial design MFA majors participate in this seminar to explore cross-disciplinary principles, theories, and methods from areas such as science, literature, architecture, urban design, anthropology, etc. that are relevant to problem solving in design. Through selected readings from current periodicals, critical writing, hands-on involvement, presentations and guest lectures, students broaden their awareness of topics such as systems thinking, human factors, semiotic theory and visual rhetoric, and become familiar with brainstorming and evaluation methods in order to sharpen their understanding of the overall design process. Focus will be directed toward meaningful concept development and the selection of appropriate methodologies for design problem-solving. (Restricted to School of Design first-year graduate students or permission of instructor) **Credit 3**

2010-712 **Graduate Typographic Design**
This course investigates typographic hierarchy- the use of typographic variables to differentiate parts of a message with attention to communication and readability. Typographic grid structure, typographic detail, and formal aspects of typographic design are explored. Project focus is on the process of developing harmonious type and image integration within sequential design applications. (Image forms and Design research; restricted to first-year graphic design MFA majors; or permission of instructor) **Credit 4**

2010-713 **Design History Seminar**
Graduate students in graphic design, computer graphics design and industrial design will be provided with a basis in the history of design which complements the overall graduate core in the School of Design as well as specific course work in each major field of design study. The course content focuses on subjects relative to the history of design (people, processes, products, places), critical thinking, and contextual historical issues. Students are expected to write critical essays and questions and to participate in weekly discussion groups. (2010-711, 2010-712, 2010-716, and 2010 717) **Credit 3**

2010-716 **Image Forms**
This course investigates formal visual aesthetics related to graphic design problem solving. Emphasis is on the process of image selection or generation, analysis, ideation, and integration. Focus is given to strategic message-making and optimal audience comprehension. Theories and principles from visual rhetoric and semiotics are discussed and employed. Image-generation tools are selected from both traditional and digital media as appropriate for specific projects. (Restricted to first-year Graphic Design MFA majors; or permission of instructor) **Credit 4**

2010-717 **Graduate Systems Design**
This course investigates various approaches toward visually and conceptually organizing components of graphic design problems (i.e., concepts, language, typography, imagery, color, space, and temporal or sensory considerations) for the purpose of clear, unified communication. Projects may include the creation of multiple components within an overall shared framework. (Image forms, Design Research, Design Theory and Methods Seminar, and graduate Typographic Design; course is restricted to first-year Graphic Design MFA majors or permission of instructor) **Credit 4**

2010-718 **Graduate Information Design**
This course stresses the importance of reader and user responses to written and visually presented information. Clarity and accessibility are prioritized during the investigation of many formats (charts, diagrams, tables, forms, maps, instructional materials, wayfinding systems, etc.) and their attributes. Projects also include testing mechanisms to substantiate design effectiveness. (Image Forms, Design Research, Design Theory and Methods Seminar, and Graduate Typographic Design; course is restricted to second-year Graphic Design MFA majors or permission of instructor) **Credit 4**

2010-721 **Project Development and Evaluation**
This course involves the application of theory and methods to the planning of a design project. Each student is responsible for formulating a comprehensive project development plan, including the use of evaluation method(s) during appropriate stages of the project. (2010-711, 2010-712, 2010-713, 2010-716, 2010-717 AND 2010-726; course is restricted to second-year JADC graduate students) **Credit 3**

2010-722 **Graduate Graphic Design Applications**
Printing production processes, relevant terminology and technical constraints from pre-press to post-press are the focus of this course. File and color management for digital and conventional printing is emphasized. (Image Forms, Design Research, Design Theory and Methods Seminar, and Graduate Typographic Design; course is restricted to first-year Graphic Design MFA majors or permission of instructor) **Credit 4**

2010-724 **Graduate Graphic Design Topics**
Content in this course is tailored each year for the particular student group. Potential modules may include: design planning, human factors, interface design, writing and design, sequencing and narrative structures, and other relevant topics. This course involves research and design applications related to the selected course topic. (Image Forms, Design Research, Design Theory and Methods Seminar, Graduate Typographic Design, Graduate Design Applications, Design History Seminar, Graduate Systems Design, Project Development and Evaluation and Graduate Information Design; course is restricted to second-year Graphic Design MFA majors) **Credit 4**

2010-726 **Design Issues Seminar**
This graduate course exposes first-year graphic design, computer graphics design, and industrial design to the range of contemporary issues that face design professionals. Topics will include, but not be limited to, issues related to sustainable design, ethics and values, audience appropriateness, and the role of the designer in society. Selected readings, essays and in-seminar discussions are integrated throughout the course content. (2010-711, 2010-712, 2010-713, 2010 716, 2010-717, 2010-718) **Credit 3**

2010-731 **Graduate Design Forum**
This course will introduce School of Design graduates to the graduate programs, foster a sense of community among students and faculty, acquaint students with various resources within the Institute and Rochester and encourage an ongoing dialog on the commonality of design philosophy, process, practice and goals across the design disciplines. Through the lectures, selects readings, a team project, presentations, and writing assignments, students will use this forum to become more familiar and comfortable with a free exchange of ideas about design, broaden their awareness of important interdisciplinary design considerations, and sharpen their communication and design criticism skills. (2010-731 is restricted to first-year JADC, JADG, and JADU majors) **Credit 3**

2010-861 **Graphic Design Thesis Planning**
This is the first in the sequence of courses focused on the MFA thesis requirement. Students are exposed to strategies that establish project content, planning, scheduling, and research. The product of the course is a fully articulated thesis plan. (All first-year graduate Graphic Design MFA studio courses) **Credit 4**

2010-862 **Graphic Design Thesis Development**
This is the second in a sequence of courses focused on the thesis project. Students are exposed to strategies appropriate to the continuation of project content, research, concept development, ideation, and in-process evaluation planning. (All first-year graduate Graphic Design MFA major courses and graduate Information Design and GD Thesis Planning) **Credit 4**

2010-863 **Graphic Design Thesis Implementation**
This is the final course in a sequence of courses focused on the MFA thesis requirement. Students are exposed to strategies appropriate to the implementation and retrospective evaluation of an intensive design problem. Verbal/written articulation of their design process and the required public exhibition are a focus of this course. (All first- and second-year graduate Graphic Design MFA major studio courses and Graphic Design Thesis Planning and Thesis Development courses) **Credit 4**

2010-890 **Thesis-Graphic Design**
The development of a thesis project initiated by the student and approved by a faculty committee is required. Primarily the solution of an applied design problem, the thesis must also include a written report and participation in a graduate thesis show. **Credit 1–14 (offered every quarter)**

2010-892 **Continuation of Thesis Graphic Design**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

Industrial Design

2035-705 **Outstanding Design-Graduate**
Design philosophies, practices and ethics are explored through examination of biographical material. Selected outstanding designers are reviewed and discusses. This course, with special criteria for graduate students, may be offered simultaneously with Outstanding Designers 2035-505 and be taught by the same instructor. (First-year graduate ID major or consent of instructor) **Credit 3**

2035-706 **Design Collaborative Graduate**
Advanced product development involving teamwork and collaboration with an industry design group providing technical information, marketing concerns, and outside review of work. (First-year graduate ID major or consent of instructor) **Credit 3**

2035-708 **Furniture Design Graduate**
Experience in the design of furniture for a defined sector of the contract market is acquired through a project exercise involving industry collaboration. (First-year graduate ID major or consent of instructor) **Credit 3**

2035-709 **Furniture Research and Development Graduate**
Students become acquainted with design factors affecting furniture style and construction through the study of selected, outstanding furniture designers and their work. This course, with special criteria for graduate students, may be offered simultaneously with Furniture Research and Development 2035-509 and be taught by the same instructor. (First-year graduate ID major or consent of instructor) **Credit**

2035-711 **Advanced Computer Modeling I**
The first of three required graduate-level electronic media courses. The emphasis in this beginning-level modeling course is learning software tools competency through assigned exercises and creative projects. The objective is student understanding of the nature, location, and use of all tools commonly available at the professional level for electronic surface modeling in degree three and higher B spline curves and surfaces. Learning simple effect-of-motion techniques (turntable animation, fly-around animation) is included. (First-year graduate ID major or consent of instructor) **Credit 3**

2035-712 **Advanced Product Design Graduate**
The application of design methods and skills to advanced level projects in industrial design. (First-year graduate ID major or consent of instructor) **Credit 3**

2035-716 **Industrial Design Presentation**
Industrial designers are required to give many visual presentations throughout their academic and professional careers. This course will reinforce presentation principles and skills, both verbal and visual. Students will give numerous design presentations using appropriate supporting materials and media. (Acceptance into MFA Industrial Design Program) **Credit 3**

2035-721 **Advanced Computer Modeling II**
The second of three required graduate-level electronic media courses. The emphasis in this second-level modeling course is learning higher software competency—techniques—for modeling complex and difficult shapes through assigned exercises and creative projects. The objective is student understanding of the most efficient use of professionally preferred tools for electronic surface modeling in degree three and higher B-spline curves and surfaces. (2035-711 or permission of instructor) **Credit 3**

2035-731 **Advanced Computer Modeling III**
The third of three required graduate-level electronic media courses. The goal for this third-level modeling course is learning higher software competency directed toward team working. The emphasis is in strategizing the process of modeling complex and difficult shapes to achieve results typically expected by professional project team members, through assigned exercises and creative projects. Included are the methods and techniques for flawless transferring of design intent of these electronic surface models to and from other professional-level surface and solids software. (2035-721 or permission of instructor) **Credit 3**

2035-732 **Exhibit Design Graduate**
Design of trade show and similar exhibits, including gallery exhibits, involving structure, graphics, lighting, and layout of space. Students will develop concepts through plan and elevation drawing as well as perspective renderings for presentation. (Restricted to first-year JADU graduate students or permission of instructor) **Credit 3**

2035-736 **Industrial Design Problems I**
This course investigates various theoretical and philosophical approaches to design and provides a basis for critical analysis of current design problems. Projects will extend these ideas into the practice of industrial design as a mode of discourse. We will design, in two- and three-dimensional form, products and artifacts through a process of iteration and reiteration. Categories of products may include: consumer goods, equipment transportation, furniture, or packaging. (Acceptance into MFA industrial design program) **Credit 6**

2035-737 **Industrial Design Problems II**
This course is the second in a three-part series. The design problems we address will now require a more theoretically rigorous and research-based design approach. Our focus will be on human centered, culturally based design problems with supporting projects including: universal and appropriate product design, and environmentally responsible design practices. (2035-736) **Credit 6**

2035-738 **Industrial Design Problems III**
This course is the third in a three-part series. This course continues product design activities, but broadens the scope to focus on products and their interaction within a context. This broadening will involve project management, product testing and results analysis, with projects including environment design, mass customization, and niche production. (2035-737) **Credit 6**

2035-741 **Professional Practice Graduate**
Business and ethical practices in the industrial design profession are examined through case studies and designer interviews. Students discuss matters of professional practice, debate issues of ethical professional behavior, prepare business correspondence, and analyze the function of industrial design in the business environment. (Restricted to first-year JADU graduate students of consent of instructor) **Credit 3**

2035-840 **Thesis Research**
Guidance in selecting and planning a thesis project, conducting a search for background material, and writing a thesis proposal. (Second-year MFA industrial design major or permission of instructor) **Credit 3**

2035-890 **Thesis: Industrial Design**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. **Credit 1–14**

2035-892 **Continuation of Thesis Industrial Design**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

School of Film and Animation

Film and Animation

2065-701, 702, 703 **History and Aesthetics of Film**
An extended comparative survey of the history and aesthetics of film that will explore the four basic forms of the medium: fiction, documentary, animated, and experimental. Emphasis is on determining the unique characteristics of the medium and how those characteristics are used as a means of interpretation and expression. **Credit 4 per quarter**

2065-711, 712, 713 **Film and Animation Core**
Major emphasis is placed on the individual's learning to generate and intensify his or her personal statement through creative projects. Some of the projects are assigned, while the candidate selects others. Work is critiqued weekly by the instructor. (Restricted to MFA computer animation major) **Credit 4 per quarter**

2065-716 **Digital Audio Tools/Animation**
Students learn technical and aesthetic concerns, which organize the design, recording, and editing of sound in animated motion pictures. Student projects focus on recording and editing sound in digital form, and shaping the sound for expressive and narrative purposes. (JPHC major or permission of instructor) **Credit 2**

2065-717 **Production Processes**
An introduction to all aspects o professional film/video narrative production. Students produce short projects while learning basic shooting and crewing procedures, equipment handling, and maintenance. Students will do research on appropriate topics arranged with instructors. (2065-611) **Credit 6**

2065-721 **Animation and Graphic Film 1**
An introduction to the techniques and practice of graphic and animated film production. This course provides training and practical experience in a wide variety of approaches to single-frame motion picture production. Students produce a number of short film exercises utilizing both existing and original artwork. Some techniques covered in the course are: direct modification of the film surface; cell, ink and paint animation; and kinestasis. Screenings of professionally made films will illustrate each technique. Proficiency in drawing is not required. (Restricted to JPHC major or permission of instructor) **Credit 4**

2065-722 **Animation and Graphic Film 2**
A continued introduction to the techniques and practice of graphic and animated film production. This course provides training and practical experience in a number of approaches to single-frame film making in addition to those covered in 2065-721. Some techniques covered in the course are: three-dimensional animation; optical printing; computer animation; and hand-drawn sound. Screenings of professionally made films will illustrate each technique. Proficiency in drawing is not required. (2065-721) **Credit 4**

2065-723 **Animation and Graphic Film 3**
This course provides practice in all phases of single-frame film production. Students produce a 16mm, 90-second graphic film with sound, utilizing one or more techniques learned in the preceding two quarters. (JPHC major or permission of instructor) **Credit 4**

2065-724 **Live Action Pre-Production**
Students will learn the basic pre-production techniques for narrative fiction, experimental and documentary filmmaking. Students will also prepare a pre-production binder in a genre of their choice to be used in an actual production workshop. Graduate students will be required to do advanced pre-production for their projects. This includes having locations secured and actors auditions completed. **Credit 3**

2065-726 **Graduate Live-Action Seminar**
This course allows students to conceive and develop their ideas for their winter core film. Students are required to complete all necessary pre-production so they are ready to move into production at the beginning of winter quarter. (2065-711) **Credit 2**

2065-727 **Scriptwriting for Animation**
This course explores the principles of dramatic structure and storytelling in both fiction and nonfiction animated film and video. Students prepare short scripts suitable for production. (Restricted to JPHC majors or by permission of instructor) **Credit 4**

2065-731 **Film and Video Tools and Technology**
An intensive tools and technology course that will allow the student to work in the digital video format. Examines the technical concerns of single and double system portable video production and editing. Production skills in camera work, editing, and sound recording will be covered. (Must have completed required bridge work) **Credit 4**

2065-732 **Basic Sound Recording**
Learn the techniques of production sound recording, how to use professional recording gear and proper recording and mixing techniques to realize a fully mixed soundtrack to professional quality standards. This course includes fundamental information about sound and sound recording equipment and establishes the foundation for future sound work in advanced production classes. **Credit 3**

2065-733 **Graduate Screen Writing**
This course explores the writing of fiction for theatrical and non- theatrical films and television. Training concentrates on the elements of dramatic construction. A brief exploration of non-fictional writing, examining preparation, information gathering techniques, and methods of investigation will also be assessed. Both nonfiction and fiction are treated as expository, storytelling forms. Students are responsible for writing a film or television script on a subject of their own choosing and for completing several brief written exercises in areas such as character, dialogue, suspense, subtext, and plot. Class discussion is based on assigned readings, in-class exercises, and in-class reading of student work. (2065-342 or equivalent) **Credit 3**

2065-734 **Graduate Screen Writing II**
A workshop in writing a short film script. This course focuses on story proposal, script treatment, writing, and rewriting a short script. (2065-733 or permission of instructor) **Credit 4**

2065-736 **Theory Via Short Narrative Film**
A screenings, classic theory readings, and discussion course designed to introduce MFA production and animation graduate students to themes in classic film theory. A variety of short films and videos will be employed paired with extensive readings from classic theory from the span of the past century of world cinema. (Limited to second-year film and animation graduate majors) **Credit 4**

2065-737 **2-D Computer Animation I**
Students in this course create animated sequences and projects using a commercial animation software package for a popular microcomputer. In addition to mastering specific software, students learn the principles of digital computer operation and how those principles apply to the problems of animation with computers. (2065-721) **Credit 4**

2065-738 **2-D Computer Animation II**
This course focuses on the integration of computer animation into film and video. Students produce a finished animated project on film or videotape with sound, which can be used as a portfolio piece. Emphasis is placed upon various postproduction strategies which involve such techniques as combining computer animation with live action, the addition of film and video special effects and combining computer animation with existing film or video imagery. (2065-721) **Credit 4**

2065-741 Graduate Drawing for Animation: Dynamics
This advanced course focuses on drawing of drawn animation. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Students explore the use of acceleration and deceleration squash, and stretch, maintaining volume, anticipation, secondary action, overlapping action, paths of motion, follow through, and exaggeration. A variety of examples of drawn animation will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-742 Graduate Drawing for Animation: Sequence
This advanced course focuses on structuring the shots in a scene. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Flexibility is provided for students at different stages of development. Students learn how to break a scene into shots and storyboard the sequence. They learn to compose the frame for action and juxtapose one shot against the next. Students learn to use exposure sheets to plan out animation, and animate short sequences using acquired skills. A variety of examples drawn animation will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-743 Graduate Drawing for Animation: Character
This advanced course focuses on character development for animation. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Students produce character sheets. They explore different perspectives of the character drawing from imagination and use the characters in sequential frames of motion. A variety of drawn animation examples will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-744 Business of Animation
This class is intended to give students an understanding of studio production and freelance animation. Students will learn the basics of running a business. Production issues particularly related to animation will be studied. Methods of examining costs and projecting work time lines will be practiced. Students will draw up contracts and negotiate terms. Copyright law as it applies to distribution and contracts will be studied. A business plan will be developed by each student. **Credit 2**

2065-745 Acting for Film and Video
A course in basic acting technique with emphasis on the special problems peculiar to film and video production. The class is taught in conjunction with Directing the Actor (2065-746). Class meetings are organized around the presentation of scenes prepared by student actors and directors. **Credit 4**

2065-746 Directing The Actor
A course in basic directorial techniques with emphasis on the special problems peculiar to film and video production. This class is offered concurrently with 2065-745. Class meetings are organized around the presentation of scenes prepared by student directors. (Limited to graduate students in the SOFA live action track) **Credit 4**

2065-747 Introduction to 3D Computer Animation
This course is an introduction to three-dimensional computer animation. Topics will include modeling using NURBSs and polygons, basic texture mapping and lighting, key-frame animation, forward and inverse kinematics, and rendering. Professional animation software such as Alias/Wavefront's Maya package will be used throughout. By the end of the course, students will be able to model basic characters and objects and to create a simple animation and render a sequence of frames. **Credit 4**

2065-748 Intermediate 3D Computer Animation
This course gives students the skills to develop their own digital characters. Topics will include advanced modeling, facial expressions, character rigging, nonlinear animation, and the use of "Paint Effects" to create hair and vegetation in software such as Alias/Wavefront's Maya. By the end of the course, students will be able to create and rig their own characters, with facial expressions and hair. They create a short animation introducing their character and demonstrating a range of emotions. (2065-747) **Credit 4**

2065-754 Writing The Feature I
A production workshop in developing and writing the outline and first act for a feature length film script or episode TV series; also can be taken by students who want to rewrite an existing feature-length screenplay. This course focuses on proposing a script and writing the outline for a feature film of TV series. Students work at their own level within the class, and discussions provide feedback and incentive. The project can be continued in Writing the Feature I (2065-755). (2065-734) **Credit 4**

2065-755 Writing The Feature II
A continuation of Writing the Feature I (2065-745). Students will complete the script they began to develop in the first class. This course can also be taken by students who want to rewrite an existing feature length screenplay. (2065-754) **Credit 4**

2065-756, 757, 758 Film and Animation Workshop
Each faculty member offers a different opportunity for students to explore the multiplicity of ways that photography or filmmaking can be used as a vehicle for expression and communication. Visual research, group critiques, field trips, studio and laboratory practice are used. (Requires departmental approval) **Credit 4**

2065-761 Image Movement Music
A seminar-level course co-sponsored by the College of Imaging Arts and Sciences at RIT, the Eastman School of Music (University of Rochester), and the Graduate Department of Dance at SUNY College at Brockport. Lecture/demonstration held during the first six-weeks of the course are designed to provide all students with a basic, practical knowledge of current and experimental performance and production techniques in film, video and animation, and contemporary art, music, dance/choreography and related arts. During the latter four-weeks of this course, students will work jointly and individually, under faculty advisement, on creative or research projects involving combinations of image, movement, and sound/music. Weekly three-hour classes will be held alternately at the three schools. Transportation will be provided. (Graduate status) **Credit 3**

2065-762 Stop Motion Animation
Explore techniques for producing stop motion animation. Gain familiarity with the use of a variety of materials, which may include clay, puppet, foam, latex, and more. Develop techniques for making armatures and skeletons and creating joints. Learn how to measure movement from frame to frame. Research and write about a stop motion technique or animator. (2065-721) **Credit 4**

2065-763 Women's Stories, Women's Films
This course provides an introduction to women's films. Through screening films and class discussion, the course examines the themes and issues of women's narratives and how they function in the medium of film. The hero's journey and traditional narrative structure are contrasted with the heroine's journey and the more personal storytelling style of the feminine. The course also examines differences in films made by women and films made by men about women. During the course, students will have an opportunity to explore their own creativity. **Credit 4**

2065-764 Business of Film and Video
This course examines the business aspects of designing, developing, and producing film or video projects. Emphasis is on development of production projects with interactive problem solving experiences in which the instructor and students work as a production team. Special attention will be given to the role of the producer, estimation and management of production costs, problems of location productions, and the legal issues involved in filmmaking. **Credit 3**

2065-766 Advanced Modeling for Animation
A detailed approach to the construction of complex three-dimensional forms, object deconstruction, problem solving, modeling methodologies, and the advantages and disadvantages of various construction methods. Lighting and texturing techniques will be incorporated into three dimensional objects as they relate to an extension of the modeling process. Each modeling solution is tested in the lab and discussed in lecture with the required notion that animation is the end goal for each model. Students will perform three-dimensional modeling exercises and create three-dimensional projects including a complex object and a humanoid character. (2065-747 or instructor permission) **Credit 4**

2065-767 Directing for Animation
A seminar in solving directorial problems for animators. Topics will include character and movement development, working with actors and models, identifying and understanding scene construction, directorial responsibility, and the relationship between images in sequence. Both the application of acting techniques for creative development and the aesthetic demands of "visual music" will be emphasized. **Credit 3**

2065-768 Lighting for Film and Video Production
This course will present the fundamental principles of lighting for film and video production. The current methods and practices of lighting used in the motion picture industry will be explored through demonstrations, lectures, and "hands on" lab assignments. (2065-731) **Credit 3**

2065-769 Digital Video Post-Production
Explore techniques for editing video in a non-linear technique. Students will be exposed to non-linear editing, titling, special effects, audio, and video. Students will produce a series of projects exploring different capabilities on a non-linear editing system. In addition students will be exposed to the various aesthetic theories of editing. (2065-731) **Credit 4**

2065-771, 772, 773 **Graduate Seminar I, II, III**
The seminar provides an opportunity for all MFA students to develop a sense of community and to openly discuss matters of concern, to discuss each other's animations or films, to meet with visiting artists on campus and to participate in a thesis sharing from time to time. (Restricted to MFA Computer Animation majors) **Credit 2 per quarter**

2065-774 **Post-Production Process**
This course is designed to teach students the professional workflow of handling digital film and video files through the complex post-production process. Areas of study include learning a cinema file database, media management, color correction, HD compositing, visual and time base effects, sound professing and track building, and titling and graphics. (2065-717) **Credit 4**

2065-776 **Dramatic Structure in Film and Television**
This course explores the theories of dramatic structure from Aristotle to the present and applies these theories to current and classic dramatic works. The course also explores writing for film and television, including feature film genres, one-hour drama, mini-series, soap opera, and sitcom. A segment on the business of writing covers reader's reports, adaptation of material from other media, and acquisition of rights. **Credit 3**

2065-777 **Film and Video Internship: Graduate**
Provides the student with on-the-job experience in the field of film/video/animation. The student seeks and acquires a school approved internship position in a business or industry. The working environment provides the forum for learning more about the student's chosen career. A final interview with the internship coordinator assists the student in evaluating the experience. The coordinator should be the faculty member most familiar with the student's internship field. (Permission of internship coordinator) **Credit 1–6**

2065-778 **Complete 3D Character Creation**
This course covers a broad range of three-dimensional animation related topics in a detail-oriented manner. The various topics will be anchored in the design and development of an original 3D character. Topics covered will include but not be limited to modeling, rigging, texturing, and lighting. Students will design and build a 3D character of their own design. Using a variety of 3D techniques, students will create a fully articulate character rig, and produce a short animation demonstrating its functionality, as well as their proficiency in techniques such as lighting, texturing, and rendering. **Credit 4**

2065-781, 782, 783 **Alternative Processes**
An advanced course in the production and presentation of still or moving images using historical and contemporary visual imaging processes. Emphasis is on extending the students' experience in image making by incorporating alternatives to conventional animation or filmmaking into their work. Processes to be covered include lighting, inverse kinematics, digital cinematography, particles, procedural animation, compositing, montage, and combinations of techniques. **Credit 4 per quarter**

2065-784 **DVD Authoring**
This course is designed to introduce the design and practices of the DVD development with emphasis on rethinking a completed film project. The student develops a specific DVD based on a film they have completed. Class discussion and presentation is oriented towards new directions for the film story with interactivity and sequencing considerations. The student will acquire development tools to include: menu development, subtitles, audio streams, encoding principals, hybrid DVD creation, web linking (DVD@ccess), and basic scripting. **Credit 4**

2065-786, 787, 788 **Contemporary Issues**
A study of current issues relevant to fine art photography and filmmaking, how they relate to broader historical/cultural issues and how they might suggest future directions. **Credit 2 per quarter**

2065-791 **Particle Effects**
This course gives students the skills to insert three-dimensional computer special effects into animation and live action footage. The students explore three-dimensional computer particle animation and dynamic simulation using Maya software. Students will create short animations using particle effects, soft bodies, and rigid bodies to simulate nature effects like fire, rain, water and physics-based dynamic, and collision events. MEL scripting is an integral part of this course. (2065-747) **Credit 4**

2065-792 **Gesture Drawing for Animators**
This course will consist of intensive anatomy and quick sketch workshops using live models and references from videos, Internet, and print sources. Live models, both human and animal, will be scheduled for a portion of each class. Students will study kinesiology, the effect of movement on muscle and bone, and comparative anatomy. As a final project students will create original imaginary characters based on their class assignments. Most of the course work will be in class drawing sessions. Graduate students will create additional materials such as maquettes and animation cycles or Maya models. (Basic drawing class) **Credit 3**

2065-793 **Node-Based Digital Compositing**
Node-based compositing is the industry standard for film and HD video image compositing. This course, currently offered only in the spring quarter, covers the basics of node based compositing trees, color correction, garbage and hold-out mattes, keying, resolution proxies, motion tracking, macros, and expressions. (2065-731) **Credit 4**

2065-796 **Programming for Artists**
Students will learn scripting languages in three-dimensional applications. General logic concepts and code structures will be discussed fully. How to use these structures within the framework of the three-dimensional application will then be the focus. A final graduate project consisting of creating a useful automating script will be assigned. (2065-747) **Credit 4**

2065-797 **Methods in Motion**
This course will give graduate students an opportunity to explore a visual language of acting, timing, posing, and animation principles that will help strengthen their animation abilities. Every animator needs to build a library and understanding of animated movements and timing that they can draw on for all of their future animated films. The graduate section will have the added elements of sound and its relationship to the visual movement to study and understand. **Credit 3**

2065-798 **Film Sound Theory: Effects**
This course is one of three in the study of film sound theory. Through readings, focused group discussion, and the viewing of/listening to select films, the course promotes critical analysis of the varied and profound uses of effects in sound design. Addressed is the history of effects from the early sound era to the modern design. The concepts studied include the modal changes in point-of-audition, and positioning across digeses. Other topics like complementarity and the acousmetre are also addressed. **Credit 4**

2065-812 **Advanced Sound Recording**
This course discusses and demonstrates how to accomplish complex audio post-production procedures like ADR, Foley recording, and mixing for film and video. This course is heavily based on the evaluation of the students' performance on three deadlines for a group project that the entire class participates in. (2065-732) **Credit 3**

2065-813 **Career Planning and Portfolio**
This course offers practical advice and assistance in job-seeking and life after RIT. In addition, the course aids students in preparing projects for festival entry and distribution. Materials produced by the student include a resume, portfolio, and work reel. Students will do research and writing related to their specific career plan. (2065 711) **Credit 2**

2065-818 **Advanced Storyboard and Layout**
This course involves creation of in-depth storyboard, production design, and art direction for various media. Students will work on predesigned characters as well as their own projects. Differing styles of layout, boarding, and workbook will be explained. (2065- 743) **Credit 3**

2065-821 **Underwater Cinematography**
This course is designed to prepare students to professionally complete cinematography assignments in the underwater environment. To accomplish this students' will complete basic scuba diving training and achieving scuba diving certification. The student will become familiar with underwater video camera housings and accessories and basic underwater shooting techniques. Graduate students will research video housing types and applications. There is a facility fee to cover equipment, off campus facility use, texts and insurance. (2065-717 and facility fee) **Credit 4**

2065-822 **Advanced Stop Motion Animation**
Explore advanced techniques for producing stop motion animation. Gain familiarity with the use of a variety of materials, which may include clay, rubbers, aluminum, and more. Develop techniques for making armatures using wire and steel joints. Learn character performance in gesture and expression. Practice methods of miniature lighting and photography, uses digital effects. (2065-372) **Credit 3**

2065-824 **Directing a 30-Second Commercial**
Graduate students learn how to direct and produce television commercials beginning with developing the creative idea, experiencing all facets of pre-production including talent casting, selecting crew, and location scouting followed by commercial film or video production through editorial. Students will meet with advertising agency personnel and established industry professionals in order to learn more about the process. Graduate students will be required to do additional post-production. (2065-717) **Credit 4**

2065-841, 842, 843 **Research Seminar**
This seminar serves as a planning stage for preparing a research thesis proposal and for an ongoing critique and discussion of the research in progress. Issues related to exhibitions, publications, distribution, and gallery also are covered. (JPHC) **Credit 2**

2065-845 **Acting for Film and Video II**
An intermediate level acting class working in depth with techniques and approaches introduced in the basic acting class with the additional focus of using external observation to determine appropriate behavior. Class meetings are organized around the presentation of scenes prepared by student actors and directors. The class is taught in conjunction with Directing the Actor II. (2065-745) **Credit 3**

2065-846 **Directing The Actor II**
The class offers in-depth study of techniques introduced in the basic directing class, with an additional focus on using external observation to determine appropriate behavior. This course emphasizes the special problems peculiar to film and video production. Class meetings are organized around the presentation of scenes prepared by student directors using the acting students in the class. Meets in conjunction with Acting for Film and Video II (2065-746) **Credit 3**

2065-857 **The New Documentary**
The goal of this course is to introduce the student to trends in documentary film during the last decade. During class discussions, we will examine each film critically; analyzing the film theme, structure, style, intent, and effectiveness. Some of the issues that will be discussed are the rise of personal voice in documentary, the impact of political documentary, the trend towards combing fiction and nonfiction techniques, and the ethical relationships between subject and filmmaker. The graduate student who takes this course is expected to go on to make their own documentary film that expresses some of the contemporary issues that we examine in this class. This will be evident by the in-depth discussion between the teacher and the graduate student, about how the issues inform and influence their own films. **Credit 3**

2065-882 **Mixing and Sound Design**
This course continues the work done in Advanced Sound Recording by mixing multi-track sessions with video to post-produce several different projects to professional standards. Students learn how to listen and develop a trained ear while understanding proper equalization and use of effects and digital signal routing. Sessions can include documentaries, dialog and musical productions. Students also create templates and develop editing/mixing techniques to balance creativity and time constraints of a typical project. **Credit 3**

2065-884 **3D Lighting**
Students will learn to use lighting in digital three-dimensional software. The process for developing projects in class will be critique based. Projects may include modeling and lighting simple objects or spaces, matching a three-dimensional object or space to a scanned photographic or video image in lighting, quality, and perspective. Elements of the rendered software that relate to lighting will be discussed fully. A final graduate project mastering one or more advanced lighting concepts will be completed for completion of the course. (2065-747) **Credit 4**

2065-890 **Research and Thesis: Film and Animation**
This thesis is designed and proposed by the candidate. It is considered his or her culminating experience in the program, involving research, a creative body of work, an exhibition or suitable presentation, and a written illustrated report. (Approval required) **Credit 1–12**

2065-892 **Continuation of Thesis Film and Animation**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

School of Photographic Arts and Sciences

Graduate Photography

2066-701, 702, 703 **History and Aesthetics of Photo**
This required seminar surveys and examines the development of the medium beginning with prehistory. Students will explore the first applications of photographic documentation, portraiture, art, and science and will study photography in the context of visual culture. (MFA graduate students only) **Credit 3 per quarter**

2066-711 **Photography Core**
Students engage in a rigorous group critique process to develop a mature body of work, which combines experimental and analytical learning methods. They develop aesthetic and technical strategies for the production and presentation of artwork. They also address theoretical research, contemporary art concepts and methodologies, informing practice. This course is required each quarter in the first-year of the MFA photography graduate program. **Credit 4 per quarter**

2066-712 **Imaging Core II**
This course is the second in the sequence of principle critique classes for students in the MFA Imaging Arts program. Having established a working methodology in Imaging Core I, students will continue to experiment and consolidate a significant body of work through a critical engagement with peers. The focus of the course will lead to half-candidacy conducted through a formal MFA faculty review of the work. **Lec 4 Credit 4 (S)**

2066-732 **Professional Development**
To prepare students for their professional life beyond graduate school. Students will gain practical knowledge in portfolio preparation, visual display, grant writing, and contract negotiations for their art making practice. In preparation for employment students will learn about and prepare teaching philosophies, resumes, and a professional portfolio. (2066-711) **Credit 4**

2066-745 **Moving Media 1**
Graduate students taking this tools course will work with still photographs, electronic images, video footage, and camera recorded sound to create new work that merges the disciplines of photography and video. Students will use media software to produce work that weaves photography and video. Students will explore experimental narratives, conceptual constructions, and performance. They will work with traditional photography processes, electronic media, and projection equipment to create and display their projects. Students will research the Media Café collection, exploring the history and evolution of the art of the moving image. Each student will produce a final project for public presentation during the final week of class. **Credit 5**

2066-754 **Museum Studies**
Students study advanced topics related to museum and gallery practice through internships, research and projects, which are formally proposed by the student. Emphasis is placed on the function and administration of museums, galleries and the conceptual nature of curating and planning exhibits. (Graduate status) **Credit 1–9**

2066-755 **Moving Media 2**
Moving Media 2 builds on the foundational skills and artistic language provided in Moving Media 1. Students work with electronically produced imagery to develop advanced technical skills. Students bring their intellectual studies to practice with a mastery of complex video editing techniques. They will learn sound recording, sound theory, sound manipulation, and sound editing techniques. Students work on assignments as well as self-generated projects. Students study contemporary sound artists and analyze the various strategies artists use to convey their ideas. Each student will produce a final project for public presentation during the final week of class. The work of each student will be stores in the Media Café collection at Wallace Library. (2066-745) **Credit 5**

2066-756, 757, 758 **Photographic Workshop**
Each faculty member offers a different opportunity for students to explore the multiplicity of ways that photography and related media can be used as a vehicle for expression and communication. Visual research, group critiques, field trips, studio, and laboratory practice and critical readings are used. Workshops may be taught as a theme class or on an individual basis to provide students with critical feedback on projects. Recent theme classes include: digital media cafe, web seminar, electronic arts seminar, and imaging the self. (Instructor approval required) **Credit 4 per quarter**

2066-761 **Graduate Digital Imagery I**
This graduate course addresses the vital issue of digital imaging in regards to workflow from a fine art perspective. In combination with this practical approach, this course also places fine art digital image-making within the historical context of art, photography, and culture, in particular its relationship to be photomechanical and new media. Students will learn both the thought and practice of digital imaging from conceptualization to capture, with consideration to its specific aesthetic language. This course does not require a pre requisite or corequisite for registration. Interested students are expected to demonstrate basic computer literacy and competency. **Credit 3**

2066-762 **Dadaism, Surrealism, and Photography**
This seminar examines the work of a group of artists, known as the Dadaists, who rejected the social order and values that produced World War I. The student will, in turn, explore surrealism, the art movement that moved beyond the "destructive program of Dada" and replaced it with a more creative approach to human values and life. **Credit 3**

2066-763 **Beyond the Family Album**
Beyond the family album is a fine art photography course that balances the production of original art work with primary and secondary research, within an intensive critique and seminar format. The narrative of the conventional family album will be a core subject for discussion and study. The concept of 'album' will go beyond the conventional book form to embrace photographic imagery, installation, text, digital forms, and the use of family mementos. Interdisciplinary critical readings and visual art projects concerning issues of identity, and representation of family life in the public and private sphere will form the underpinnings of primary research, against which visual and written projects will be produced. Graduate students will create an original body of artwork on the topic and contribute written and visual material to a class research archive. (MFA or permission of instructor) **Credit 4**

2066-764 **Minor White Seminar**
A study of the photography and philosophy of Minor White and his contribution to photographic publications, photographic education and photography as an art form. **Credit 3 (not offered every year)**

2066-765 **Photography Extensions**
Strip photography, slit/scan photography and stroboscopy are used to probe and artistically manipulate spatial and temporal dimensions in order to create unseen poetic expressions of a space/time continuum. Perceptual principles and technical problems associated with the production and exhibition of such images are studied. (Additional hours will be arranged with instructor) **Credit 4**

2066-768 **Conservation Procedures**
The principles of photographic conservation and archival practice in a museum context will be presented through lecture, practical demonstration and field visits to local museums. Included are the methods for examining photographs, stabilizing them and restoring them. Special emphasis will be given to proper techniques for display and storage of photographs, together with instruction on how to gain access to information and materials pertinent to those activities. **Credit 4**

2066-770 **Photography in the Desert Southwest**
An extended workshop for students to photograph and travel in the Four Corners region of the American southwest with an instructor leading a camping tour through New Mexico, Utah, Colorado, and Arizona. Federal and state campgrounds are exclusively used. Students participate in day trips and hikes or make their own daily itinerary. Maps and reading assignments introduce students to the geology, climate, history, and cultures of the Southwest. **Credit 3–9**

2066-771 **Graduate Seminar**
Graduate Seminar is designed to engage students in dialogue with guest speakers and faculty on their professional work. Each class involves a professional presentation by a different speaker to be followed by discussion. Activities that foster the emerging career of the artist are stressed. **Credit 2**

2066-781, 782, 783 **Alternative Processes**
An advanced course in the production and presentation of still or moving images using historical and contemporary visual-imaging processes. Emphasis is on extending the students' experience in image making by incorporating alternatives to conventional photography into their work. Processes to be covered include various light sensitive emulsions and the production of the visual book. **Credit 4 per quarter**

2066-786, 787, 788 **Contemporary Issues**
A study of current issues relevant to fine art photography and related media, how they relate to broader historical/cultural issues and how they might suggest future directions. Emphasis is placed on the integration of critical theoretical discourses and studio practice. **Credit 2 per quarter**

2066-791 **Photography Preservation I**
Introduction to the basic philosophy, ethics, concerns and methods of conservation. This course will cover the various materials, sources of supply, workshop design, examination methods, documentation style, monitoring systems, utilized in the protection of photographs. **Credit 4**

2066-792 **Photography Preservation II**
Introduction to the tools, materials and methods of providing intimate protection for photographs through proper mounting, housing and stabilization intervention. Special focus is given to the development of practical skills in protective housing construction utilized in display and storage. **Credit 4**

2066-842 **Research Seminar**
The seminar serves as a planning stage for preparing a research thesis proposal and for ongoing critique and discussion of the research in progress. Additionally this course will review the thesis process, provide guidelines and resources for thesis preparation and presentation of the written thesis research paper. Over the course of the quarter the research proposal will be completed and submitted to thesis advisers for critique and approval. **Credit 2 per quarter**

2066-890 **Research and Thesis**
The thesis is designed and proposed by the candidate to a committee of graduate faculty. It is considered his/her culminating experience in the program, involving the development of independent research leading to new work. There are three components to the thesis: the thesis exhibition, the thesis paper, and the public defense. The defense is a public presentation of both the paper and the exhibit. (Department approval is required to register) **Credit 1–12**

2066-892 **Continuation of Thesis**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

School of Print Media

Printing Management

2080-707 **Estimating and Analyzing in Graphic Arts**
Course content covers the application of information from other management and technical courses to comprehensive situations in estimating. Its aim is to provide the student with an understanding of the relationships between estimation, pricing, and the supply and demand forces which occur in the marketplace and to expose students to several printing specialties so they may appreciate the various cost advantages and disadvantages involved in the use of particular technologies. Class sessions include lectures, discussions, labs, and project presentations by students. In addition to normal reading assignments, the student will be required to prepare and deliver an oral report or a written term paper on a topic related to an estimating, pricing, time-study, or some other cost-related problem of special interest to the student. **Credit 4**

2080-712 **Operations Management in Graphic Arts**
Designed to give the student a broad perspective of the many topics related to managing a printing facility. Topics include an examination of the systems approach to production management, the use of statistics and other quantitative techniques in methods and decision analysis, the cost-volume-price relationship in printing production, and the effect of organizational structure on decision making, line-staff relationships, and management personnel. **Credit 4**

2080-840 **Project Design**
This course exposes graduate students to the applications of the principles of research in the graphic media industry. This includes a systematic study of the scientific method, research statement generation, and types of research design. The students will study problems in the graphic media industry in preparation to complete a graduate level research project. Additional outside work will concentrate on problem solving, the use of the Internet and the library in developing bibliographies and the form of the technical writing required for the Research Project. (Required for all MS Print Media majors) **Credit 2**

2080-841 **Project Design II**
Weekly lectures provide the fundamental theory of the research project design, especially, the data collection, measurement and reporting components. Students will apply the theory to the selection of their project topic and methodology. Students will complete the data collection, data analysis and final project by the end of the quarter. (2080-840) **Lec 2, Credit 2**

2080-999 **Printing Grad Co-op**
Printing Grad Co-op will provide students with the opportunity to work in the graphic communication field (permission required). **Credit 0**

Printing Technology

2081-701 **Research Methods and Trends in Graphic Media**
The theory and applications of the principles of scientific research in the graphic arts will be covered, including a systematic study of the scientific method, hypothesis generation, the nature of theory, types of research design, and measurement. The study of problems in the graphic arts includes ink and paper, reproduction methods, and quality control. **Credit 4**

2081-709 **Printing Industry: Trends and Issues**
This course presents a detailed analysis of the trends and issues related to the printing industry. It provides an in-depth look at key technologies as well as business and related issues which contributes to the student's fuller understanding of the technology and the issues affecting print communication. This course prepares students for successful careers by providing insights into the nature and scope of the major challenges facing industry managers and leaders. Research and survey projects help to focus the student's understanding of the industry. (Required for MS Print Media majors) **Credit 4**

2081-711 **Tone and Color Analysis**
This course addresses principles and practices of color measurement for color matching and color image rendering in graphic arts imaging. Emphases are placed on the analyses and rendering of spot colors and pictorial images with the use of ICC-based color management systems. Topics include densitometry, CIE colorimetry, color management systems, graphic arts technology standards, and process control. There are lab assignments on color measurement and tone, and color analyses. A self-directed project is required. The instruction is a combination of lectures (live and video-taped), demonstrations, discussions of lab assignments, and when appropriate, guest speakers. **Credit 4**

2081-716 **Materials and Processes in Printing**
This course offers a survey of the materials and processes used in print reproduction. Students will learn the basic theory of image reproduction embodied in the available analog and digital printing processes, and learn to identify the process origins of print samples. Additionally, students will learn the chemical and physical properties associated with the consumables in order to obtain an understanding necessary to make informed decisions about use and application. **Credit 4**

2081-721 **Digital Print and Publishing**
This course provides students with an opportunity to learn the principles and applications of digital printing. Technical aspects of the major digital print engines and comparison of digital printing to conventional printing processes will be presented. The strategic use of digital printing will be emphasized from a digital workflow standpoint. Variable data personalization and on-demand printing will be studied from both technical and marketing perspectives. **Credit 4**

2081-723 **Contemporary Publishing**
An examination of how various contemporary publishing entities are responding to changes in technology with an emphasis on editorial, production, circulation/distribution, and marketing issues and concerns. The course will begin with a review of historic book models and practices with respect to their continued influence on today's formats and designs. The advantages and disadvantages of the various kinds of publishing mechanisms are discussed, together with an exploration of the divisions now occurring between print- and web based deliveries of content. The degree to which the intellectual content of books is changing in response to technology will also be covered. **Credit 4**

2081-728 **Database Publishing Applications**
This course presents the various processes, methods, and techniques related to the effective application of databases to the publishing process. Topics include the use of database output as the content for print, electronic media and online viewing, as well as the use of databases (such as digital asset management systems, font management systems, etc.) as enablers within the digital publishing process. Course projects range from elementary database construction to sophisticated variable data publishing. The course includes a survey of the spectrum of database applications that enable variable information printing and on-demand publishing. A final project incorporating one or more database publishing methods is required. (Basic Macintosh computer skills and competency in using page-layout applications such as InDesign or QuarkXPress) **Credit 4**

2081-747 **Cross Media Workflow I**
This course is designed to expose students to all the elements needed to master a cross media workflow project. It will introduce students to concepts and laws around copyright and intellectual property and will explore ways companies create and utilize digital asset management systems. Emerging industry and ISO standards for each of the fields will be presented. Hands-on exercises, conducted outside of class, will complement lectures to broaden the understanding of the various topics. **Credit 4**

2081-763 **Advanced Color Management**
This course will further the scientific methodology in process control for repeatable color and extend the scope of ICC-based color management practices by integrating a number of image capture devices in color-managed digital workflows. Students are expected to work in a team environment, to engage in planning, and conducting press run analyses, and to publish a technical publication using the state-of-the-art printing facilities at RIT. (2081-711) **Credit 4**

2081-766 **News Production Management**
This course brings together all the elements of new media publishing technologies such as various computer platforms, digital photography, scanners, storage devices, and distribution mechanisms. This course focuses on the management of these elements rather than the technology. The lecture portion focuses on the specific supplication of managerial principles to new media production while the lab portion is based on group production exercises. **Credit 4**

2081-767 **Media Industries Analysis**
This course provides students with an understanding of the major industries closely allied with the printing industry; advertising, publishing, and packaging. The intent is to give students in-depth knowledge of (1) the structure of each of these industries; (2) the channels and methods through which and by which each distributes its products and services; and (3) the major customer/clients of its products and services. Particular attention will be devoted to investigating the business models for the use of print to create value in advertising, publishing, and packaging. (2081-706) **Credit 4**

2081-783 **Media Distribution and Transmission**
In this course students will gain extensive knowledge of the various methods and techniques used to electronically and physically distribute information. Students will study planning, scheduling, inventory management and customer fulfillment. **Credit 4**

2081-786 **Gravure Process**
This course analyzes the infrastructure as well as the print production workflows in the gravure printing industry. Students will comprehend the use of gravure as a business solution for publication, packaging, and special product applications. In addition to classroom lectures and laboratory assignments, students will meet and interact with gravure industry professionals during RIT Gravure Day and take an extensive industry field trip to visit cylinders engravers and gravure printers. (2081-716) **Credit 4**

2081-787 **Substrates for Printing**
This course covers the science and technology of the many kinds of printing substrates used by various printing processes. Students will learn the basic concepts of the substrate composition, structure, manufacture, optical and appearance properties, and testing of printing substrates, with an emphasis on factors which relate to print quality and press runnability. Students will learn to identify the full range of printing substrates and their applications. (2081-716 and 2081-717) **Credit 4**

2081-840 **Research Project**
Individual research projects in which independent data are collected by the student, followed by analysis, and evaluation. A comprehensive written report is required. Consent of adviser is required. **Credit 4**

2081-890 **Thesis**
An experimental survey of a problem area in the communication industry. (Approval is required to register) **Credit 8**

2081-890-99 **Continuation of Thesis/Research**
This course involves the completion of an established thesis or research project requirements coordinated between the student and the thesis research adviser. **Credit 0**

Semester Courses
Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Graduate Study

ARTH-601 **Forms of Inquiry**
Forms of Inquiry aims to expose students to a broad range of critical issues related to conception and production, to inspire and provoke critical reflection, and to facilitate the development of a preliminary thesis topic. Presentations, discussions, and written assignments will examine concerns from aesthetics, psychology, anthropology, philosophy, and critical theory as they relate to contemporary art, crafts, design and image making. **Class 3, Credit 3 (F, S)**

ARTH-605 **Thinking About Making: The Practice of Art in a Global Society**
A discussion based art history elective for graduate students. The course seeks to bridge the gap between studio practice and contemporary art history. The course will explore very current work and ask questions about what is art, who is the audience, what is our art making practice and how does that fit within the larger context of the current state of the global art world. How do we measure success and artistic failure? The course emphasizes observation, critical analysis and written interpretation. **Class 3, Credit 3 (F, S)**

School of American Crafts

Ceramics

CCER-701 **Ceramics Graduate Studio I**
Ceramics Graduate Studio I is the first of a four-semester sequential class covering the advanced aesthetics and techniques of ceramics and culminating in the Master of Fine Arts Thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramics techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. **Studio 18, Credit 6 (F)**

CCER-702 **Ceramics Graduate Studio II**
Ceramic Graduate Studio II is the second of a four-semester sequential class covering the advanced aesthetics and techniques of ceramics and culminating in the Master of Fine Arts thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the Master of Fine Arts thesis, proposed by the student and approved by the faculty. Lab fee is required. (CCER-701 Ceramics Graduate Studio I) **Studio 18, Credit 6 (S)**

CCER-790 **Ceramics Thesis Initiation**
Ceramics Thesis Initiation is the third of a four-semester sequential class covering the advanced aesthetics and techniques of ceramics and culminating in the Master of Fine Art thesis. Students will develop a topic of investigation for the Master of Fine Arts thesis, select a graduate thesis committee, and begin the planning, research, and development of a body of creative work. This program is structured on the basis of the individual student's needs, interests and background preparation determined through research and faculty consultation. There will be a strengthening of ceramics techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. This course is the prequel to the Master of Fine Arts thesis, proposed by the student and approved by the faculty. Lab fee is required. (CCER-702 Ceramics Graduate Studio II) **Studio 18, Credit 6 (F)**

CCER-890 **Ceramics Thesis Resolution**
Ceramics Thesis Resolution is final course covering the advanced aesthetics and techniques of ceramics. Working from an approved topic of investigation for the Master's Thesis, students work independently and create a body of work supported by a written Thesis paper. In consultation with a selected graduate Thesis Committee, students plan, research, and develop a body of creative work for exhibition and review. This program is structured on the basis of the individual student's needs, interests and background preparation determined through research and faculty consultation. There will be a strengthening of ceramic techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. Lab fee is required. (CCER-790 Ceramics Thesis Initiation) **Studio 18, Credit 9 (S)**

General Craft Studies

CGEN-702 **Crafts Graduate Seminar**
This course will examine the investigative process required for a craft artist to develop a comprehensive and well-integrated body of work. Students will review the work of known artists and will research the themes and issues in their own work. They will work with the faculty and their thesis committee to develop strong viable themes for their thesis. This course is offered only in the Spring Semester. (Selected prerequisite based on program major: CCER-701 Ceramics Graduate Studio I, CGLS-701 Glass Graduate Studio I, CMTJ-701 Metals and Jewelry Design Graduate Studio I, CWFD-701 Furniture Design Graduate Studio I) **Class 3, Credit 3 (S)**

CGEN-890 **Thesis Implementation**
This course, coordinated and overseen by the SAC Graduate Director and Thesis Chief Adviser, will monitor the progress of a graduate student in the development of their Thesis. Students will review their work regularly throughout the semester, with both major faculty and the thesis committee. A minimum of three comprehensive thesis reviews with thesis committee members will take place during the semester. Students will create a written response, submitted to their Thesis Chief Adviser, for each review. In addition, a final and formal thesis critique by the student's thesis committee will take place at the end of the semester. Students will receive a written evaluation of this critique from the committee. (CGEN-702 Crafts Graduate Seminar and one of the following based on program major: CCER-701 Ceramics Graduate Studio II, CGLS-701 Glass Graduate Studio II, CMTJ-701 Metals and Jewelry Design Graduate Studio I, CWFD-701 Woodworking and Furniture Design Graduate Studio I) **Class 3, Credit 3 (F)**

Glass

CGLS-701 **Glass Graduate Studio I**
Glass Graduate Studio I is the first of a two-semester sequential class covering the advanced aesthetics and techniques of glass and culminating in the master's thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be strengthening of glass techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. **Studio 18, Credit 6 (F)**

CGLS-702 **Glass Graduate Studio II**
Glass Graduate Studio II is the second of a two-semester sequential class covering the advanced aesthetics and techniques of glass working and culminating in the master's thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of glass working techniques, design fundamentals and encouragement of personal expression. Students will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. (CGLS-701 Glass Graduate Studio I) **Studio 18, Credit 6 (S)**

CGLS-790 **Glass Studio Thesis Initiation**
Glass Studio Thesis Initiation is the first of a two-semester sequential class covering creation of the master's thesis exhibition. Students will develop a topic of investigation for the master's thesis, select a graduate thesis committee, and begin the planning, research, and development of a body of creative work. There will be a strengthening of glass working techniques, design fundamentals and encouragement of personal expression. Students will be encouraged to evaluate new techniques, materials and concepts. This course is the prequel to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. (CGLS-702 Glass Graduate Studio II) **Studio 18, Credit 6 (F)**

CGLS-890 **Glass Studio Thesis Resolution**
Glass Studio Thesis Resolution is the final course covering the completion of the Masters Thesis exhibition. Working from an approved topic of investigation for the Master's Thesis, students work independently and create a body of work supported by a written thesis paper. In consultation with a selected graduate thesis committee, students plan, research, and develop a body of creative work for exhibition and review. There will be a strengthening of glass working techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. Lab fee is required. (CGLS-790 Glass Studio Thesis Initiation, permission required) **Studio 18, Credit 9 (S)**

Metals and Jewelry Design

CMTJ-701 **Metals and Jewelry Design Graduate Studio I**
This is the first of a four-quarter sequential class covering the advanced aesthetics and techniques in metals. This program is structured on the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of metals techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. **Studio 18, Credit 6 (F)**

CMTJ-702 **Metals and Jewelry Design Graduate Studio II**
This is the second of a four-quarter sequential class covering the advanced aesthetics and techniques in metals. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of metals techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. (CMTJ-701 Metals and Jewelry Design Graduate Studio I) **Studio 18, Credit 6 (S)**

CMTJ-790 **Metals and Jewelry Design Thesis Initiation**
This is the first of a two-semester thesis course sequence covering the advanced aesthetics and techniques in metals. This is a culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. (CMTJ-702 Metals and Jewelry Graduate Studio II) **Studio 18, Credit 6 (F)**

CMTJ-799 **Metals and Jewelry Design Independent Study**
Metals and Jewelry independent study will provide students with the ability to study in a specialized area with an individual faculty member. Students, with the assistance of a faculty adviser will propose a course of study to pursue over the course of the semester. Goals and objectives will be outlined by the student in conjunction with their faculty adviser. Metals and Jewelry independent study students must obtain permission of an instructor and complete the independent study permission form to enroll. (Permission of instructor) **Credit 1–6 (F, S)**

CMTJ-890 **Metals and Jewelry Design Thesis Resolution**
This is the second of a two-semester thesis course sequence. The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report which addresses the body of work. The work will be exhibited in the graduate thesis show. (CMTJ-790 Metals and Jewelry Design Thesis Initiation, permission required) **Studio 18, Credit 6 (S)**

Woodworking and Furniture Design

CWFD- 701 **Furniture Design Graduate Studio I**
Furniture Design Graduate Studio I is the first of a two semester sequential class covering the advanced aesthetics and techniques of woodworking and culminating in the master's thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of woodworking techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. **Studio 18, Credit 6 (F)**

CWFD- 702 **Furniture Design Graduate Studio II**
Furniture Design, Graduate Studio II is the second of a two semester sequential class covering the advanced aesthetics and techniques of woodworking and culminating in the master's thesis. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of woodworking techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Lab fee is required. (CWFD-701 Furniture Design Graduate Studio I) **Studio 18, Credit 6 (S)**

CWFD-790 **Furniture Design Thesis Initiation**
Furniture Design Thesis Initiation is the first of a two semester sequential class covering creation of the master's thesis exhibition. Students will develop a topic of investigation for the master's thesis, select a graduate thesis committee, and begin the planning, research, and development of a body of creative work. There will be a strengthening of woodworking techniques, design fundamentals and encouragement of personal expression. Student will be encouraged to evaluate new techniques, materials and concepts. (CWFD-702 Furniture Design Graduate Studio II) **Studio 18, Credit 6 (F)**

CWFD-890 **Furniture Design Thesis Resolution**
Furniture Design Thesis Resolution is final course covering the completion of the Masters Thesis exhibition. Working from an approved topic of investigation for the master's thesis, students work independently and create a body of work supported by a written thesis paper. In consultation with a selected graduate thesis committee, students plan, research, and develop a body of creative work for exhibition and review. There will be a strengthening of woodworking techniques and design fundamentals, and encouragement of personal expression. (CWFD-780 Furniture Design Thesis Initiation, permission required) **Studio 18, Credit 9 (S)**

School of Art

Art Education

ARED-701 **Child Development in Art**
In this course students will investigate and study the topic of child development in art and education. Students will explore a range of perspectives on developmental theories; the creation, and understanding of children's art and meaning making; and approaches to teaching art to children in a birth-12 setting. Resources from the areas of art, psychology, sociology and art education will be investigated. Projects will include the development of a case study, relevant readings, research and studio activities, and collaborative research. Students will be expected to complete weekly reading and writing assignments. In a seminar format, the students realize the course objectives through participatory means. Students are expected to write critical essays, conduct research and field experience, and to participate in weekly small and large format discussion groups. Online technology is utilized in addition to lectures, videos, and other forms of media. This course has a field experience component of 30 hours. **Class 3, Credit 3 (F)**

ARED-702 **Inclusive Art Education: Teaching Students with Disabilities in the K-12 Art Classroom**
This course focuses on how to promote equity in art education K-12 for students with disabilities. Art Educators are expected to be able to understand the diverse learning needs of all students. Students in this course will discover how to adapt their own curricula and collaborate with special needs teachers to help students succeed in the art classroom. Through course work and field experience students will build a foundation of knowledge for working with children and youth with special needs. Students will develop new instructional strategies for making visual art more accessible for students with exceptionalities. Students will develop a plan to incorporate accessibility strategies into their daily teachings. In a seminar format, the students realize the course objectives through participatory means. Students are expected to write critical essays, conduct research and field experience, and to participate in weekly small and large format discussion groups. On-line technology is utilized in addition to lectures, videos, and other forms of media. This course has a field experience component of 20 hours. **Class 3, Credit 3 (F)**

ARED-703 **Multicultural Issues in Art and Education**
In this course students will explore a range of perspectives on multicultural issues in the visual arts and education fields. The focus will be on: making connections with contemporary multicultural art; the implementation of lesson plans based on multicultural issues for the art education classroom; and an examination of curriculum and policy issues. Resources from the areas of contemporary art, cultural studies, the visual arts, and education will be investigated. Students are expected to write critical papers and essays, develop curriculum resources, and to participate in weekly small and large format discussion groups. Online technology is utilized in addition to lectures, videos, and other forms of media. **Class 3, Credit 3 (F)**

ARED-704 **Methods in Teaching and Learning**
This course will explore the process of teaching art in the public school classroom at the Elementary level. Theories and practices relevant to teaching and learning in visual art will be addressed. Students will be encouraged to explore highly structured as well as highly experimental approaches to teaching art. Projects will include lesson-planning, unit planning, classroom management, investigating new technologies, urban education, action research, and other relevant topics, such as: human development, students with disabilities, multiple intelligences, assessment processes and personal inquiry as reflective practice. This course has a field experience component of 30 hours. **Class 3, Credit 3 (F)**

ARED-705 **Methods II: Studio Thinking**
This course explores the relationship between curriculum, instruction, and the assessment of learning. Students are introduced to process and procedures for developing curriculum, and assessing student learning in the art classroom, specifically at the secondary level. An emphasis is placed on a studio-thinking approach to teaching and learning. Students will explore innovative and creative approaches to curriculum design. Pedagogical knowledge is developed and extended through artistic practice and meaning making in lesson and unit development. This course compliments the course: Methods in Teaching and Learning. **Class 3, Credit 3 (F)**

ARED-711 **Professional Practices in Art Education**
This course focuses on the development of professional practices for entry-level art educators who are involved in their student teaching practicum. The focus will be on understanding the requirements for entry into the field and reflecting on the day-to-day professional responsibilities of an art teacher in the K–12 classroom. Projects will include presentations, relevant readings, assessment practices, mock interviews, case studies, visiting speakers, and preparing materials for applications in the field of art education. Students will be expected to complete weekly assignments. Goals for excellence in teaching and State and National standards are investigated and addressed. In a seminar format, the students realize the course objectives through participatory means. Online technology is utilized in addition to lectures, videos, and other forms of media. **Class 3, Credit 3 (S)**

ARED-790 **Student Teaching**
The student teaching practicum is designed to provide the student teacher with in depth pedagogical experiences, real world challenges, and rich learning opportunities. Two student teaching placements are arranged for each student for the duration of 6–7 weeks each. Full-time involvement at the school site is required. The student teacher will be under the guidance of experienced mentor teachers and college supervisors. This experience includes observation, full-responsibility planning and teaching, and involvement in the culture of the school setting. Students are assigned a cooperating teacher and a college supervisor for each setting. A student teaching handbook is provided. Students are required to meet state and national standards when teaching. Unit and work sample preparation, instruction and assessment are required. Online technology is utilized in addition to lectures, video, and other forms of media. (ARED-704 Methods in Teaching and Learning and ARED-705 Methods II Studio Thinking and ARED-702 Inclusive Art Education; corequisite: ARED-890 Graduate Seminar In Art Education) **Class 18, Credit 6 (F)**

ARED-890 Graduate Seminar Art and Education

This course supports the student who is student teaching. Social, political and cultural issues are important for art educators to reflect on and be active in. Developing an issues-based educational philosophy is relevant for today's classroom. Teaching in the K-12 classroom intersects with the day-to-day lives of our students and their world. Through a thoughtful investigation into the varied and complex issues in our contemporary visual lives, we can bring relevant teaching strategies and content to the studio classroom. In this course students will explore the day-to-day issues they experience in their student teaching practicum. The focus will be on exploring a range of perspectives on contemporary theories in art and education, making connections with theory, meeting state and national standards, and reflecting on pedagogical experiences to address the overall goals of the program. Students focus on the following areas to meet NYSED and TEAC requirements: content/subject matter knowledge, pedagogical knowledge, teaching skills, curriculum development, assessment and professional skills. The development of a teaching portfolio occurs in conjunction with a capstone project and exhibition. Online technology is utilized in addition to lectures, video and other forms of media. This course requires the student to complete 20 field experience hours, which will complete their required 100 hours. (ARED-704 Methods in Teaching and Learning and ARED-705 Methods II Studio Thinking and ARED-702 Inclusive Art Education; corequisite: ARED-790 Student Teaching) **Class 6, Credit 6 (F)**

Fine Arts Studio

FNAS-601 Fine Arts Studio: New Forms

Graduate students in the Fine Arts Studio program may choose any combination of Fine Arts Studio classes (Painting, Non-Toxic Printmaking, Sculpture or New Forms) to meet the 24 credit course requirements in their major. Any course may be repeated four times (up to 12 credit hours). Fine Arts Studio: New Forms focuses on the diverse new forms of expression that have emerged in contemporary fine art, including installation, performance art, and artwork that includes video and digital components among many other possibilities. Students will research some of these new forms and produce artwork in at least one of these forms. **Class 1, Studio 4, Credit 3 (F, S)**

FNAS-602 Fine Arts Studio: Non-Toxic Printmaking

Graduate students in the Fine Arts Studio program may choose any combination of Fine Arts Studio (Painting, Non-Toxic Printmaking, Sculpture or New Forms) to meet the 24 credit course requirements in their major. Any course may be repeated four times (up to 12 credit hours). This course is designed to introduce advanced non-toxic printmaking technical concepts that may include non-toxic printmaking techniques such as Intaglio-Type, screen, relief, monoprint, digital transfer, halftone, photo and the art of the master printer. The focus will be on non-toxic intaglio printmaking research and how to creatively apply techniques that will result in sophisticated works of art. **Class 1, Lab 4, Credit 3 (F, S)**

FNAS-603 Fine Arts Studio: Painting

Graduate students in the Fine Arts Studio program may choose any combination of Fine Arts Studio classes (Painting, Non-toxic Printmaking, Sculpture or New Forms) to meet the 24 credit course requirements in their major. Any course may be repeated four times (up to 12 credit hours). Fine Arts Studio: Painting students engage in a personal exploration of techniques in painting to advance their understanding and practice of visual art. Individual approaches to painting from the representational through the abstract present a cross section of current art issues which students must address as they build their portfolio. **Class 1, Studio 4, Credit 3 (F, S)**

FNAS-604 Fine Arts Studio: Sculpture

Graduate students in the Fine Arts Studio program may choose any combination of Fine Arts Studio classes (Painting, Non-Toxic Printmaking, Sculpture or New Forms) to meet the 24 credit course requirements in their major. Any course may be repeated four times (up to 12 credit hours). Fine Arts Studio: Sculpture allows students to explore concepts, materials, processes, and techniques to develop a personal, cohesive three-dimensional body of work. Theories and history of sculpture will be discussed as relevant to individual directions. **Class 1, Lab 4 Credit 3 (F, S)**

FNAS-606 Business Practices for Fine Artists

This class is devoted to business issues that artists must address including portfolio management, pricing and marketing strategies and public relations. Financial planning and communication skills are highlighted as are networking skills for the advancement of an artist's work. **Class 3, Credit 3 (F)**

FNAS-702 Fine Art Research

Graduate students prepare for the written component of the thesis through practice with research, critical judgment, and development of outlines and essays. Contemporary art issues are clarified through discussion and readings in art history, art criticism, artist statements and interviews. Fine Arts studio students are required to take this course spring semester before advancing to the thesis credits. **Class 3, Credit 3 (S)**

FNAS-890 Research and Thesis

After the 1st year of academic and studio study, graduate students in the Fine Arts Studio program undergo a review by a faculty committee to approve their advancement to thesis. Once approved, students begin the thesis process by choosing a thesis committee that they will work with throughout the thesis process. During the Fall semester of Research and Thesis the student develops a proposal that sets out the direction for research and the development of artwork. Once this proposal is approved, the research and artwork commences with regular thesis committee meetings. In Spring semester the student must exhibit this work in a gallery. In the exhibition space, during this show, the student will meet with the thesis committee to examine the success of the artwork in relation to the proposal. The student will be expected to orally present and defend the ideas explored through the artwork. The student will conclude the thesis process by explaining the work and putting it into both a personal and artistic context in a written and published document. **Credit 1–10 (F, S)**

Medical Illustration

ILLM-601 Human Gross Anatomy

An in-depth study of the structure of the human body. Emphasis is on understanding the relationships between anatomical structures as well as their form, texture, and color. Dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. **Class 3, Lab 9, Credit 6 (F)**

ILLM-602 Anatomic Studies

Through independent research and acquired understanding of human gross anatomy, students create illustrations designed to support medical or graduate level instruction of Human Gross Anatomy. Course requires students to cognitively illustrate their subjects, rather than creating literal interpretations of their observations. Work is intended for full color print media. **Class 2, Lab 3, Credit 3 (F)**

ILLM-603 3D Modeling of Biomedical Forms

This course introduces strategies to create polygonal models of biomedical subjects in a three-dimensional environment. Students will be asked to research contemporary theory defining their subjects' anatomy and create models consistent with their findings. Instruction will also focus on creating lighting and hader systems that emphasize form and are consistent with tissue characteristics. **Class 2, Lab 4, Credit 3 (F)**

ILLM-606 3D Animation of Biomedical Forms

This course explores animating biomedical subjects and processes in their native environment. Students will be asked to research contemporary theory defining their subjects' anatomy and create animations consistent with their findings. Frame by frame animation, blend shapes, non-linear deformers and rigging systems will be introduced to permit students to choose the more effective methods for creating motion and transformation. (ILLM-603 3D Modeling of Biomedical Forms) **Class 2, Lab 4, Credit 3**

ILLM-607 Computer Applications in Medical Illustration

Students will learn to use industry-standard raster and vector illustration software to create images based on independent research of medical topics. Students will also use page layout applications to combine digital images with text and other graphic elements. Course work emphasizes creation of illustrations to support medical education and publishing. **Class 2, Lab 3, Credit 3 (S)**

ILLM-608 Scientific Visualization

Emerging technologies enable scientists to visualize structures that are otherwise invisible to the naked eye. For example, molecular visualization software allows us to construct highly accurate molecular models from X-ray crystallography and other structural data. Cryo-EM and confocal microscopy are revealing the previously unknown structure of cellular organelles. Medical imaging systems allow us to reconstruct the human body in three dimensions from actual patient data (CT scans, MRI, etc.). This course explores the use of these technologies to provide references for traditional artwork and to export models for digital rendering and animation. (ILLM-601 Human Gross Anatomy) **Class 2, Lab 3, Credit 3 (S)**

ILLM-612 Surgical Illustration

Students observe and sketch live surgical procedures at a local hospital. After further background research, students translate their sketches into finished illustrations that are used in medical training, patient education, and litigation. Demonstrations of sketching and rendering techniques are supplemented with lectures on general surgical principles and common procedures. (ILLM-601 Human Gross Anatomy, ILLM-607 Computer Applications in Medical Illustration) **Class 3, Lab 3, Credit 3 (F)**

ILLM-615 **Interactive Media I**
This course is an introduction to two-dimensional computer illustration, animation, and interactive media as they apply to contemporary methods of instruction in medicine and allied health. Students will research a current topic in health care and develop interactive lessons that match the instructional objectives of their topic. Students will organize these lessons as a website. (ILLM-607 Computer Applications in Medical Illustration) **Class 2, Lab 3, Credit 3 (F)**

ILLM-616 **Interactive Media II**
This course continues the development of a student-created website designed to teach those studying allied health. Advanced topics in two dimensional computer illustration, animation, and interactive media will be presented. Students will research current topics in health care and continue the development of the interactive lesson begun in the previous class. (ILLM-615 Interactive Media I) **Class 2, Lab 3, Credit 3 (S)**

ILLM-617 **Portfolio and Business Practices**
This course helps prepare students to enter the workforce in full-time positions or as freelance illustrators. Students create a traditional portfolio, personal identity package, and marketing materials. The course also introduces important business concepts such as copyright, licensing, pricing, contracts, taxation, and formation of a proper business. (ILLM-612 Surgical Illustration) **Class 2, Lab 3, Credit 3 (S)**

ILLM-890 **Thesis**
Students conduct background research and create a body of artwork on a contemporary medical topic. The artwork is exhibited during one of several graduate thesis shows or during a screening of digital animation and interactive works. The thesis culminates with the production of a written thesis paper that documents the process of creating the work. (Permission required) **Credit 1–6 (F, S)**

School of Design

Industrial Design

IDDE-698 **Industrial Design Internship**
The Industrial Design Internship provides students the option to work in the Industrial Design field. Students must obtain permission of an instructor and complete the internship permission form to enroll. (Permission of instructor) **Credit 1-6 (F, S)**

IDDE-699 **Industrial Design Co-op**
The industrial design co-op provides students the option to work full time in the industrial design field. (Permission of instructor) **Credit 0 (F, S, Su)**

IDDE- 701 **Design Laboratory I**
Design Laboratory I and II is a two-part studio sequence that provides a forum for discourse and experimentation in design. Critical analysis, contextual relevance and research methodologies are developed and used as a means to define the role of design and the designer in creating consequential solutions for the social, economical and environmental betterment of the global communities. Design Lab I investigates various theoretical and philosophical approaches to design and provides a basis for critical analysis of current design. Projects will extend these ideas into the practice of industrial design as a mode of understanding the relationships that exist between the user, the community and the designed artifacts. Opportunities for inter and trans-disciplinary collaborations will broaden the scope of the projects. We will design through a process of iteration and reiteration, empathic exploration, and the development of the physical artifacts. Categories of products may include: consumer goods, equipment, transportation, furniture, or packaging. **Class 3, Lab/Studio 6, Credit 6 (F)**

IDDE-702 **Design Laboratory II**
Design Laboratory I and II is a two-part studio sequence that provides a forum for discourse and experimentation in design. Critical analysis, contextual relevance, and research methodologies are developed and used as a means to define the role of design and the designer in creating consequential solutions for the social, economical and environmental betterment of the global communities. Design Lab II continues the design activities of Lab I, but extends the scope to human-centered approaches and contextual relevance of concepts, artifacts and systems at both the local and global level. Design process will be explored and concentrate on developing responsible design practices. Supporting projects may include universal design, and environmentally sensibility, project management and production. (IDDE-701 Design Laboratory I) **Class 3, Lab/Studio 6, Credit 6 (S)**

IDDE- 703 **Function of Form**
The first of a two-semester sequence, Function of Form emphasizes the experience of seeing, developing, and manipulating three-dimensional forms and compositions. Projects focus on developing the ability to see, organize, and understand the ambiguity inherent in the design process through the study of three-dimension design elements, the analysis of their relationships and the subsequent sensory responses. **Class 0, Lab/Studio 6, Credit 3 (F)**

IDDE-704 **Form of Function**
The second of a two-semester sequence, Form of Function emphasizes the technical skills necessary to manipulate material and data for the accurate three-dimensional communication of design intent. Projects focus on understanding the relationship of materials, manufacturing processes, products and the user. (IDDE-703 Function of Form) **Class 0, Lab/Studio 6, Credit 3 (S)**

IDDE-705 **2D Ideation and Visualization**
The first of a two-semester visualization sequence, this course focuses on developing the skills and methods necessary to generate, visualize and define design concepts in two-dimensions, in both analog and digital formats. Assignments may include orthogonal views, perspective drawings and descriptive illustrations, as means to develop and communicate design solutions. **Class 0, Lab/Studio 6, Credit 3 (F)**

IDDE-706 **Integrated Design Visualization**
The second of a two-semester visualization sequence, this course further develops analog and digital visualization techniques, while expanding on graphic and three-dimensional components needed to create effective presentations and the workflows to achieve them. Assignments will also include crafting visual and verbal presentations that synthesize the concepts developed. (IDDE-705 2D Ideation and Visualization) **Class 0, Lab/Studio 6, Credit 3 (S)**

IDDE-790 **Thesis: Research and Planning**
The first of a two-course thesis sequence, the focus of this course is on establishing content, planning, scheduling, and research seeking innovative solutions through the process of concept development, ideation, and in-process evaluation. Final articulation of the project is approved by a faculty committee, presented in a graduate thesis show and accompanied by a written document that addresses how the theories and methods used in the project impact the current and future state of design in society. **Class 3, Lab/Studio 9, Credit 6 (F)**

IDDE-799 **Industrial Design Independent Study**
Industrial Design Independent Study provides students the means to study in a specialized area with an individual faculty member. With the assistance of a their faculty advisers, Students, will propose a course of study. Students must obtain permission of an instructor and complete the independent study permission form to enroll. (3.0 GPA and permission of Instructor) **Credit 1-6 (F, S)**

IDDE-890 **Thesis: Implementation and Evaluation**
The second of a two-course thesis sequence, this course focuses on continued concept development of a thesis, concluding with the implementation and retrospective evaluation of chosen design problem. Solution is presented in a public exhibition, complemented by a written articulation of how the theories and methods employed in the project impact the current and future state of design in society. (IDDE-790 Thesis: Research and Planning, permission required) **Class 3, Lab/Studio 6, Credit 6 (S)**

Visual Communication Design

VCDE-698 **Visual Communication Design Internship**
The Visual Communication Design internship will provide students with the option to work in the visual communication design field. Students may apply for internships to businesses based on the availability of positions and business job needs. Students must obtain permission of an instructor and complete the internship permission form to enroll. (Permission of instructor) **Studio 1–6, Credit 3 (F, S)**

VCDE-699 **Visual Communication Design Co-Op**
The Visual Communication Design co-op will provide students with the option to work in the visual communication design. Students may apply for co-op employment to businesses based on the availability of positions and business job needs. (Permission of instructor) **Credit 0 (F, S)**

VCDE-701 **Design History Seminar**
This seminar focuses on a basis in the history of design, which complements the overall graduate studies in the School of Design. Interdisciplinary in nature, the course is thematic and emphasizes performance on the part of the student in dynamic dialogue on course topics. The course content focuses on subjects relative to the history of design (people, processes, products, and places), critical thinking and contextual historical issues. Students are expected to write critical essays and questions and to participate in weekly discussion groups. On-line technology is utilized in addition to slide lectures. **Class 3, Credit 3 (F)**

VCDE-706 3D Modeling and Motion
This course is an introduction to digital 3D visualization. Students learn all aspects of 3D design, from modeling all the way through rendering the final images to setting keyframes for animation. Once familiar with the basics of production, students are encouraged to focus on specific topics such as lighting and texturing and the creation of visual effects for gaming, broadcast, visualization and education. **Classroom 2, Studio 3, Credit 3 (F)**

VCDE-707 Web and UI Design
This course provides an in-depth look at human-centered interface design. Students develop interactive web pages with functional design and usability for e-commerce, education, and the communication of visual communication. Emphasis is placed on the integration and application of design skills applied to information architecture, user navigation and orientation. Projects are focused on designing alternative navigational solutions for online Web applications and touch-screen devices such as mobile phones and touch-pads. **Classroom 2, Studio 3, Credit 3 (F)**

VCDE-708 Typography
This course examines the historical, theoretical, and perceptual aspects of typography for print and screen use. Grid structure, composition, hierarchy, message conveyance, and formal aspects of typographic design are explored with an emphasis on developing harmonious type and image integration into cohesive, sequential design applications. How temporal structural elements such as rhythm and pacing affect visual communication in a dynamic medium is also investigated and applied. **Class 2, Studio 3, Credit 3 (F)**

VCDE-709 Digital Design in Motion
This course focuses on motion design from story reels to the final project. Course content focuses on visual components, and assignments translate production techniques used in traditional filmmaking into the online environment. This includes the use of line, space (2D and 3D), composition and framing, simulated camera movements, color, and sound. Using a time-based application as the authoring tool and the techniques outlined in this course, a student will be able to produce interactive stories, such as online graphic novels and webisodes. **Class 2, Studio 3, Credit 3 (F)**

VCDE-711 Design Theory and Methods Seminar
This seminar explores cross-disciplinary principles, theories and methods that can be used by designers. Through selected readings from current periodicals, critical writing, hands-on involvement, presentations and guest lectures, students will broaden their awareness of topics such as systems thinking, human factors, semiotic theory, and visual rhetoric, and become familiar with brainstorming, problem solving and evaluation methods in order to sharpen their understanding of the design process. Information will be directed toward meaningful concept development and the selection and use of appropriate methodologies for design problem solving. (VCDE-701 Design History Seminar) **Class 3, Credit 3 (S)**

VCDE-716 3D Particles and Dynamics
This course focuses on 3D special effects using 3D software in combination with other techniques. Course content addresses particle systems and dynamic simulations in a 3D environment. Physical reality concepts such as water flow, air movement, smoke, clouds, fire, and gravitational effects are explored in relation to their effects on cloth, hair, and fluids. Students will incorporate these dynamic simulations in practical design contexts for film, broadcast, and online. (VCDE-706 3D Modeling and Motion) **Class 2, Studio 3, Credit 3 (S)**

VCDE-717 Design Systems
This course investigates a systems thinking approach for the purpose of clear, unified communication. The complexity of multiple components are integrated into a common framework to solve graphic design problems. Conceptual mapping, design process strategies, user-centric goals, visual symbolism, the balance of design with cultural, environmental and technological factors, design writing, and design evaluation are integrated into the course. Both theoretical and applied problems will be developed. **Class 2, Studio 3, Credit 3 (S)**

VCDE-718 Project Design and Implementation
This course provides students with the necessary skills to further develop a research plan into a specific design inquiry with an application component. Emphasis is placed on identifying connections and integrating content between this course and the culminating first-year experience in the MFA Visual Communication Design program. Students will chose a topic, write a design proposal, and design and implement a project from inception to conclusion. This involves research, development, evaluation, refinement, completion of a finished creative project, and documentation of the process. The project can be produced independently or collaborative with advice from the instructor. **Class 2, Studio 3, Credit 3 (S)**

VCDE-723 Interaction Design
This course applies design methodologies to multimedia applications. Students communicate ideas and information to specific audiences through interactive, instructional applications. Course work will integrate content research, developing measurable objectives, and information architecture with interactivity. At the completion of this course students will be able to design site maps and flowcharts, implement an effective graphical user interface, communicate layered information through a hierarchical structure, control user navigation and feedback using interactivity, and design cross-platform projects for entertainment, games, information systems, and education. (VCDE-707 Web and UI Design) **Class 2, Studio 3, Credit 3 (F)**

VCDE-728 Motion Graphics
This course focuses on motion graphics as an extension of traditional design that incorporates a temporal or time-based element into the message. Students are exposed to video compositing software and learn the craft, practice, and theory of what it takes to make it in the fast-paced, competitive world of motion graphics design. Computer software is used to composite visual effects in both animation and live video. Sequencing, storyboarding, digital audio, titling, and animation are integrated to produce time-based projects for film, broadcast, and the Web. (VCDE-709 Digital Design in Motion) **Class 2, Studio 3, Credit 3 (S)**

VCDE-731 3D Visual Design
This course focuses on the visual look of a 3D model. Students apply lighting methods to illuminate 3D models and spaces. The interaction of light and pigment, use of light in painting, photography, and film are used as examples. Techniques in using shading networks are incorporated into the projects. Displacement textures are used to create detail in models. This course also covers a contrast and comparison of various methods and resolutions of rendering and outputting information from 3D software. (VCDE-706 3D Modeling and Motion) **Class 2, Studio 3, Credit 3 (F)**

VCDE-732 Branding and Identity Design
This course provides an examination of the role of design in brand strategy and cohesive identity systems. Historical and current systems will be researched and analyzed. Development of formal proposals, research, and design strategies for developing integrated solutions are explored. Projects will include client contact, writing of design briefs, collaborative projects, use of social networks for brand expansion, information structures, screen and print formats, and presentation methods. **Class 2, Studio 3, Credit 3 (F)**

VCDE-733 Digital Video and Audio
This course uses digital video cameras for motion recording and microphones for digital audio recordings. Emphasis is placed on digital video and audio design, production, and integration in multimedia applications. Course projects focus on shooting, digitizing and editing video plus recording, editing and mixing of audio for digital movies. **Class 2, Studio 3, Credit 3 (F)**

VCDE-741 Environmental Graphic Design
This course focuses on the functions of environmental graphic design in a three-dimensional environment. Through studies of theory of environmental design, exploration and conceptual development, design solutions are directed to assist users in negotiating; or wayfinding, through a space or environment, to identify, direct and inform. Topics include learning methods, communication theory, ergonomics, visual hierarchy, design principles and process. Areas of application include architectural graphics, signage systems, dynamic environments, mapping, exhibit design, museum experiences, and themed environments. Students also explore how to integrate both 2D and 3D components to develop physical and digital-based environments. **Class 2, Studio 3, Credit 3 (F)**

VCDE-742 Information Design
This course explores the importance of reader and user responses to written and visually presented information. Problem-solving, functional requirements, information transmission, accessibility and design structure are integrated while investigating a variety of formats (i.e., charts, diagrams, business forms, tables, maps, instructional materials, wayfinding systems, and technical data.) Applied problems are solved through principles of language, structure, diagrammatic interpretation and the visual display of information. Solutions will be developed for both print media and digital use (i.e., mobile devices, computer screens, kiosks, etc.). **Class 2, Studio 3, Credit 3 (F)**

VCDE-746 **Professional Practices**
The course will integrate concepts taught in the Design History Seminar and the Design Theory and Methods Seminar to help students prepare for a professional career in design. Equally as important as design theory, the content focuses on the practical knowledge of production and design skills, and exposure to basic business practices. An overview of business and economics related to the design world, goal setting and productivity skills, professional ethics, marketing, the interviewing process, and strategic analysis is addressed. Projects provide an in-depth look at creating an effective digital portfolio and curriculum vitae based upon personal strengths and interests, with professional standards, and career expectations in mind. (VCDE-701 Design History Seminar, VCDE-706 Design Theory and Methods Seminar) **Class 3, Credit 3 (S)**

VCDE-790 **Thesis: Research and Planning**
Research is the backbone for any project. This course focuses on the design research and planning stages of a thesis project. Students define a design problem that provides a significant addition to the design field while addressing needs in the local, regional and/or global community. Course content addresses establishing content, planning, scheduling, and research seeking innovative solutions through the process of concept development, ideation, and in-process evaluation. **Credit 1-6 (F)**

VCDE-799 **Visual Communication Design Independent Study**
Visual Communication Design Independent study will allow students to obtain instruction in specialized areas of interest to enhance their individual course of study. Working with a faculty adviser, students will propose a focused curriculum related to their academic and/or future career interests. Visual Communication Design Independent Study students must obtain permission of an instructor to enroll. (Permission of instructor) **Credit 3 (F, S)**

VCDE-890 **Thesis: Implementation and Evaluation**
This course focuses on the physical thesis project. Students continue with concept development concluding with the implementation and retrospective evaluation of their chosen design problem. Solution is presented in a public exhibition, complemented by a written articulation of how the theories and methods employed in the project impact the current and future state of design in society. (VCDE-790 Thesis: Research and Planning, permission required) **Class 3, Studio 6, Credit 6 (S)**

School of Film and Animation

Film and Animation

SOFA-602 **Production Processes**
This course is an introduction to all aspects of professional film/video narrative production. Students produce short projects while learning basic shooting and crewing procedures, studio protocol, equipment handling and maintenance, and basic sync editing. (SOFA-601 Graduate Production) **Class 4, Studio 6, Credit 4 (S)**

SOFA-603 **2D Animation I: Fundamentals**
This course will introduce graduate students to the concepts and mechanics of movement for animation, focusing on, but not limited to, character based movement. Animation principles and theories on movement and acting will be introduced and applied using hand-drawn methods, which will serve as the foundation for their application in any desired medium. Various styles of animation timing will be examined and students will have the opportunity to develop their own sense of timing and movement. Multi-week exercises will be recorded using standard animation software, and will be reviewed, discussed and open to group critique. **Class 3, Credit 3 (F)**

SOFA-604 **2D Animation II: Mechanics**
This course builds on information gained from foundation animation courses. Multi-week assignments will allow students to fully grasp the production process involved in hand-drawn animation and develop an understanding of different parameters commonly found in animated films, including but not limited to character interaction, emotion and animal movement. Students will have the opportunity to explore various approaches to timing, movement, acting and characterization. Character design and solid drawing skills are highly recommended. (SOFA-603 2D Animation I: Fundamentals) **Class 3, Credit 3 (S)**

SOFA-605 **Basic Sound Recording**
This course provides specialized knowledge and work in sound to prepare the student to be able to distinguish and evaluate proper sound techniques and productions to encourage the beginning of professional work in the sound industry. Each student records audio and prepares a mixed soundtrack to professional quality standards. **Class 3, Credit 3 (S)**

SOFA-606 **Directing the Actor for Film and Video**
A course in basic directorial techniques with emphasis on the special problems peculiar to film and video production. The class is taught in conjunction with SOFA-666 Acting for Film and Video. Class meetings are organized around the presentation of scenes prepared by student directors. **Class 3, Credit 3 (F, S)**

SOFA-607 **Directing the Actor II**
This class offers in-depth study of techniques introduced in the basic directing class, with an additional focus on using external observation to determine appropriate behavior. This course emphasizes the special problems peculiar to film and video production. Class meetings are organized around the presentation of scenes prepared by student directors using the acting students in the class. Meets in conjunction with Acting for Film and Video II. (SOFA-606 Directing The Actor For Film And Video) **Class 3, Credit 3 (S)**

SOFA-608 **Dramatic Structure**
This course explores the theories of dramatic structure from Aristotle to the present and applies these theories to current and classic dramatic works. The class also explores dramatic script structure as it is used in dramatic works on stage and screen. **Class 2, Screen 3, Credit 3 (F)**

SOFA-610 **Graduate Seminar**
A forum to establish among a diverse student group a common vocabulary for discussing film language and structure, collaborative relationships, and a sense of community, while exploring issues related to scene analysis, production practice and planning, story boarding, storytelling, visual music, SoFA policies, and professional business realities. **Class 2, Credit 2 (F)**

SOFA-611 **History and Aesthetics of Animation**
This course will provide a general survey of the development of animated film making around the world from the late 19th century to today. It will be an exploration of the history and aesthetics of Animation with emphasis on the unique characteristics of the form and how those characteristics are used as a means of interpretation and expression. **Class 2, Screenings 3, Credit 3 (S)**

SOFA-613 **Graduate Screenwriting I**
This course focuses on the forms and techniques of writing for visual media, particularly the short film. Throughout the course, students develop resources for finding stories and concepts that can be turned into films. Students are responsible for writing a short script of their own choosing and for completing several brief written exercises in areas such as personal storytelling, character development, dialogue, and plot. Scripts written in this class can be used as the basis for films produced in other classes. **Class 3, Credit 3 (F)**

SOFA-615 **3D Animation Fundamentals**
This course is an introduction to three-dimensional computer animation. Topics will include modeling, rigging, keyframe animation, forward and inverse kinematics, and rendering. Professional animation software will be used throughout. By the end of the course, students will be able to do basic modeling, rigging, and animation. **Class 2, Lab 3, Credit 3 (F)**

SOFA-616 **Intermediate 3D Animation**
This course teaches character animation with an emphasis on personality and emotion. Topics will include advanced modeling, facial expressions, and character rigging. Professional animation software will be used. By the end of the course, students will be able to create and rig their own characters. Students will also create short animations demonstrating a range of emotions. (SOFA-615 3D Animation Fundamentals) **Class 2, Lab 3, Credit 3 (S)**

SOFA-617 **Stop Motion Puppet Fundamentals**
This course will give graduate students a basic and solid understanding of stop-motion animation. The class covers all aspects of stop-motion in its various forms but will mainly concentrate on stop-motion puppet/character animation. There will be demonstrations on model fabrication, animation techniques and camera/grip techniques. This is an introductory course; more in-depth topics—like latex and silicon mold making and intensive postproduction techniques—will be introduced but not pursued in depth. **Class 3, Lab 2, Credit 3 (F)**

SOFA-620 **3D Modeling Mastery**
This is an advanced 3D modeling course. Students will refine their knowledge and skill in creating objects and characters in 3D space. Students will build on their previous modeling knowledge to create more artistic creations. Modeling concepts such as edge loop placement for proper animation deformation will be emphasized. Students will be introduced to the concept and use of digital sculpting. (SOFA-615 3D Animation Fundamentals) **Class 2, Lab 3, Credit 3 (S)**

SOFA-621 **Spring Film**
Graduate students complete their first full semester production. They must decide on a concept, develop a treatment, write a script or research a non-fiction subject and produce the film complete with mixed track and finished titles and credits. (SOFA-601 Graduate Production) **Class 3, Credit 3 (S)**

SOFA-622 **30-Second Film**
An introduction into the world of producing television commercials or other 30-second films. Major emphasis is placed on learning to generate and intensify a personal statement through creative projects. Work is critiqued weekly by the instructor and class. Students execute the production of a completed 30-second film. (SOFA-602 2D Animation I: Fundamentals or SOFA-615 3D Animation Fundamentals or SOFA-617 Stop Motion Fundamentals) **Class 3, Credit 3 (S)**

SOFA-623 **Stop-Motion Master Class**
This course will introduce stop motion MFA students to more advanced techniques of single-frame production. The class will be divided into teams that will execute a finished short film complete with post and sound work. Although these finished films will be short and simple, they will expose the students to stop-motion set and puppet building, lighting, grip work, camera movement, and post work. This class builds on the fundamentals that were taught in the Puppet Fundamentals class and advances the student's understanding of stop-motion production. The team members will specialize in certain areas of building, camera work, animation, and post work and will contribute to the team film until the completion of that project. The next step for these advanced students upon completion of this class will be to create an MFA thesis film. (SOFA-617 Stop Motion Puppet Fundamentals) **Class 2, Lab 3, Credit 3 (S)**

SOFA-624 **Tradigital Animation**
The computer has become an integral part of modern animation production. This course will introduce students to the application of computer technology to animation to aid them in incorporating it into their personal skill sets. The focus will be on adapting traditional techniques to the digital production environment. The student will work with professional level animation software using both raster and vector graphics to produce several short exercises adapted from traditional techniques that will develop the skills needed to efficiently and effectively use 2D digital tools in their own work. **Class 2, Lab 3, Credit 3 (F)**

SOFA-625 **Animated Acting Principles**
This course will give graduate animation students an opportunity to explore a visual language of acting and posing that will help their storytelling abilities. Acting, timing and pacing are critical elements to any successful character animated film. Identifying and building a library of expressions, poses, and movement for emotional and visual expression is the goal for each student. Students will study reference material from successful silent and animated films. They will also create their own reference material through acting and filming themselves and other students. The visual references will be scrutinized on a frame-by-frame basis for a deeper understanding of this visual language. The class will include demonstrations by practicing actors and animators. Graduates will produce some animated studies related to the acting principles. **Class 3, Credit 3 (S)**

SOFA-626 **Writing the Short Film**
This is a course in writing for short films. The course includes an exploration of the short film genre and how that differs from other narrative forms. In the course, students complete exercises to improve their ability to write scenes and develop characters. To conclude the course, students write a short script appropriate for filming in one of the production courses. (SOFA-613 Graduate Screenwriting I) **Class 3, Credit 3 (S)**

SOFA-627 **Pre-Production for Animators**
Students collect and produce short film ideas and learn to express them in a variety of methods. Short film scripts will be written in a workshop setting and shared with class in critiques. Students will learn how to create digital soundtracks and read digital sound. Students will make animation bar sheets for sound/image relationships and timings and exposure sheet design. Students will also work with storyboards scanned into the computer and manipulated in time with sound to create an animatic as another tool for initializing animation production. **Class 2, Lab 3, Credit 3 (F)**

SOFA-628 **Animation Writing and Visual Storytelling**
This course is an in-depth examination of structural elements of both the written and visual aspects of the animated film and the pre-production process, specifically. Particular attention is given to the application of materials to a short film format and the layout of movements and visual composition via editing into storyboards. Students will create and submit various written scripts culminating in a final production script for development into working, formatted animation storyboards. Story elements will be created and shown by developing elements of the script, as well as visual treatments by utilizing subtext and thematic understanding. (SOFA-627 Pre-Production for Animators) **Class 3, Credit 3 (S)**

SOFA-630 **Animation Film Language**
This class is intended to introduce the student to the theory and practice of making animated films. Lectures, readings and classroom discussions will emphasize the history, theory and practice of animated filmmaking with extensive film screenings to illustrate various techniques and related aesthetics and ideas. A contrast and comparison of animation and live action film theory will elucidate the unique aesthetic and expressive properties of the animated film. **Class 1, Screening 3, Credit 2 (F)**

SOFA-638 **Complete 3D Character Creation**
This course covers a broad range of 3D animation related topics in a detail-oriented manner. The various topics will be anchored in the design and development of an original 3D character. Topics covered will include, but not be limited to, modeling, rigging, texturing, and lighting. Students will design and build a 3D character of their own design. Using a variety of 3D techniques, students will create a fully articulate character rig and produce a short animation demonstrating its functionality, as well as their proficiency in techniques such as lighting, texturing, and rendering. (SOFA-620 3D Modeling Mastery) **Lab 3, Credit 3 (F)**

SOFA-641 **Advanced Sound Recording**
This course continues the work from SOFA-605 Basic Sound Recording to include audio synchronized or locked to picture and the use of Foley and ADR production techniques. Students develop workflow approaches for complex multi-track mixing and signal manipulation. Each student prepares a mixed track to professional quality standards and manages sound and video files between various hardware and software platforms. (SOFA-605 Basic Sound Recording) **Class 3, Credit 3 (F, S)**

SOFA-642 **History and Aesthetics: Animation Stories**
This course provides an in-depth study of a specific movement or individual**(S)** that has made a major contribution to the animated film art form. Films will be viewed and discussed in the context of the specific times and places in which they were made. Emphasis is on determining the unique characteristics of the animation medium and how those characteristics have been used as a means of interpretation and expression from historical, cultural and individual perspectives. **Class 2, Screenings 3, Credit 3 (F)**

SOFA-644 **Cinematic Compositing**
Students will learn digital compositing using rotoscoping, image tracking, alpha channels and transparency. Composites may be accomplished through green screen shooting, transfer modes, masks, and/or traveling mattes. Students will shoot their own footage to combine with their effects to create the final image. Node based compositing will be addressed as well. (SOFA-624 Tradigital Animation or SOFA-602 Production Processes) **Class 2, Lab 3, Credit 3 (S)**

SOFA-660 **Documentary Film History**
This course will examine the development of documentary film from 1920 to the present. It will explore central themes in documentary filmmaking, including the Grierson social documentary, the Flaherty romantic tradition, cinema verite, propaganda films, first person narratives, and experimental documentary. Through film viewings, class discussions, and assigned readings, the student will critically examine how documentary film is constructed and the critical relationship between the construction of the film and the film's content and meaning. **Class 2, Screen 3, Credit 3 (S)**

SOFA-661 **New Documentary Issues**
This course examines current trends in documentary film during the last decade. We will view one-two documentary films each week. We will examine each film critically; analyzing the film's theme, structure, style, relationship to reality, and effectiveness. In addition, we will look at how current filmmakers interpret and build upon the basic ideas and discourse that have defined documentary filmmaking since its beginnings. **Class 2, Screen 3, Credit 3 (F)**

SOFA-662 **International Film History**
This course examines selected, varying film topics in a wider socio-historical context. Seminar themes change each year and may include topics such as post-war German film, films of the Holocaust, Japanese film, Surrealist and Magic Realist film, Soviet film, Native Americans on film, etc. Students are expected to participate actively in the course discussions. (SOFA-608 Dramatic Structure) **Class 2, Screening 3, Credit 3 (F, S)**

SOFA-663 **Writing the Feature I**
This is the first course in a two-semester course in writing for feature films. The course includes an exploration of the feature film structure. Students propose ideas for a feature-length film and, in consultation with the instructor and other students, move forward to complete a feature-length film script. The script begun in this class will be completed in SOFA-664 Writing the Feature II. (SOFA-614 Writing the Short Film) **Class 3, Credit 3 (F)**

SOFA-664 **Writing the Feature II**
This is the second part of a two-semester course in writing for feature films. In this course, students complete the script begun in SOFA-663 Writing the Feature I. (SOFA-663 Writing the Feature I) **Class 3, Credit 3 (S)**

SOFA-666 **Acting for Film and Video**
A course in basic acting technique with emphasis on the special problems peculiar to film and video production. The class is taught in conjunction with SOFA-606, Directing the Actor for Film and Video. Class meetings are organized around the presentation of scenes prepared by student actors and directors. **Class 3, Credit 3 (F, S)**

SOFA-667 **Acting for Film and Video II**
This course builds on the basic acting class with the additional focus of using external observation to determine appropriate behavior. Class meetings are organized around the presentation of scenes prepared by student actors and directors. The class is taught in conjunction with Directing the Actor II. (SOFA-606 Directing the Actor for Film and Video, or SOFA-666 Acting for Film and Video) **Class 3, Credit 3 (S)**

SOFA-668 **Alternate Traditional Animation Techniques**
This class is intended to introduce the student to the variety of traditional techniques for making animated films directly under the camera. Lectures, readings and hands-on experiences will explore the practice of optically recorded animated filmmaking. Extensive film screenings will illustrate various techniques and their related aesthetics. Students will create several short film projects using the techniques they have learned. **Class 2, Lab 3, Credit 3 (S)**

SOFA-670 **30-Second Commercial Production**
An introduction to the world of producing television commercials. Students learn the workflow between advertising agencies, their clients and production companies. They also execute the production of a television commercial from conception to editorial. (SOFA-602 Production Processes) **Class 4, Credit 3 (S)**

SOFA-671 **Advanced Production Immersion**
This workshop provides students with the opportunity to learn more about a particular area of production, editing, cinematography, lighting, sound, etc., with an industry professional. (SOFA-601 Graduate Production) **Class 3, Credit 3 (F, S)**

SOFA-672 **Mixing and Sound Design**
This course continues the work done in SOFA-641, Advanced Sound Recording, by mixing multi-track sessions with video to post-produce several different projects to professional standards. Students learn how to listen and develop a trained ear while understanding proper equalization and use of effects and digital signal routing. Sessions can include documentaries, dialog, and musical productions. Students also create templates and develop editing/mixing techniques to balance creativity and time constraints of a typical project. (SOFA-641 Advanced Sound Recording) **Class 3, Credit 3 (F)**

SOFA-673 **Camera Choreography**
An exploration of multiple camera movement techniques utilized in obtaining proper coverage of a scene. Students participate in weekly hands-on exercises to develop and improve cinematic storytelling through various camera moves. (SOFA-763 Cinematography and Lighting) **Class 3, Credit 3 (S)**

SOFA-674 **Animation Pre Production Concept Design**
This course will focus on creating and designing environments and spaces for animated projects. Strong attention and development will be paid to color, composition, and atmosphere. Projects require a high level of drawing skill and knowledge of perspective, as well as story and character development. Projects will utilize hand-drawn, digital painting, live action, and subjective techniques. A variety of exercises will cover tone, mood, deep and shallow space, multi-plane movement, and natural and imagined spaces. (SOFA-630 Animation Film Language) **Class 2, Lab 3, Credit 3 (F)**

SOFA-675 **3D Lighting and Texturing**
Students will learn to use lighting in three-dimensional software. Projects include modeling, texturing, and lighting of objects, characters and spaces. Students will match photographic images and three-dimensional objects in lighting, blur, color, contrast, and perspective. Students will imitate photorealism by combining shadows, textures, direct lighting, indirect lighting, reflections, and refractions. Students will use a variety of rendering programs to create composites. (SOFA-615 3D- Animation Fundamentals) **Class 2, Lab 3, Credit 3 (S)**

SOFA-676 **After Effects for Animators**
Adobe After Effects is an indispensable tool for anyone working in animation or motion media. This course provides the instruction needed to go beyond the basics to make full use of this powerful tool. Students will be instructed in the program's theory of operation and given practical experience performing operations commonly used in animation production. (SOFA-624 Tradigital Animation) **Class 2, Lab 3, Credit 3 (S)**

SOFA-677 **Animation Pre Production Character Design**
This course will combine basic design elements and character as applied to an animated production. Historical reference from popular design movements will be discussed and students will create and develop a "cast" of characters from a written property, focusing on group dynamics, visual appeal and personality development. Line, color, texture, shape, form and story will be referenced when developing characters. Students will institute a process of visual development through a variety of exercises, working toward a final, finished group of characters. Students will produce hand drawn and sculpted (with clay) character model sheets and style guides. (SOFA-630 Animation Film Language) **Class 3, Credit 3 (S)**

SOFA-681 **Particle Effects and Dynamics**
This course gives students the skills to insert three-dimensional computer special effects into animation and live action footage. Students explore three-dimensional computer particle animation and dynamics simulation. Students will create short animations to simulate fire, rain, smoke, lighting, water and other dynamics-based collisions. (SOFA-615 3D Animation Fundamentals) **Class 2, Lab 3, Credit 3 (F)**

SOFA-682 **Underwater Cinematography**
This course is designed to prepare students to professionally complete cinematography assignments in an underwater environment. To accomplish this, the student will complete basic scuba diving training and achieve scuba diving certification. The student will become familiar with underwater video camera housings and accessories and basic underwater shooting techniques. A facility fee covers all equipment, off campus facility use, texts and insurance. (SOFA-601 Graduate Production) **Class 2, Lab 3, Credit 3 (F)**

SOFA-683 **Advanced Editing**
This course is designed to teach students the professional workflow of editing digital film and video files. Students learn the technical craft as well as the aesthetic choices that editors make. Students practice the editing of all genres by editing short fiction, documentary, and experimental projects. Students will explore and learn advanced tools in Final Cut Pro editing software while editing short projects and tutorials. Areas of study include learning a cinema file database, media management, color correction, visual and time based effects, sound processing and track building, multi-camera editing, and titling and graphics. In the second half of the semester, students will learn the basic operation system of AVID editing software and complete three short projects using AVID software. (SOFA-601 Graduate Production) **Class 2, Lab 4, Credit 3 (S)**

SOFA-684 **Animation Pre-Production Gesture**
This course focuses on the mechanics of motion as applied to animated characters, both human and non-human. Working directly from a live model, costumed and nude, and also employing visualization techniques, students will apply figure-drawing skills along with gesture drawing, focusing on the correct representation of weight, energy and force in sequential poses. Specific attention is paid to improving drawing skills in order to create stronger storytelling poses for animated properties. A variety of drawn animation examples will be screened in class. **Class 1, Lab 3, Credit 3 (S)**

SOFA-686 **Programming for 3D Artists**
This programming course is designed specifically for artists and animators with little or no programming experience. It is designed to give students the ability to solve software problems by making their own tools or finding existing tools. All of the assignments and examples in class are graphics related and will include tools for animation, rigging, particles, texturing, and modeling. (SOFA-615 3D Animation Fundamentals) **Class 2, Lab 3, Credit 3 (S)**

SOFA-687 **Digital Clay**
Beyond creating objects per polygon, using digital sculpting, this course demonstrates the latest techniques for creating from your imagination in the most intuitive way. In this course students will not only carve out their characters and objects, but also digitally paint on the 3D model as well. Instruction will include methods for creating organic as well as hard surface creations. (SOFA-620 3D Modeling Mastery) **Class 2, Lab 3, Credit 3 (S)**

SOFA-688 **DVD Authoring**
Students will develop a specific DVD that is based on a film they have completed. Class discussion will be geared towards presentation and interactivity. The student will use a variety of tools: menu development, subtitles, audio streams, encoding principles, hybrid DVD creation, Web linking (DVD@ccess), and basic scripting. (SOFA-622 30-Second Film or SOFA-601 Graduate Production) **Class 2, Lab 3, Credit 3 (S)**

SOFA-691 **Film Sound Theory Music**
This course is one of three in the study of film sound theory. Through readings, focused group discussion, and the viewing of/listening to select films, the course promotes critical analysis of the varied and profound uses of music in sound design. Addressed is the history of music from the silent era to the modern score. The concepts studied include the modal changes in point-of-audition, and positioning across diegeses. Newer topics including audio-visualization and ventriloquism theory are also addressed. **Class 2, Screenings 3, Credit 3 (F, Su)**

SOFA-692 Film Sound Theory Effects
This course is one of three in the study of film sound theory. Through readings, focused group discussion, and the viewing of/listening to select films, the course promotes critical analysis of the varied and profound uses of effects in sound design. Addressed is the history of effects from the early sound era to the modern design. The concepts studied include the modal changes in point-of-audition, and positioning across diegeses. Other topics like complementarity and the acousmetre are also addressed. **Class 2, Studio 3, Credit 3 (F, Su)**

SOFA-694 Alternative Cinema Workshop
Students produce at least one major artistic work that uses the moving image. This course demands the use of alternative expressions in concept, style, or technology, and students are encouraged to take risks, break "rules" and explore their own unique creative potential. Students may work in a variety of media, depending on their proficiencies and the vision of their project. Graduate students from film and animation, fine arts, photography, performance arts, installation, crafts, music, multimedia, gaming, computer sciences, and other relevant disciplines are typically welcomed. Students complete projects for presentation at the SOFA public screenings at the end of the semester. (SOFA-601 Graduate Production) **Class 4, Credit 4 (F, S)**

SOFA-696 Fusion Team Production
Students will learn to combine various media including live action, two dimensional animation, and/or three dimensional animation. Projects include camera matching and compositing. Students will match the lighting, blur, color, contrast and perspective across composited media. Students will have characters and objects interacting across different media. (SOFA-604 2D Animation II or SOFA-616 Intermediate 3D Animation or SOFA-673 Camera Choreography) **Class 2, Lab 3, Credit 3 (S)**

SOFA-698
Film and Animation Graduate Internship
SOFA Internship is open to all SOFA graduate students with a minimum of a 3.0 GPA. SOFA students should first procure an internship opportunity within our industry. Students must submit a completed permission form identifying the firm and what they have been told will be their duties and responsibilities. All Film and Animation Internships must be approved by the student's Program Director or Administrative Chair. Students are required to submit a minimum 10-page paper about their experience and obtain a letter of review from their jobsite supervisor. Ninety hours of work earns 1 semester credit. Permission from the SOFA graduate program director required. **Credit 1-6 (F, S, U)**

SOFA-699 Film and Animation Graduate Co-op
The SOFA Graduate Co-op will provide students with the option to work in the Film Industry and get paid. There is no academic credit awarded for this course. The opportunity must demand a minimum of 20 hours per week. Students may apply for co-op employment to businesses based on the availability of positions and business job needs. Permission from the SOFA graduate program director required. **Credit 0 (F, S)**

SOFA-704 2D Animation III: Camera and Sequence
This course builds on information gained from previous animation courses as well as concepts of visual storytelling and sequence construction. Students will create multiple characters, environments and a "story" to animate through shot selection, building on action and performance. Students will use and utilize a moving camera, pans, character interaction, and the connectivity of four shots that show a cohesive idea as well as advanced animation skills. Considerable drawing and character design skills are highly recommended. (SOFA-628 Animation Writing and Visual Storytelling) **Class 3, Credit 3 (F)**

SOFA-711 Theory Via Short Narrative Film
This is a free-ranging seminar with the uncommon luxury of small student numbers. We wish to examine specific classic, modernist, and post-modern written materials and films and to openly discuss all examined written and cinematic works. Extended readings and writing in film theory, especially aesthetic and cultural matters leading to better film analysis and media production will be central to the investigation. (SOFA-610 Graduate Seminar) **Class 3, Credit 3 (F)**

SOFA-716 Advanced 3D Animation
This course pushes character animation to a new level with drama, emotion, and speech. Topics will include facial expressions, character rigging, and scenes with multiple characters interacting. Professional animation software will be used. By the end of the course, students will be able to create advanced biped and quadruped character animation with dialogue and emotion. (SOFA-616 Intermediate 3D Animation) **Class 2, Lab 3, Credit 3 (F)**

SOFA-717 Animation Workshop
This course is the student's second experience producing a complete animated film individually or in collaboration with a classmate. In this workshop style course, students design and implement all phases of a single-frame film production and produce a short film with sound. Weekly meetings will discuss and critique the progress and merits of each student's work. Students will rely only on techniques learned in previous classes. The final film must be screened for the school community at the end of the course. (SOFA-622 30-Second Film) **Class 4, Credit 4 (F)**

SOFA-721 Fall Film
This course allows the second-year graduate student in Production or Screenwriting an opportunity to complete their second major production in the program. They must decide on a concept, develop a treatment, write a script or research a non-fiction subject and produce the film complete with mixed track and finished titles and credits. (SOFA-602 Production Processes) **Class 3, Credit 3 (F)**

SOFA-725 Business Careers and Animation
This class will be geared toward the small animation business owner and individual freelance animator. We will discuss the setting up of a small business and all of its operations. There will be reference to bigger business entities and many of the same principles will apply to both types of businesses. The elements of discussion will teach students how to go about approaching animation work in the industry from a small business point of view and from an individual approach. There will be many references and sources pointed out in class, including State, Federal and private websites full of information on the workplace. The class will discuss the creation of sample reels, websites, self-promotion, research and interview techniques all related to the individual animator. Discussions of ethics and individual responsibilities will be covered. **Class 3, Credit 3 (S)**

SOFA-735 Business and Careers in Film
An introduction to all aspects of the business side of professional film/video narrative and commercial production. Students develop a business plan to create their own production company while learning alternative careers in film, basic financial and legal protocol, and mental preparation needed to enter the film business market. (SOFA-602 Production Processes) **Class 3, Credit 3 (F)**

SOFA-763 Cinematography and Lighting
In this course students explore the world of cinematography and lighting and how they relate to each other. Students participate in weekly hands-on exercises to develop and improve cinematic storytelling through composition, framing and lighting techniques. (SOFA-602 Production Processes) **Class 3, Credit 3 (F)**

SOFA-765 Creative Research Workshop
A research and/or production opportunity for advanced students with extensive prior experience in the field of animation or live action filmmaking to work on a special project independently or collaboratively under the supervision of a faculty adviser. Enrollment in this course is by application only and with permission of a faculty adviser. (Permission required) **Class 3–6, Credit 3–6 (F, S)**

SOFA-772 Frame by Frame Techniques
This course will give all students a chance to explore three different approaches to stop-motion animation. The class will study and experiment with pixilation, time-lapse and relief animation with a down-shooter. These techniques will expand the MFA student's knowledge of traditional or character animation and present an alternative means of expression. Students can explore character or experimental approaches to animation with these non-traditional alternative approaches to single frame animation. The class will study existing works that utilize these techniques, analyze and discuss them with the instructor, and then produce several examples of their own after instruction for each approach. There will be a final project in the technique of the student's choice. **Class 3, Credit 3 (F)**

SOFA-780 Thesis Preparation Seminar
Thesis Preparation Seminar provides the opportunity for students to develop a written proposal for an MFA thesis, to find a thesis chair and committee, and to present and argue for that thesis before a faculty committee seeking approval of the proposal. The thesis will provide the backbone of a candidate's final filmmaking production leading to the Masters of Fine Arts and the written and final thesis paper. (SOFA-721 Fall Film or SOFA-717 Animation Workshop, permission required) **Class 2, Credit 1 (S)**

SOFA-790 Research and Thesis I
Students work independently according to their approved timeline on their thesis project. They must meet on a regular basis with their committee chair and at least twice with their full committee during the semester. This is the first of two courses designed to advance a student towards completion of their thesis. Once the thesis committee determines that the candidate has completed 50% or more of the project the student should register for SOFA-890 Research and Thesis. (Permission required) **Credit 1–4 (F)**

SOFA-890 Research and Thesis II
Students work independently according to their approved timeline on their thesis project. They must meet on a regular basis with their committee chair and at least twice with their full committee during the semester. This is the second of two courses designed to advance a student towards completion of their thesis. Once the thesis committee determines that the candidate has completed 50% or more of the project in Research and Thesis I the student should register for this course. Students must also write a thesis paper that summarizes in detail their thesis experience. (Permission required) **Credit 1–4 (S)**

School of Photographic Arts and Sciences

Graduate Photography

PHGR-701 Histories and Aesthetics of Photography I
This fall semester course presents an overview of the multiple, intersecting histories and aesthetic practices of photography, integrating fine art, documentary, photojournalism, and commercial and editorial photography within a broader cultural discussion. Beginning with the announcement of photography in 1839, we will study technological advancements, photographers' oeuvres, and cultural and artistic movements during the first 100 years of photography. **Class 3, Credit 3 (F)**

PHGR-702 Histories and Aesthetics of Photography II
This spring semester course focuses on conceptual developments within the significant themes of the multiple, intersecting histories and aesthetic practices of photography. Integrating fine art, documentary, photojournalism, and commercial and editorial photography, we will consider photographic genres and movements within a broader cultural framework. (PHGR-701 Histories and Aesthetics of Photography I) **Class 3, Credit 3 (S)**

PHGR-703 Imaging Core I
The principle critique class for students in the MFA Imaging Arts program. Each student will establish a working methodology, which allows for experimentation with attention to process. Students are expected to undertake a conceptually creative and intellectually challenging investigation into their own work. Through a critical engagement with peers, each student develops a body of new work and an artist's statement. The course culminates with a faculty review of the student's artwork. **Class 3, Credit 3 (F)**

PHGR-704 Imaging Core II
This course is the second in the sequence of principle critique classes for students in the MFA Imaging Arts program. Having established a working methodology in Imaging Core I, students will continue to experiment and consolidate a significant body of work through a critical engagement with peers. The focus of the course will lead to half-candidacy conducted through a formal MFA faculty review of the work. (PHGR-703 Imaging Core I) **Class 3, Credit 3 (S)**

PHGR-705 Imaging Workshop
Each faculty member can offer graduate students a different opportunity to explore the multiplicity of ways in which Imaging Arts can be used as a vehicle for expression and communication. Visual research, individual critiques, field trips, studio and laboratory practices and critical readings will be used. Imaging workshops may be conducted using one focus and taught on a one-on-one basis, or organized to provide a class with critical feedback on their various self-assigned focused projects. Topics may include experimentation with specialized technology such as platinum printing, working on an installation, on a suite of new prints, or on an artist's book. The content of the workshop will be unique to each student's interests and will assist them in the development of their core and thesis work directly or indirectly. **Class 3, Credit 3 (F, S)**

PHGR-711 Graduate Seminar
This course is the primary community-building experience for new graduate students, introducing them to their classmates, faculty, staff, and RIT facilities. Each MFA faculty will present his/her artwork and interests to the class. Students will hone their skills in image interpretation, critical analysis, and scholarly writing as applied to visual artwork while also learning about the multiple research facilities and capabilities of the university and the larger region (George Eastman House, Visual Studies Workshop, etc.). Students will increase their visual language vocabulary and attend ongoing MFA thesis exhibitions and thesis defense sessions of second-year graduates. **Class 3, Credit 3 (F)**

PHGR-721 Research Core
This course will outline the policies and procedures required for the MFA thesis (thesis committee, written thesis, thesis exhibition, and thesis defense) and provide students with research tools and resources to begin writing their first draft of the written Thesis proposal. Class presentations will include methods of scholarly writing and editing procedures. The class will attend concurrent thesis exhibitions and defense sessions that are scheduled during the semester. As a continuation of the first-year's critique of creative visual work, each student will produce more advanced work required for their thesis exhibition. Class critiques will address this work as well as components of drafts of written thesis manuscripts. At the end of the semester, final drafts of the written thesis are to be delivered to the appropriate thesis committee of each student. **Class 3, Credit 3 (F)**

PHGR-722 Contemporary Issues
A study of current issues relevant to photo-based fine art and related media, how they relate to broader historical/cultural issues and how they might suggest future directions. Emphasis is placed on the integration of critical theoretical discourses and studio practice. **Class 3, Credit 3 (F, S)**

PHGR-724 Professional Development for the Emerging Artist
This class prepares the advanced student for a career in the arts. It covers practical information related to the idea of professional practice such as resume writing, grant writing, developing a teaching philosophy, writing an artist's statement and researching exhibition spaces. It addresses the role of the artist in society, and includes interviews with artists and museum professionals. Students undertake research, develop an individual class syllabus, apply for professional opportunities, and create an individualized career profile and resource blog and/or notebook. **Class 3, Credit 3 (S)**

PHGR-756 Moving Media I
Students will work with digital video recording and electronic imagery to create new work that expands the disciplines of photography and video. Projects will involve creating experimental narratives, conceptual constructions, and performance pieces. Students will work with traditional photographic processes, electronic media, Web resources, editing software, and projection technologies to create and display their work. **Class 2, Lab 3, Credit 3 (F)**

PHGR-757 Workflow for Image Makers
This course addresses the vital issue of digital imaging workflow within a fine art discipline. In combination with this practical approach, this course also places fine art digital image-making within the historical context of art, photography, and culture, in particular its relationship to photomechanical processes and new media. Students will learn digital imaging from conceptualization to capture to output with consideration of its specific aesthetic language. **Class 3, Credit 3 (S)**

PHGR-766 Moving Media II
This course uses foundational skills developed in Moving Media I to work with time-based imagery projects in order to advance visual language and technical skills. Students learn to record sound with off-camera microphones and sound recorders. Students study historic and contemporary media artists, and analyze various strategies used to convey conceptual ideas. Students will design a series of independent projects and produce a final project for presentation in the Media Café. (PHGR-756 Moving Media I) **Class 2, Lab 3, Credit 3 (F)**

PHGR-767 Beyond the Family Album
This course balances the production of original artwork with primary and secondary research within a seminar format. The narrative of the family photographic album is a core subject of investigation. The concept of an album and its content move beyond the conventions of a book form to embrace new technologies and installation. Visual art projects addressing the representation of family life in the public and private spheres and interdisciplinary critical readings form the underpinnings of research against which written and visual work will be produced. **Class 3, Credit 3 (S)**

PHGR-799 Imaging Arts Graduate Independent Study
Imaging Arts Graduate Independent Study will provide students with the ability to study in a specialized area with an individual faculty member. Students, with the assistance of a faculty adviser, should propose a course of study or project with clearly defined goals and outcomes. Students must obtain permission of an instructor and complete the Independent Study Permission Form to enroll. Student must have a minimum 3.0 GPA. (permission required) **Credit variable 1–4 (F, S)**

PHGR-890 Thesis
The thesis work produced represents the capstone project of the MFA degree in Imaging Arts. There are several components which includes primary and secondary research, the completion of the thesis exhibition, the writing of the thesis paper, and presentation of the thesis defense. (PHAR-721 Research Core, permission required) **Class 3, Credit 3 (F, S)**

School of Print Media

Print Media

PPRT-601 — Materials and Processes in Printing
This course offers a survey of the materials and processes used in print reproduction. Students will learn the basic theory of image reproduction embodied in the available analog and digital printing processes, and learn to identify the process origins of print samples. Additionally, students will learn the chemical and physical properties associated with consumables in order to obtain an understanding necessary to make informed decisions about use and application. **Class 2, Lab 3, Credit 3 (F)**

PPRT-602 — Tone and Color Analysis
This course covers fundamentals of color measurement, color management system, and color reproduction technology for color matching and color image reproduction. Emphasis is placed on CIE colorimetry, device calibration and characterization, and color management systems. **Class 2, Lab 3, Credit 3 (F)**

PPRT-699 — Print Media Co-op
The Co-op will provide students with the opportunity to work in the graphic communication field. (Permission required) **Credit 0 (F, S, Su)**

PPRT-701 — Operations Management in the Graphic Arts
An in-depth study of the factors affecting the efficiencies and effectiveness of print media organizations and ultimately their profitability. Includes consideration of both internal factors, such as quality level goals, training, scheduling, plant layout, and financial management, and external factors, such as environmental and legal issues and safety enforcement. **Class 3, Credit 3 (F)**

PPRT-703 — Cross Media Workflow
This course is designed to expose students to all the elements needed to master a cross media publishing project. Students will learn concepts and laws around copyright as it applies to cross media publishing. Concepts and tools necessary for the implementation of a cross media workflow will be discussed and reinforced with hands-on exercises. Additionally, ways companies create and utilize cross media workflows will be studied. Emerging industry and ISO standards as well as best practices for each of the fields discussed in the course will be presented. **Class 3, Credit 3 (S)**

PPRT-704 — Research Methods and Trends in Graphic Media
This course provides a foundation for conducting scientific research in the graphic communications industry. Students will learn the scientific method, how to generate a hypothesis or research question, conduct secondary research, select the best research design to answer the research questions, and how to analyze basic survey data. The course will also introduce students to the current issues in the industry in preparation for them to identify a thesis or capstone project problem. **Class 3, Credit 3 (S)**

PPRT-741 — Digital Printing and Publishing
This course provides students with the opportunity to learn the concepts and applications of digital printing. The course examines the technology of several major digital print engines and compares digital printing to conventional print processes. The economics and application of specific digital printing processes are examined from a workflow perspective. **Class 2, Lab 3, Credit 3 (S)**

PPRT-742 — Industry Issues and Trends
This course presents a detailed analysis of the critical trends and issues related to the graphic communication industry. It provides an in-depth analysis of key technologies as well as business, environmental and regulatory issues. This course provides a capstone experience that contributes to the student's fuller understanding of changes in graphic communication constituencies and their role within the industry. By tracing historical roots, analyzing present issues and detailing future trends, students are prepared develop insights into the nature and scope of the major challenges facing industry leaders and how to manage these challenges. **Class 3, Credit 3 (S)**

PPRT-743 — Perspectives on Contemporary Publishing
An examination of how various contemporary publishing entities are responding to changes in technology and social habits with an emphasis on editorial, production, circulation/distribution, and marketing issues and concerns. The course will begin with a brief review of historic book models and practices with respect to their continued influence on today's formats and designs. The advantages and disadvantages of the various kinds of publishing dissemination mechanisms are discussed, together with an exploration of the divisions now occurring between print-based, Web-based, and digital-device-based delivery of content. The degree to which the intellectual content of books is changing in response to technology will also be covered. **Class 3, Credit 3 (S)**

PPRT-744 — Advanced Color Management
This course embraces ICC-based color management practices by assessing color reproduction quality quantitatively and psychometrically. It also examines state-of-the-art tools, procedures, and techniques for device calibration and color control. Students are expected to work in a team environment, to plan, conduct experiments, and to publish a technical publication. (PPRT-602 Tone and Color Analysis) **Class 2, Lab 3, Credit 3 (S)**

PPRT-745 — Typography Research
The course builds on fundamentals and skills taught in introductory and advanced typography courses by developing methods of investigation, research, and analysis, with the goal of enabling students to conduct independent research. Students choose individual typographic topics to research (e.g. technology, psychology, history, aesthetics, imaging, writing systems, culture, and society). Students each give presentations on their topics and prepare a written report. The course emphasizes individual initiative and seminar participation. **Class 3, Credit 3 (S)**

PPRT-790 — Thesis
To conduct research on a topic relevant to the graphic arts industry. Topic must be approved by a committee comprising graduate faculty and an adviser. (PPRT-704 Research Methods and Trends in Graphic Media, permission required) **Credit 1-6 (F, S)**

PPRT-799 — Independent Study
The student will work with a faculty adviser to create a series of readings, writings, or original research that addresses a key concern in the field of graphic communications. (Permission required) **(F, S, Su)**

College of Liberal Arts

James J. Winebrake, Dean
www.rit.edu/cla

Programs of study

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The College of Liberal Arts offers master of science degrees in the following areas: applied experimental and engineering psychology; communication and media technologies; criminal justice; science, technology, and public policy; and school psychology.

Elective graduate courses complement the professional emphasis of our degree programs by exploring the broader knowledge and social implications embodied in these areas of study. By providing this humanistic perspective, these courses play an integral role in professional education, making a direct and distinct contribution to the student's preparation for a specialized career.

The college also provides a number of graduate courses that serve as electives for graduate degree programs offered by other RIT colleges.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

Members of the faculty serve as students' advisers as well as their professors. Their backgrounds in their fields, in the classroom, and in their research are the basis for academic standards and expertise that anticipate graduates' career requirements.

Study options

Most graduate programs offer a variety of study options, including full-time, part-time, and online study. Please refer to each individual program for specific information regarding these options.

Applied Experimental and Engineering Psychology, MS

http://www.rit.edu/cla/psychology/engg.htm
Andrew Herbert, Department Chair
(585) 475-4554, amhgss@rit.edu

Program overview

The master of science degree in applied experimental and engineering psychology emphasizes the role of human behavior and performance in both simple and complex human-machine systems. The departments of psychology, industrial and systems engineering, and information technology all contribute to the program's curriculum.

Engineering psychology examines human capabilities to sense, perceive, store, and process information, and how these human factors impact interactions with technology. This knowledge is applied to the design, use, and maintenance of human-machine systems. Students are trained in both research methods of experimental psychology and application of the results to contemporary problems in industry.

Engineering psychologists are interested in how and why performance might be changed through the use of technology. For instance, a new interface for controlling the radio in a vehicle may cause errors because a control is too sensitive for human-motor performance or because the driver is confused as to how to use the interface.

The program prepares students to function as effective engineering psychologists in industrial, governmental, or consulting organizations. The program also provides a foundation for further advanced academic study in human factors or experimental psychology.

Curriculum

The MS program in applied experimental and engineering psychology includes 16 quarter credit hours of core courses, 16 quarter credit hours of required engineering pscyhology courses, two elective courses, and 8 quarter credit hours of thesis work.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program title change
Effective fall 2013, the program in applied experimental and engineering psychology will be renamed experimental psychology. This change will not affect currently matriculated students.

Applied experimental and engineering psychology, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0514-784	Graduate Statistics	4
0514-785	Advanced Perception	4
0514-786	Research Methodology	4
0514-787	Advanced Cognition	4
0514-788	Topics in Engineering Psychology	4
4004-745	Foundations of Human-Computer Interaction	4
0303-731	Advanced Topics: Ergonomics/Human Factors	4
0303-734	Systems Safety Engineering	4
Second Year		
	Electives	8
0514-889	Thesis Proposal	8
Total Quarter Credit Hours		**48**

Experimental psychology, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
PSYC-640	Graduate Statistics	3
Choose one of the following:		3
PSYC-714	Graduate Engineering Psychology (AEEP Track)	
	PSCY Elective (Experimental Track)	
PSYC-751	Graduate Research Seminar	0
PSYC-642	Graduate Research Methods	3
PSYC-752	Thesis Proposal	3
	PSYC Elective	3
	Free Electives	6
Second Year		
PSYC 753	Thesis	3
	PSYC Elective	3
Choose one of the following:		3
	PSYC Elective	
	Free Elective	
Total Semester Credit Hours		**30**

Electives

Students select two from the following (Students should check for course prerequisites or if permission of the instructor is required):
4004-748 Usability Engineering
4004-749 Usability Testing
4004-755 Advanced Topics in HCI
0303-760 Product/Process Development and Design
0303-732 Biomechanics
2014-701 Introduction to Computer Graphics
2014-717 Authoring Multimedia
2014-723 Graphical User Interface

Thesis

The thesis requires a minimum of eight quarter credit hours. Students select a thesis adviser during the first year. Selection of an adviser, thesis topic, and research proposal must be completed in the third quarter of the first year of the program. Ongoing research activity is expected in the spring and summer quarters of the first year of the program. At the completion of the thesis, students will publically present their findings and defend their research before a thesis committee.

Admission requirements

To be considered for admission to the MS in applied experimental and engineering psychology, candidates must fulfill the following requirements:

- Have 20 quarter credit hours (15 semester hours) of course work in undergraduate psychology or a related field (e.g., engineering, computer science, information technology), including one course in experimental psychology and another in statistics,
- Submit official transcripts (in English) for all previously completed undergraduate and graduate work,
- Have a minimum GPA of 3.0 (for undergraduate work),
- Submit scores from the Graduate Record Examination (GRE),
- Submit at least two letters of reference from professors or supervisors,
- Submit a biographical statement describing the applicant's experience and goals regarding the program, and
- Complete a graduate application.

Additional information

Cooperative education

The program includes an optional cooperative education component. Co-op is generally completed in the summer quarter after the first year of the program. The goal of a co-op experience is to provide experiential learning that integrates with classroom education. It allows students to apply psychological principles to problems in a variety of work environments. Co-op may be completed in any business or industrial setting.

School Psychology, MS

http://www.rit.edu/cla/schoolpsychology/
Suzanne Bamonto, Graduate Program Director
(585) 475-2765, sbggsp@rit.edu

Program overview

The master of science degree in school psychology is approved by the National Association of School Psychologists and prepares students for provisional New York state certification as school psychologists. Designed to provide students with a strong background in psychological foundations, the program develops professional skills and competencies in assessment, counseling, consultation, and program evaluation.

A school psychologist works with young children (birth to age five); elementary, junior high, and high school students; teachers and administrators; parents; and professionals to offer services that lead to the amelioration of existing student difficulties and attempts to prevent school problems. Through diagnostic testing, counseling, consultation, and intervention, school psychologists help students deal with learning and behavioral difficulties and help improve students' adjustment to school and their community.

The master of science degree is awarded after students have completed all course work, an internship, and have passed a portfolio review. The advanced certificate in school psychology is awarded to students who have met all the requirements of the MS degree and have completed and defended a thesis or research project.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

School psychology, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0527-726	Psychoeducational Assessment I	4
0527-724	Interpersonal Intervention Skills	4
0527-733	Applied Behavioral Analysis	4
0527-712	Practicum I	2
0527-731	Psychoeducational Assessment II	4
0527-749	Advanced Consultation	4
0527-701	Advanced Developmental Psychology	4
0527-713	Practicum II	2
0527-732	Psychoeducational Assessment III	4
0527-744	Advanced Counseling	4
0527-723	Developmental Psychopathology	4
0527-714	Practicum III	2
Second Year		
0527-734	Linking Assessment to Intervention	4
0527-745	Alternative Assessment Techniques	4
0527-759	Research Methods I	2
0527-728	Inferential Statistics I	2
0527-715	Practicum IV	2
	Project/Thesis	3
0527-742	Biological Basis of Behavior	4
0527-702	Psychology of Teaching/Learning	4
0527-810	Research Methods II	2
0527-811	Inferential Statistics II	2
0527-716	Practicum V	2
0527-703	Cultural Diversity in Education	4
0527-752	Children and Trauma	4
0527-730	Seminar—Professional and Legal Issues	4
0527-717	Practicum VI	2
Third Year		
0527-777	Internship I	3
0527-777	Internship II	3
0527-777	Internship III	3
	Project/Thesis (If needed)	
Total Quarter Credit Hours		**96**

School psychology, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SPSY-631	Cognitive Assessment	3
SPSY-630	Academic Assessment	3
SPSY-620	Interpersonal Intervention Skills	3
SPSY-610	Advanced Developmental Psychology	3
SPSY-600	Field Experience I: Professional School Psychology Foundations	3
SPSY-632	Social-Emotional Assessment	3
SPSY-721	Academic Intervention	3
SPSY-640	Statistics	3
SPSY-650	Applied Behavior Analysis	3
SPSY-601	Field Experience II: Professional School Psychology Foundations	3
Second Year		
SPSY-730	Comprehensive Assessment Integration	3
SPSY-641	Research Methods	3
SPSY-720	Advanced Consultation	3
SPSY-710	Developmental Psychopathology	3
SPSY-701	Advanced Practicum I: Issues in Diversity	3
SPSY-722	Advanced Counseling	3
SPSY-723	Systems and Organizational Interventions	3
SPSY-611	Biopsychology	3
SPSY-603	Ethical and Legal Issues	3
SPSY-702	Advanced Practicum II: Issues in Diversity	3
Third Year		
SPSY-750	Internship	3
SPSY-750	Internship	3
Total Semester Credit Hours		**66**

Degree requirements

A minimum of 96 quarter credit hours are required for completion of the program. Before registering for the internship, students must pass a portfolio review. A cumulative GPA of 3.0 or above is required.

Admission requirements

To be considered for admission to the MS program in school pscyhology, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at an accredited college or university,
- Have a minimum undergraduate cumulative GPA of 3.0,
- Have completed at least 18 semester hours (27 quarter hours) in behavioral sciences with a grade of B or above,
- Have completed prerequisite undergraduate courses in general psychology, elementary statistics, child or developmental psychology, and abnormal psychology,
- Submit scores from the Graduate Record Exam (GRE),
- Submit letters of reference,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit an essay outlining the candidate's goals and related experience that shows evidence of a professional commitment and the potential for developing effective relationships with children, youth, and adults,
- Complete an individual interview, and
- Complete an application for graduate study.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. A minimum score of 580 (paper-based) is required. This requirement is waived for native speakers of English and those submitting transcripts from American universities.

All credentials must be submitted and reviewed before the student completes 12 quarter credit hours of graduate work in the program. Applications are due by February 1. Later applications will be reviewed on a space-available basis.

School Psychology, Adv. Cert.

http://www.rit.edu/cla/schoolpsychology/
Suzanne Bamonto, Graduate Program Director
(585) 475-2765, sbggsp@rit.edu

The advanced certificate in school psychology is awarded to students who have met all the requirements of the MS degree and have completed and defended a thesis or research project. (The master of science degree is awarded after students have completed all course work, an internship, and have passed a portfolio review.) Please refer to the program description for the MS degree in school psychology for information on course work and admission requirements.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Program modification
Effective fall 2013, the advanced certificate in school psychology will be offered as a stand-alone program. This change will not affect currently matriculated students.

School psychology, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0527-726	Psychoeducational Assessment I	4
0527-724	Interpersonal Intervention Skills	4
0527-733	Applied Behavioral Analysis	4
0527-712	Practicum I	2
0527-731	Psychoeducational Assessment II	4
0527-749	Advanced Consultation	4
0527-701	Advanced Developmental Psychology	4
0527-713	Practicum II	2
0527-732	Psychoeducational Assessment III	4
0527-744	Advanced Counseling	4
0527-723	Developmental Psychopathology	4
0527-714	Practicum III	2
Second Year		
0527-734	Linking Assessment to Intervention	4
0527-745	Alternative Assessment Techniques	4
0527-759	Research Methods I	2
0527-728	Inferential Statistics I	2
0527-715	Practicum IV	2
	Project/Thesis	3
0527-742	Biological Basis of Behavior	4
0527-702	Psychology of Teaching/Learning	4
0527-810	Research Methods II	2
0527-811	Inferential Statistics II	2
0527-716	Practicum V	2
0527-703	Cultural Diversity in Education	4
0527-752	Children and Trauma	4
0527-730	Seminar—Professional and Legal Issues	4
0527-717	Practicum VI	2
Third Year		
0527-777	Internship I, II, III	9
	Project/Thesis (If needed)	
Total Quarter Credit Hours		**96**

School psychology, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
SPSY-630	Academic Assessment	3
SPSY-620	Interpersonal Intervention Skills	3
SPSY-650	Applied Behavior Analysis	3
SPSY-640	Statistics	3
Second Year		
SPSY-641	Research Methods	3
SPSY-720	Advanced Consultation	3
SPSY-723	Systems and Organizational Interventions	3
Total Semester Credit Hours		**21**

Communication and Media Technologies, MS

http://www.rit.edu/cmt
Rudy Pugliese, Graduate Program Director
(585) 475-5925, rrpgsl@rit.edu

Program overview

Communication and the technologies for message creation and dissemination are at the center of dramatic economic, social, and cultural changes occurring as a result of technological development and global connectedness. The master of science degree in communication and media technologies is an interdisciplinary advanced program of study combining liberal arts courses in communication with course work in an applied or professional program. Graduates will be adept at the analysis of communication problems, the development of solutions, and the creation of messages as a result of their combined training in the social sciences, humanities, and applied technologies.

Communication courses rooted in the humanities and social sciences provide students with the opportunity to gain a broad, historical understanding of issues in communication, including the ethical, legal, and social dimensions. Additional courses give students advanced guidance in the creation of written and visual message content. Courses in applied technologies or professional programs provide opportunities for implementation and application. The required thesis combines knowledge, practice, original research, and application under the guidance of a graduate advisement committee.

Graduates are prepared for careers as communication experts in such venues as commerce, industry, education, entertainment, and government, as well as for graduate work toward a doctoral degree.

Curriculum

The degree requires the completion of a minimum of 45 quarter credit hours of graduate course.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Communication and media technologies, MS, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0535-701	History of Media Technologies	4
0535-702	Communication Theory	4
0535-703	Research Methods in Communication	4
0535-704	Communications Law and Ethics	4
	Communication Elective 1, 2, 3	12
	Applied Professional or Technical Electives 1, 2	8
Choose one of the following:		4
	Communication Elective 4	
	Applied Professional or Technical Elective 3	
0535-800	Project/Thesis	5–9
Total Quarter Credit Hours		**45-49**

Communication and media technologies, MS, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
COMM-701	History of Media Technologies	3
COMM-702	Communication Theories	3
	Communication Elective	3
	Professional Core	3
COMM-703	Research Methods in Communication	3
COMM-704	Media Law and Ethics	3
	Communication Elective	3
	Professional Core	3
COMM-800	Communication Thesis (summer)	6
	Communication Elective	3
	Professional Core	3
Total Semester Credit Hours		**36**

Communication electives

Students are required to select three communication electives from the choices below; a fourth elective is optional. History of Media Technologies (0535-701) and Communication Theory (0535-702) are prerequisites for all communication electives.

COURSE		QUARTER CREDIT HOURS
0535-705	Electronic Communication and Society	4
0535-706	Crafting the Message	4
0535-707	International Media	4
0535-708	Communication Education	4
0535-709	Online Advertising	4
0535-710	Visual Communication	4
0535-713	Readings in Mass Media	4
0535-725	Special Topics in Communication	4

Applied professional or technical courses

Students are required to select three applied professional or technical courses from the choices below; a fourth applied or technical course is optional.

COURSE		QUARTER CREDIT HOURS
College of Imaging Arts and Sciences		
2081-709	Printing Industry: Trends	4
2081-721	Digital Print and Publishing	4
2081-723	Contemporary Publishing	4
B. Thomas Golisano College of Computing and Information Sciences		
4002-722	Fundamentals of Instructional Technology	4
4002-741	Fundamentals of Web-Based Multimedia	4
4004-745	Fundamentals of Human-Computer Interaction	4
E. Philip Saunders College of Business		
0105-761	Marketing Concepts	4
0113-750	Marketing in a Global Environment	4
0105-767	Advertising and Integrated Marketing Communications	4
0105-772	Internet Marketing: Strategy and Tactics	4
0105-778	Commercializing and Marketing of New Products	4
0102-740	Organizational Behavior and Leadership	4
0102-741	Managing Organizational Change	4
0102-742	Technology Management	4
College of Applied Science and Technology		
0626-707	Applied Data Analysis in Human Resource Development	4
0635-840	Health Systems Policy and Law	4
0625-844	Breakthrough Thinking, Creativity, and Innovation	4
0635-715	Information Systems in Health Administration	4
0635-754	eHealth	4
0635-830	Health Systems Planning	4
0635-882	Bioethics	4
College of Liberal Arts		
0521-700	Readings in Public Policy	4
0521-708	Technological Innovation and Public Policy	4
0521-709	Public Administration and Management	4
0521-710	Information and Communication Policy	4

Graduate committee

A full-time student will create a graduate advisement committee by the end of the first semester of study. The committee will be comprised of at least one faculty member from the department of communication and one faculty member from outside the department. The outside member should have a terminal degree. The committee advises and guides the student's elective course selection and course sequencing. With the guidance and approval of the graduate advising committee, students design and conduct a thesis or thesis/project appropriate to their course of study and their career goals.

Master's thesis/project

A thesis or thesis/project is required of all students in the program. The thesis/project topic should complement the student's academic graduate interests and scholarly training. Topic selection and method(s) for implementing the thesis/project occur in consultation with the student's graduate advisement committee.

Admission requirements

To be considered for admission to the MS program in communication and media technologies, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at an accredited college or university,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a minimum cumulative undergraduate GPA of 3.0,
- Submit three letters of reference from academic advisers, major professors, and/or supervisors or managers,
- Submit a writing portfolio consisting of at least three writing samples, such as academic papers written for class, work-related brochures and pamphlets, or newspaper or magazine articles, and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 600 (paper-based) or 100 (Internet-based) are required.
  This requirement may be waived for students who submit undergraduate transcripts from American colleges and universities.

Criminal Justice, MS

http://www.rit.edu/cla/criminaljustice
John McCluskey, Graduate Program Chair
(585) 475-2666, ldmgcj@rit.edu

Program overview

The master of science degree in criminal justice emphasizes a multidisciplinary approach to urban studies with a focus on public safety. The program stresses training in policy analysis and practice, particularly as it is relevant to community and urban issues.

The program builds on a foundation of locally relevant policy research by providing students with the critical skills to carry out such work and the experience to assure success in employment or in pursuit of further graduate studies. The program's objective is to provide students with a strong foundation in criminological, criminal justice theory, and social scientific research skills, thus enabling graduates to have successful careers in the policy analysis arena or to be prepared to pursue advanced study beyond the master's degree.

Curriculum

A minimum of 48 quarter credit hours is required for completion of the MS in criminal justice.

Students transferring into the program from other BS degree programs at RIT or from outside the university should have a strong undergraduate foundation in criminology and research methods. Students that do not possess these skills may be required to complete additional undergraduate course work (e.g., Criminology, Theories of Crime, and Research Methods) or demonstrate that they have equivalent skills for completion of the degree.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Criminal justice, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0501-710	Pro-Seminar In Criminal Justice Theory	4
0501-720	Pro-Seminar in Research Methods	4
0501-721	Pro-Seminar in Law and Policy	4
0501-722	Advanced Criminology	4
0501-715	Advanced Statistics	4
0501-723	Crime, Justice and Community	4
0501-724	Interventions and Change in Criminal Justice	4
	Electives	12
	Research Practicum	4
	Thesis	4
Total Quarter Credit Hours		**48**

Criminal justice, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CRIM-700	Pro-Seminar In Criminal Justice Theory	3
CRIM-701	Statistics	3
CRIM-702	Pro-Seminar in Research Methods	3
	Elective	3
CRIM-703	Advanced Criminology	3
CRIM-704	Crime, Justice and Community	3
CRIM-705	Interventions and Change in Criminal Justice	3
	Elective	3
CRIM-800	Thesis in Criminal Justice	6
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in criminal justice, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited college or university,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate coursework,
- Submit two writing samples, one of which is a personal statement,
- Complete a personal interview,
- Have completed a statistics course (students may be required to take a data analysis or a statistics course if not taken previously),
- Submit two letters of recommendation (letters should be from faculty familiar with the applicant's academic work),
- Submit scores from the Graduate Record Examination (GRE),
- Have a minimum cumulative GPA of 3.0 (on a 4.0 scale), and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of Engish as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

Science, Technology and Public Policy, MS

http://www.rit.edu/cla/publicpolicy
Franz A. Foltz, Graduate Program Director
(585) 475-5368, fafgsh@rit.edu

Program overview

This innovative master of science degree in science, technology and public policy emphasizes the creation and understanding of engineering, science, and technology policy. The program builds on RIT's strengths as a technological university, enabling students to interact with faculty members and researchers who are working on scientific developments and technological innovations that drive new public policy considerations.

The program is interdisciplinary and draws significantly from disciplines and courses of study in RIT's colleges of Liberal Arts, Business, Science, Engineering, and Applied Science and Technology. The program is geared toward graduates who will make significant contributions in the private, public, and not-for-profit sectors.

All students take a set of policy core courses that emphasize analysis, problem solving, and interdisciplinary approaches. Students work with an adviser to choose electives that focus their policy studies in a particular area, such as environmental policy, telecommunications policy, or energy policy. Typical students include those with science or engineering backgrounds looking to broaden their career opportunities in government or business settings, as well as those with liberal arts undergraduate degrees (e.g., economics) interested in science, technology, and policy issues. Full-time students can typically finish the program in one to two years. The program prides itself on working one-on-one with students to ensure that their educational needs and academic goals are attained.

Curriculum

A minimum of 48 quarter credit hours is required for completion of the program. The program has five required core courses. In addition, students choose five courses within an area of specialization. Students also are required to successfully complete a master's thesis, which allows students to work with a faculty adviser on an independent research project in their area of interest.

Students may be required to complete an additional three-course policy analysis sequence (Graduate Policy Analysis I, II, and III) or demonstrate equivalent skills for completion of the degree.

Electives

Students choose five elective courses based on their interests and career goals. Courses may be offered in various colleges throughout the university, including the colleges of Business, Engineering, Science, and Applied Science and Technology. Course selection is done jointly with a faculty adviser and typically is aimed at developing a specialized area of interest for the student (e.g., biotechnology policy, environmental policy, energy policy, communications policy).

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Science, technology and public policy, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
0521-700	Readings in Public Policy	4
0521-701	Advanced Theory and Methods in Public Policy	4
0521-702	Evaluation Research	4
0508-740	Science, Technology and Policy Seminar	4
0521-709	Public Administration and Management	4
	Electives	20
	Thesis	8
Total Quarter Credit Hours		**48**

Science, technology and public policy, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
PUBL-700	Readings	3
PUBL-701	Graduate Policy Analysis	3
	Graduate Electives	6
STSO-710	Science and Technology Policy Seminar	3
PUBL-702	Graduate Decision Analysis	3
PUBL-703	Program Evaluation and Research Design	3
	Graduate Elective	3
PUBL-790	Thesis	6
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in science, technology and public policy, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at an accredited college or university,
- Have a minimum 3.0 overall GPA,
- Submit two writing samples, one of which should be a statement of interest,
- Submit scores from the Graduate Record Examination (GRE),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have completed course work in calculus and statistics (students may be required to take a data analysis or statistics course and an introductory calculus course, if not taken previously),
- Submit two formal letters of reference, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

Graduate Faculty

James J. Winebrake, BS, Lafayette College; MS, Massachusetts Institute of Technology; Ph.D., University of Pennsylvania—Dean; Professor

M. Ann Howard, BS, Cornell University; JD, Rutgers University—Sr. Associate Dean; Professor

Babak Elahi, BA, San Diego State University; MA, University of California at San Diego; Ph.D., University of Rochester—Associate Dean; Professor

Communication

Bruce A. Austin, BA, Rider College; MS, Illinois State University; Ph.D., Temple University—Professor

Keri Barone, BA, MA, State University College at Brockport—Lecturer

Grant C. Cos, BA, University of Massachusetts at Amherst; MA, Emerson College; Ph.D., Kent State University—Associate Professor

Andrea Hickerson, BA, Syracuse University; MA, University of Texas at Austin; Ph.D., University of Washington—Assistant Professor

Keith B. Jenkins, BA, University of Arkansas; MA, Ph.D., Florida State University—Associate Professor

Mike Johansson, MA, Syracuse University—Lecturer

Ammina Kothari, BA, North Central College; MA, University of Oregon; Ph.D., Indiana University—Assistant Professor

Ki-Young Lee, BA, Hanyang University (South Korea); MA, Northwestern University; Ph.D., Michigan State University—Associate Professor

Hinda Mandell, BA, Brandeis University; MA, Harvard University; Ph.D., Syracuse University—Assistant Professor

Kelly Norris Martin, BA, John Carroll University; MS, Ph.D., North Carolina State University—Assistant Professor

David R. Neumann, BA, Ithaca College; MA, Ph.D., Bowling Green State University—Professor

Elizabeth Reeves O'Connor, BS, MS, Rochester Institute of Technology—Senior Lecturer

Rudy Pugliese, BA, State University College at Oneonta; MA, State University College at Brockport; Ph.D., Temple University—Graduate Program Director; Professor

Andrew Quagliata, BS, MBA, Rochester Institute of Technology—Lecturer

Patrick M. Scanlon, BA, State University of New York at Albany; MA, Ph.D., University of Rochester—Department Chair; Professor

Jonathan E. Schroeder, BA, University of Michigan; MA, Ph.D., University of California at Berkeley—William A. Kern Professor in Communications

Wang, Xiao, BA, Beijing University of Aeronautics and Astronautics (China); MA, Marquette University; Ph.D., Florida State University—Assistant Professor

Tracy R. Worrell, BA, Otterbein College; MA, University of Cincinnati; Ph.D., Michigan State University—Assistant Professor

Criminal Justice

John Klofas, BA, College of the Holy Cross; MA, Ph.D., State University of New York at Albany—Professor

John McCluskey, BA, MA, Ph.D., State University of New York at Albany—Associate Professor

LaVerne McQuiller Williams, BS, Rochester Institute of Technology; MS, Buffalo State College; JD, Albany Law School; Ph.D., University at Buffalo—Department Chair; Associate Professor

Judy Porter, BA, University of Northern Colorado; MA, New Mexico State University; Ph.D., University of Nebraska at Omaha—Associate Professor

Christopher Schrek, BA, University of Florida; MA, University of Arizona; Ph.D., Pennsylvania State University—Professor

Jason Scott, BS, Roberts Wesleyan College; MA, Ph.D., State University of New York at Albany—Associate Professor

Tony Smith, BA, MA, Ph.D., State University of New York at Albany—Assistant Professor

Economics

Amit Batabyal, BS, Cornell University; MS, University of Minnesota; Ph.D., University of California at Berkeley—Arthur J. Gosnell Professor of Economics

Javier Espinosa, BS, Miami University; MA, Ph.D., University of Maryland at College Park—Assistant Professor

M. Jeffrey Wagner, BA, University of Missouri; MA, Ph.D., University of Illinois—Associate Professor

Humanities

Charles D. Collins, AB, Rutgers University; MA, Ph.D., University of Iowa—Professor, Fine Arts

Rebecca O. Edwards, BA, College of the Holy Cross; Ph.D., University of Rochester—Associate Professor, History

Timothy H. Engström, BA, MA, Ph.D., University of Edinburgh—Professor, Philosophy

David B. Suits, BA, Purdue University; MA, Ph.D., University of Waterloo—Professor, Philosophy

Psychology

Suzanne Bamonto, AA, Finger Lakes Community College; BA, State University College at Geneseo; Ph.D., University of Oregon—Graduate Program Director; Associate Professor

Joseph Baschnagel, BA, MA, Ph.D., State University of New York at Buffalo—Assistant Professor

Kirsten Condry, BA, Swarthmore College; Ph.D., University of Minnesota—Assistant Professor

Caroline DeLong, BA, New College of Florida; MA, Ph.D., University of Hawaii—Assistant Professor

Nicholas DiFonzo, AB, Lafayette College; MA, Rider College; MA, Ph.D., Temple University—Professor

John E. Edlund, BS, MA, Ph.D., Northern Illinois University—Assistant Professor

Roger Harnish, BA, University of Rochester; Ph.D., Oklahoma State University—Professor

Rhiannon Hart, BA, University of Washington; MS, Ph.D., University of Pittsburgh—Assistant Professor

Andrew M. Herbert, B.Sc., McGill University; MA, Ph.D., University of Western Ontario—Department Chair; Professor

Arturo Kiyama, BS, University of Arizona; MS, Montclair State University—Visiting Lecturer

Jennifer Lukomski, BA, Williams College; MA, Gallaudet University; Ph.D., University of Arizona—Associate Professor

Scott P. Merydith, BA, M.Ed., Ph.D., Kent State University—Professor

Vincent Pandolfi, BA, Lafayette College; MA, Ph.D., Hofstra University—Associate Professor

Esa Rantenen, BS, MS, Embry-Riddle Aeronautical University; MS, Ph.D., Pennsylvania State University—Associate Professor

Lindsay Schenkel, BA, St. John Fisher College; MA, Ph.D., University of Nebraska at Lincoln—Assistant Professor

Tina Sutton, BS, Union College; MA; Ph.D., State University of New York at Albany—Assistant Professor

Tywanquila Walker, BS, Vanderbilt University; Ph.D., Cornell University—Assistant Professor

Science, Technology, and Public Policy

Deborah Blizzard, BA, Smith College; MS, Ph.D., Rensselaer Polytechnic Institute—Acting Department Chair; Associate Professor

Thomas Cornell, BA, Rhodes College; MS, Georgia Institute of Technology; Ph.D., Johns Hopkins University—Professor

Franz A. Foltz, BS, MS, Pennsylvania State University; Ph.D., Rensselaer Polytechnic Institute—Graduate Program Director; Associate Professor

Ron Hira, BS, Carnegie Mellon University; MS, Ph.D., George Mason University—Associate Professor

M. Ann Howard, BS, Cornell University; JD, Rutgers University—Professor

William A. Johnson Jr., BA, MA, Howard University—Distinguished Professor

Christine Keiner, BA, Western Maryland College; Ph.D., Johns Hopkins University—Associate Professor

Robert J. Paradowski, BS, Spring Hill College; MA, Brandeis University; Ph.D., University of Wisconsin—Professor

Richard Shearman, BA, Western State College of Colorado; MS, Eastern New Mexico University; Ph.D., State University of New York College of Environmental Science and Forestry—Associate Professor

James J. Winebrake, BS, Lafayette College; MS, Massachusetts Institute of Technology; Ph.D., University of Pennsylvania—Dean; Professor

Quarter Courses

2012–2013 Academic Year

Note: *Prerequisites are within parentheses at the end of the course descriptions*

Applied Experimental and Engineering Psychology

0514-784 **Graduate Statistics**

This course introduces students to advanced inferential parametric and non-parametric data-analysis techniques commonly used in psychological research. These include single, independent and dependent samples, t-tests, factorial, repeated and mixed ANOVA, ANCOVA, contrast analysis, linear and multiple regression, chi-square goodness of fit and tests of independence, and Mann-Whitney U. The focus is on the conceptual understanding of these statistics, how different statistical procedures are applied in different research methods, how to perform analyses, how to interpret the results in the context of the research question, and how to communicate these results. No prerequisite. **Class 3, Lab 1, Credit 4 (offered at least every other year**

0514-785 **Advanced Perception**

This course will be organized so students will work in groups on various projects as well as covering topics through readings and classroom instruction. It is designed to provide students with a deeper understanding of topics in perception. The course will examine topics related to human factors and engineering psychology such as temporal and spatial frequency perception; after effects, visual illusions and their relationship to cortical function and pattern perception; color perception; depth and motion perception; higher order perception such as face and object recognition; and/or music and speed perception. The goal is to cover current research and theories in perception, looking at current developments and their antecedents. There will be lab time for students where they will examine empirical findings in perception and develop their research skills. **Class 3, Lab 1, Credit 4 (offered at least every other year)**

0514-786 **Research Methodology**

This course offers an in-depth examination of acquiring knowledge of human behavior and performance through the observation, identification, description, experimental investigation, and theoretical explanation of phenomena, that is, methods of science. Particular emphasis is placed on design of experiments, measurement of appropriate dependent variables, manipulation and transformations of data, exploratory data analysis and data visualization, and drawing conclusions from statistical tests. **Class 3, Lab 1, Credit 4 (offered at least every other year)**

0514-787 **Advanced Cognition**

This course will survey theoretical and empirical approaches toward understanding the nature of the mental processes involved in attention, object recognition, learning and memory, reasoning, problem solving, decision-making, and language. The course attempts to present a balance between historically significant findings and current state-of-the-art research. Readings that have structured the nature and direction of scientific debate in these fields will be practical applications. Students will have opportunities to develop their research skills and critical thinking by designing research studies in cognitive psychology. **Class 3, Lab 1, Credit 4 (offered at least every other year)**

0514-788 **Topics in Engineering Psychology**

The purpose of the course is to provide the students a solid foundation in the fundamental principles and methods of the very broad discipline of engineering psychology, but in the context of contemporary issues and problems reflecting current interests of both the instructor and the students. The topics covered in this course may vary each time it is offered. Students may thus repeat the course as many times as they want as long as it is on a different topic each time. **Class 3, Lab 1, Credit 4 (offered at least every other year)**

0514-889 **Thesis Proposal**

This course is restricted to GPSA students only. Permission of department is required to register for this course.

0514-890 **Thesis**

The thesis option will be available to students only with prior written approval of program faculty. Students must make clear their intent to enroll in the thesis option during the quarter prior to registration. Students will submit a proposal to a faculty member who agrees to serve as the student's committee chair. The proposal will describe the basic research question to be investigated and how the student will gain access to subjects. Proposal will be reviewed by the program faculty who will give permission to register for thesis credit. **Credit: one quarter for three quarters.**

0514-893 **Continuation of Thesis**

This course is restricted to GPSA students only. Permission of department is required to register for this course.

Communication and Media Technology

0535-700 Film and Society
This course provides an inquiry concerning the relationship between motion pictures and society that will use historical, humanistic, and social science research to achieve an understanding of movies as a social force, industry and art form. **Class 4, Credit 4 (offered occasionally)**

0535-701 History of Media Technology
This course is an introduction to the history of media technologies including print, telephone, broadcasting, and digital media. The course will also cover the inventors, landmark events, regulations and ethics of communication media along with their effects on and relationships with people and culture. **Class 4, Credit 4 (offered occasionally)**

0535-702 Communication Theory
This course focuses on theories of communication as they relate to technology. Theories based in both the humanities and in the social sciences that explain or predict the effects of communication technology on audiences will be presented. **Class 4, Credit 4 (offered annually)**

0535-703 Research Methods in Communication
This course provides an introduction to and overview of the methods and ethics of scholarly communication research including quantitative and qualitative approaches. The course focuses on methods of locating, critically analyzing and conducting communication research, and leads to the development of a research proposal suitable for a thesis or project. (0535-701, 702) **Class 4, Credit 4 (offered annually)**

0535-704 Communication Law and Ethics
This course focuses on issues presented by communication technologies to the practice of law and study of standards of ethics. Legal challenges presented by communication technologies will be examined in the following contexts: intellectual property, technology rights, patents, privacy and information networks, access to information, defamation, indecency, obscenity, and pornography. Special attention will be paid to the difficulty of applying national laws to international media. (0535-701,702) **Class 4, Credit 4 (offered occasionally)**

0535-705 Electronic Communication in Society
Electronic communication is an inquiry into interactive media and how they exert a powerful influence on communicative practices and society. Positioned at the intersection of technology, identity, and culture, interactive media are altering the ways in which people communicate in a wide range of contexts, including education, marketing, civic discourse, politics and popular culture. Utilizing theories about the relationship between communication technology and culture, this course will explore the current and potential future impact of interactive electronic communication and the social changes that are occurring. (0535-701, 702) **Class 4, Credit 4 (offered occasionally)**

0535-706 Crafting the Message
This course will focus on the creation of written and visual messages appropriate to a targeted audience and a specific medium including print, broadcast, interactive, digital and on-line technologies. Case studies of effective and unsuccessful messages from advertising, politics, public service, education, entertainment and development will be examined. Students will have the opportunity to create and execute a variety of messages using various writing styles and images, and with varying purpose. (0535-701, 702) **Class 4, Credit 4 (offered occasionally)**

0535-707 International Media
This course will evaluate media technology use in the international setting and in various countries and regions of the world. Major theories about the media, international communication developments, and governmental challenges and restrictions are considered. Comparative and cross-cultural studies of the uses and effects of media technologies within various countries and on global implications of the Internet and digital technologies on international cooperation, trade, and culture. (0535-701, 702) **Class 4, Credit 4 (offered occasionally)**

0535-708 Communication Education
This course examines various aspects of teaching communication in higher education. Students will explore teaching and learning styles, the role of technology in higher education, and assessment methods. Students will create teaching resources and gain experience teaching in a college classroom. **Class 4, Credit 4 (offered occasionally)**

0535-709 Online Advertising
This course reviews the theory and practice of interactive advertising. Topics include digital interactive media used for advertising purposes, interactive advertising theories and models, and the strategies and tactics for developing effective ad campaigns using interactive media, including the Internet, virtual communities, video games and mobile phones. (0535-701, 702) **Class 4, Credit 4 (offered occasionally)**

0535-710 Visual Communication
This course focuses on the use of still or moving images in mediated communication. Examples from print, television, internet, photography and film will be examined in light of traditional and emerging media. Rhetoric of image based technologies is examined. **Class 4, Credit 4 (offered occasionally)**

0535-712 Computer-Mediated Communication
This course is a graduate seminar examining the evolving forms and functions of computer-mediated communication, including e-mail, discussion groups, newsgroups, chat, instant messenger, and web pages. Grounded in rhetorical, mass media, and interpersonal theory the seminar explores electronically-mediated communication in its many contexts and manifestations in an effort to understand the evolving forms and functions of CMC and its impact on communicative behaviors and public discourse. Course objectives are met through readings, written papers, online observations, lectures, and class discussions. **Class 4, Credit 4 (offered occasionally)**

0535-713 Readings in Mass Media
This course is an introduction to the sub-discipline of mass communication via a series of essential texts of twentieth century thought on the subject. Complementing the readings will be a series of films with theses relating to media and their influence on society. It may be taken as an elective. (Matriculation in a graduate program or permission of the instructor.) **Credit 4, Class 4 (F)**

0535-725 Special Topics: Master's Level
This course is a focused, in-depth study and analysis of a selected advanced topic in communication and associated issues. Specific topics vary according to faculty assigned and are published when the course is offered. This course is an elective for communication and media technology majors. **Class 4, Credit 4 (offered occasionally)**

0535-800 Communication Thesis/Project
The graduate thesis/project will be guided and approved by the student's graduate advisement committee. Students may elect to conduct original research reported in a graduate thesis or to apply theory and research in an applied project. A minimum of 5 credits and no more than 9 credits can be earned as thesis/project credits. **Class 4, Credits 5–9 (offered annually)**

Criminal Justice

0501-710 Pro-Seminar in Criminal Justice Theory
In this pro-seminar students examine the theoretical foundation of criminal justice. This course integrates studies of criminal justice systems, enforcement organizations, judicial decision-making, courtroom communities and correctional systems by focusing on the study of governmental social control premised on punishment or blame worthiness. It examines the underlying causes and patterns of official responses to behavior that may be labeled criminal, and the structures, policies and practices of criminal justice. Required course for criminal justice master's degree program. May be taken as a graduate elective. (0501-400 or equivalent) **Credit 4, Class 4 (offered annually)**

0501-715 Advanced Statistics
The purpose of this course is to provide students with training in quantitative analysis of social science data. Students will develop a conceptual understanding of techniques, the ability to recognize the appropriate selection of techniques, and the ability to use those statistical measures and interpret their results. Students will gain experience with inferential statistics through the level of commonly used multivariate analyses. The prerequisite for this course will be a strong undergraduate foundation in statistical analysis. With the consent of their advisor and the graduate coordinator, qualified students may substitute more specialized statistics courses(s) in such areas as geographical information systems (GIS). Other students may select those courses as electives. Required course in criminal justice master's degree program. May be taken as a graduate elective. **Class 4, Credit 4 (offered annually)**

0501-720 Pro-Sem Research Methods
This seminar will focus on the principles and techniques of research with a special focus on evaluation research. The course will cover research conceptualization and design, development of appropriate measures, collection and analysis of data using a wide range of methods. Students will gain a thorough understanding of the research process as well as the policy implications and consequences of research and evaluation. Students will also begin to develop a thesis research proposal. Required course for the criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-721 Pro-Seminar in Law and Policy
The course will consider the processes of policy development and analysis in criminal justice with a particular emphasis on the intersection of policy and law. The legal and political environments of criminal justice policy will be examined in study of the development of federal crime policy. Additionally, the roots, development, legal context and impact of major policies such as contemporary policing strategies, problem solving courts and restorative justice will be explored. Required course in the criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-722 Advanced Criminology
This course will provide students with a detailed understanding of the theories that have guided criminological research and policy. Subject matter will cover the major influences in criminology: the classical school, the Chicago School, strain theories, socialization and learning theories, and conflict theories, among others. Required course for the criminal justice master's degree program. (0501-528 or equivalent) **Class 4, Credit 4 (offered annually)**

0501-723 Crime, Justice and Community
This course provides an overview of the role of communities in crime and criminal justice. The course begins by preparing a foundation in community theory. Students will gain an understanding of the critical dimensions and attributes which define "community." The course will involve an examination of community-based theory and research with a special emphasis on the criminology of place and how crime and justice patterns are embedded in particular social structures and cultures. We will discuss the extent to which structural characteristics and social processes are related to crime and disorder. The course will also examine the potential that exists within criminal justice to intervene in communities to reduce crime and disorder and "build community" in the process. Required course for the criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-724 Interventions and Change in Criminal Justice
This course will focus on theory and research regarding the effectiveness of broad anti-crime strategies and specific intervention efforts at the local, state, national and international level. Theoretical explanations of crime and ideological orientations towards crime will be linked with the crime control and prevention strategies associated with those perspectives. Each strategy of crime control/prevention (including deterrence, incapacitation, rehabilitation, and community crime prevention) will be assessed in terms of research findings focused on the effectiveness of such strategies. Detailed attention will be given to prevention/control strategies aimed at both juvenile and adult offenders. Required course in the criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-725 Criminal Justice Research Practicum
This research practicum will involve students designing and undertaking an evaluation of a program or intervention conducted in the field. Under the supervision of faculty, students will complete background research, review of literature, discussions with program leaders, design of a program evaluation and a preliminary evaluation. This may be conducted as a group project. Students will gain a thorough understanding of the research process as well as the policy implications and consequences of research and evaluation. Required course for the criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-726 Current Issues in Criminal Justice
This course focuses on contemporary issues and topics not otherwise distinctly incorporated in established criminal justice courses. It concentrates on student discussion and interaction surrounding required readings on topics such as crime prevention, qualitative design, crime mapping, and crime analysis. Elective course for criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-727 Crime and the Media
This course focuses on how media impacts the criminal justice arena. The course focuses on student discussion and interaction surrounding required readings on topics such as wrongful convictions, the Atticariots, violent crime, and how race, gender and class are related to the way crime is depicted in the media. Elective course for criminal justice master's degree program. **Class 4, Credit 4 (offered annually)**

0501-728 Directed Readings in Criminal Justice
This course will involve students designing and undertaking research related to crime or criminal justice policy conducted in the field. Under the supervision of faculty, students will complete background research and in-depth inquiry into the literature influencing key contemporary debates in crime and criminal justice. **Class 4, Credit 4 (offered annually)**

0501-799 Criminal Justice Independent Study
A student may register for a graduate independent study project subject to the approval of the faculty sponsor, chair of the Department of Criminal Justice and the dean of the College of Liberal Arts. Students who wish to take independent study should make arrangements several weeks before the quarter begins. An independent study project enables the interested students and his or her faculty sponsor to coordinate efforts on topics that range beyond the normal graduate course offerings. **Credit variable (offered annually)**

0501-800 Thesis in Criminal Justice
The master's thesis in criminal justice involves independent research on an approved topic judged by a faculty committee and under the supervision of one faculty member. The thesis requires students to develop, design and complete an original research project; orally defend the thesis before the thesis committee and the public; and submit a bound copy to the library. Students will meet weekly with their thesis chair. Required course for the criminal justice master's degree program. (0501-710, 0501-720, 0501-721, and 0501-722) **Class 4, Credit 4 (offered annually)**

Economics

0511-711 Microeconomic Graduate Students
This course develops the tools that are commonly used to study the allocation of resources in a mixed economy of private and public enterprises. This course provides an intensive overview of the microeconomic models underlying the actions of consumers and households, firms, regulators, and other public institutions. These models will be applied to current issues in policy (as it arises in all fields of inquiry). This course is an elective for science, technology, and public policy master's degree students; environmental science master's degree students; and students in other graduate programs seeking an economics elective course. **Class 4, Credit 4 (offered annually)**

0511-750 Benefit Cost Analysis
Most programs of governmental agencies are now normally evaluated using the techniques of benefit-cost analysis and debates about the usefulness of alternate projects often draw on benefit-cost findings. Yet, the application of benefit-cost analysis is controversial, in part because of disagreements about the goals of such analysis and about the way in which such analysis ought to be conducted. Thus, this graduate level course will explore the use and the abuse of benefit-cost and related analytical techniques commonly encountered in economic policy analysis. This course is an elective for science, technology and public policy graduate students; environmental science graduate students, and students in other graduate programs seeking an elective course in economics. (0511-211 or 0511-711 or equivalent) **Class 4, Credit 4 (offered annually)**

0511-757 Applied Econometrics
This course provides students with an opportunity to develop their skills in applied regression analysis. It covers the various regression models, estimation techniques, data preparation and transformation, and the interpretation of regression results. There is particular emphasis on the dangers of misuse of regression techniques. This course is an elective for the science, technology and public policy graduate students and students in other graduate programs with an interest in economics who have fulfilled the prerequisites. (0511-211, or 711, 1016-319, 1016-226) **Class 4, Credit 4 (offered annually)**

0511-766 Health Care Policy
This course examines the economics of health care including, the organization of its delivery and financing, analyzing access to care issues, the role of insurance, the regulation of hospitals, physicians, and the drug industry, the role of technology, and limits on health care spending. Calculus, intermediate or accelerated microeconomics, statistics and regression analysis are necessary tools for reading health care policy research and conducting economic modeling. This course is an elective for the science, technology and public policy graduate students and students in other graduate programs seeking an economics elective course. (0511-211 or equivalent) **Class 4, Credit 4 (offered annually)**

0511-781 Environmental Economics
This course examines the relationship and apparent conflict between economic growth and environmental quality, the economics of environmental issues and policy, the environment as a resource and a public good, and the ability and lack of ability of free markets and the government to deal adequately with pollution and other environmental problems. This course is an elective for science, technology and public policy graduate students; environmental science graduate students and students in other graduate programs seeking an economics elective course. (0511-211 or 0511-711 or equivalent) **Class 4, Credit 4 (offered annually)**

0511-784 **Natural Resource Economics**
This course develops an economic perspective on one of the most important and challenging issues facing global society— the allocation, use, and preservation of natural resources. The course presents and discusses the methodology economists use to inform natural resource managers and policy makers. Economic thought and analysis are used to evaluate a variety of issues in this area. The course concludes with a brief discussion of the interdisciplinary aspects of natural resource management. This course is an elective for the science, technology and public policy graduate students; environmental science graduate students; and students in other graduate programs seeking an economics elective course. (0511-211 or 0511-711 or equivalent) **Class 4, Credit 4 (offered annually)**

0511-810 **Economics of Sustainability**
The economics of sustainability entails conceptualizing appropriate dynamic consumption and production paths and strategies for attaining such paths. This course begins by exploring how problems of sustainability can be analyzed using the neoclassical economics paradigm. We then consider how sustainability concerns arise within consumer theory and within the theory of the firm (e.g., issues of green design). Standard modeling tools used in economics are introduced. Environmental and resource economic policy instruments are critically evaluated for use in various contexts in which sustainability is of concern. Consideration is given to how the economic theory of sustainability complements perspectives from other disciplines. The course concludes with a discussion of current issues in sustainability such as climate change. (0511-711 or equivalent or permission of instructor) **Class 4, Credit 4 (offered annually)**

History

0507-701 **History of Deaf Education and Thought**
This is an historical analysis of change and continuity in educational history from colonial through contemporary America. Special emphasis will be given to the development of the field of deaf education in the United States. Lectures, seminar discussions, and readings offer comprehensive coverage of the salient intellectual themes of American deaf educational history. **Class 4, Credit 4 (offered annually)**

Philosophy

0509-705 **Phosophy of Art and Aesthetics**
The four-hour meetings of this seminar are based largely on discussions, and participation of all students is required. Since the theories and examples discussed are mostly from the Western canon, familiarity with the history of Western art is recommended. The questions discussed are philosophical questions about art and aesthetic experience: What is the relationship between art and beauty, art and truth, art and knowledge, art and judgment, art and politics, art and interpretation, art and contemporary philosophical theory? What makes an interpretation of an artwork valid or invalid? How is aesthetic value related to other values? **Class 4, Credit 4 (offered annually)**

0509-706 **Philosophy of Mind**
Philosophy of mind is the philosophical discipline that explores what a mind is and how it fits in the natural world. In doing this, philosophy of mind raises further questions such as: What do we mean by the mind? How do we attribute mentality? How are mental and physical properties related? What is consciousness? Can computers think? How is rationality connected to mental states like beliefs and desires? In this course we discuss and critically assess answers to these and related philosophical questions. No prerequisite. **Class 4, Credit 4 (offered annually)**

0509-707 **Philosophy of Vision/Imaging**
This course appeals to sight, to the rhetoric of seeing, and to various media and technologies of imaging that have had an enormous impact on philosophy and on human culture generally. This course will introduce students to the philosophy of vision and imaging by critically investigating four interrelated sets of concerns: (1) the relation between appeals to vision and the imaging technologies that mediate what and how we see; (2) the relation between imaging technologies and the acquisition and representation of knowledge; (3) the relations between imaging technologies and human identity and agency; (4) the relations between imaging theories/practices and ethical, political, ideological, and social contexts. No prerequisite. **Class 4, Credit 4 (offered occasionally)**

0509-708 **Philosophy of Film**
The course will consider such thinkers/writers as: Sergei Eisenstein, Andre Bazin, Christian Metz, Sigfried Kracauer, Rudolf Arnheim, Noel Carroll, Jonathan Crary, Gilles Deleuze, Stanley Cavell, Leo Braudy, David Bordwell, Laura Mulvey, Roland Barthes, Lev Manovich, Anne Friedberg, and others. We will also consider such writers in the context of specific classical and contemporary films; and one of the responsibilities of the students in the class will be to determine some of the films to be considered for inclusion in the course. The course may also involve the occasional participation of faculty from other departments and disciplines who are interested in film theory. **Class 4, Credit 4 (offered occasionally)**

Public Policy

0521-700 **Seminar: Readings in Public Policy**
This course provides an in-depth inquiry into the seminal literature influencing key contemporary public policy debates. Students engage in critical reflection and original thought on theoretical and applied public policy problems. Emphasis is placed on policy issues in selected science and technology fields. (Graduate standing in the science, technology and public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (F)**

0521-701 **Seminar: Advanced Theory and Methods**
This course will cover the major theoretical and applied analytical methods and techniques in both quantitative and qualitative analysis. An emphasis will be placed on integrating empirical and normative concerns. Methods covered vary by quarter, but may include optimization, cost benefit analysis, systems modeling, and multi criteria decision analysis. (Graduate standing in the science, technology and public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (W)**

0521-702 **Seminar: Evaluation Research**
The focus of this course is on evaluation of program outcomes. Students will explore the questions and methodologies associated with meeting programmatic outcomes, secondary or unanticipated effects, and an analysis of alternative means for achieving program outcomes. Critique of evaluation research methodologies will also be considered. (Graduate standing in the science, technology and public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (S)**

0521-703 **Thesis Research**
The master's thesis in science, technology, and public policy requires the student to select a thesis topic, advisor and committee; prepare a written thesis proposal for approval by the faculty; present and defend the thesis before a thesis committee; and submit a bound copy of the thesis to the library and to the program chair. (Graduate standing in the science, technology and public policy master's program, acceptance of a thesis proposal and satisfactory completion of a minimum of 16 graduate credits are required.) **Class 4, Credit 8 (F, S, Su)**

0521-706 **Qualitative Policy Analysis**
This course examines multiple methodologies and techniques used for the qualitative analysis of public policy. The course examines methods known for their descriptive richness, interpretive insights, heightened concern for research subjects' views, and socio-cultural relativism. Specific techniques include: interviewing, field methods, participant observation, ethnography, focus groups, Delphi panels, and case studies. (Graduate standing) **Class 4, Credit 4 (offered annually)**

0521-708 **Technological Innovation and Public Policy**
Technological innovation, the incremental and revolutionary improvements in technology, has been a major causal factor for economic growth and social and political change. This course will introduce generic models of innovation that span multiple sectors including: energy, environment, biotechnology and information technologies. The course will then analyze how governments choose policies to spur innovation. (Graduate standing) **Class 4, Credit 4 (offered annually)**

0521-709 **Public Administration and Management**
This course provides an introduction to the fields of public administration and public management. This survey course covers topics such as bureaucratic behavior, program implementation, and recent innovations in management of public organizations. (Graduate standing) **Class 4, Credit 4 (offered annually)**

0521-710 **Information and Communication Policy**
This course examines how federal and international policies are developed to influence innovation of information and communication technology. In particular the course will examine such topics as privacy, freedom of speech, intellectual property rights, access to information technology, and regulation of the Internet. (Graduate standing) **Class 4, Credit 4 (offered occasionally)**

0521-712 **Graduate Policy Analysis I**
This course is the first in a three-course sequence (Graduate Policy Analysis I-III) that will provide students with tools to become effective policy analysts. This course will emphasize tools stemming from the decision sciences, statistics, and the rational choice method for policy analysis. Graduate standing in the science, technology and public policy master's program or permission of the instructor. Students who have taken 0521-402 may not take this course. **Class 4, Credit 4 (F)**

0521-713 **Graduate Policy Analysis II**
This course is the second in a three-course sequence (Graduate Policy Analysis I-III) that will provide students with tools to become effective policy analysts. This course will emphasize tools stemming from the decision sciences, statistics, and the rational choice method for policy analysis. Graduate standing in the science, technology and public policy master's program or permission of the instructor. Students who have taken 0521-403 may not take this course for credit. **Class 4, Credit 4 (W)**

0521-714 **Graduate Policy Analysis III**
This course is the third in a three-course sequence (Graduate Policy Analysis I-III) that will provide students with tools to become effective policy analysts. This course will emphasize tools stemming from the decision sciences, statistics, and the rational choice method for policy analysis. Students who have taken 0521-404 may not take this course for credit. **Class 4, Credit 4 (S)**

0521-749 **Special Topics**
This course will examine current topics in public policy and may be used with consent of advisor as a policy elective for the science, technology, and public policy master's degree. The course will examine a special problem or area relevant to the other courses in the degree. **Class 4, Credit 4 (offered occasionally)**

0521-751 **Energy Policy**
This course provides an overview of energy resources, technologies, and policies designed to ensure clean, stable supplies of energy for the future. The course evaluates the impacts of fossil fuel, renewable energy, and hydrogen technologies and how public policies can be used to influence their development. The development of U.S. energy policy is of particular concern, although a global perspective will be integrated throughout the course. This course is a professional elective for the science, technology, and public policy master's degree program and students in other graduate programs looking for policy electives (e.g., environmental science). **Class 4, Credit 4 (offered annually)**

0521-799 **Public Policy Independent Study**
A student may register for a graduate independent study project subject to the approval of the chair of the Public Policy Program and the dean of the College of Liberal Arts. Because of the length of the approval process, students who desire to take independent study should make arrangements several weeks before the quarter begins. An independent study project enbables the interested student and his or her faculty sponsor to coordinate their efforts on subjects and topics that range beyond the normal sequence of the graduate course selection. **Credit variable**

0521-810 **Technological, Policy, Sustainability**
This course introduces students to public policy and its role in building a sustainable society. The course places particular emphasis on the policy process; the relationship among technology, policy, and the environment; and policy mechanisms for addressing market and government failures that threaten sustainability. Enrollment is restricted to students in the PhD in Sustainability program or permission of instructor. May be taken as an elective by MS and BS/MS students in the science, technology, and public policy program; MBA students, MS students in sustainable engineering; other graduate students interested in the relationships among public policy, technology, and sustainability. **Class 4, Credit 4 (offered annually)**

0521-890 **Continuation of Thesis**
Involves the completion of established thesis or research project requirement as coordinated between the student and thesis/research advisor. **Credit 0**

School Psychology

0527-701 **Advanced Developmental Psychology**
This course will cover the major theoretical approaches to the understanding of human development. Areas of study will include, but not be limited to, cognitive development, language development, development of personality, social development and moral development. (see admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-702 **Psychology of Teaching and Learning**
This course is designed to furnish students with an understanding of the basic psychological processes underlying the educational process, and to apply them to concrete situations that may arise for persons who teach. Instruction and remedial techniques are reviewed. (see admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-703 **Cultural Diversity in Education**
The aim of the course is to understand the historical and structural origins of the present schooling system in the United States. The functions of schools, from an ideological as well as technical viewpoint, will be analyzed. In addition, different forms of school organizations will be compared, as in the public vs. private dimensions. The functionalist theoretical approach will be presented as well as the conflict perspective to frame the discussion and analysis of opposing sociological systems of thought. The role of education in promoting or inhibiting socio-economic mobility will also be analyzed. The course attempts to understand how role expectations are actually carried within the school system and how it's different actors react to technical as well as alue constraints. (See requirements for admission for prerequisites or receive permission of the instructor.) **Class 4, Credit 4 (offered annually)**

0527-712 **Practicum I**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-713 **Practicum II**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-714 **Practicum III**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-715 **Practicum IV**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-716 **Practicum V**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-717 **Practicum VI**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2 (F, S)**

0527-723 Developmental Psychopathology
This course focuses on maladaptive behavior of children and youth. Models of deviant behavior are presented, with attention to physiological, learned and environmental bases of behavior. Assessment and treatment approaches are discussed. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-724 Interpersonal Intervention Skills
This course will concentrate on the development of individual counseling and consultation skills for the School Psychologist. Students will acquire an understanding of the basic models and stages of the counseling and consulting processes. Throughout this class, emphasis will be on building fundamental active listening skills and helping clarify problem situations. Extensive laboratory work will involve role-play. Readings, classroom and laboratory activities have been designed to ensure that the students will view counseling and consultation processes as systematic. (Matriculation in school psychology program) **Class 4, Credit 4 (offered annually)**

0527-726 Psychoeducational Assessment I
This introductory course in a series of assessment courses will study assessment generally, types of tests and their uses, strengths and weaknesses of specific instruments, principles of reliability and validity, scales and norms. Students will acquire an understanding of the quantitative and qualitative aspects of measurement. There will be extensive laboratory experience with a variety of instruments which measure academic achievement and sensory-motor perception. Emphasis will be placed on the clinical use of tests in schools and other settings. (Matriculation in the school psychology program or permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-728 Inferential Statistics I
This course will train students in understanding and using inferential statistical concepts. Special attention will be placed upon use of computer applications, conceptual understanding of statistical tests, proper selection of statistical test, and proper interpretation and reporting of results. Topics include a brief review of descriptive statistics, confidence intervals, hypothesis testing, power, effect size, one-sample z and t tests, two-sample t tests, and one-way ANOVA. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 2 (offered annually)**

0527-730 Seminar: Professional and Legal Issues
Historic foundations and current critical professional issues, roles and functions of the school psychologist are emphasized in the course. Legal and ethical issues that bear on the role of the psychologist in the school are considered. (Matriculation in the school psychology program plus 32 quarter credit hours successfully completed in the program or permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-731 Psychoeducational Assessment II
This course concentrates on development of theory and applied skills in intellectual assessment. Students learn to select and administer individual intelligence tests, to interpret results, to form test based recommendations for intervention, and to provide written and oral reports. Assessment of persons who are culturally different or disabled is emphasized. (Matriculation in school psychology program and a grade of B or better in 0527-726) **Class 4, Credit 4 (offered annually)**

0527-732 PsychoEducational Assessment III
This course uses interview, behavioral observation, rating scales and projective measures for assessment of child and adolescent personality and adaptive behavior. Students gain experience administering, interpreting and reporting results of measures currently used in the practice of psychology in the schools. (Matriculation in the school psychology program plus a grade of B or better in 0527-726 and 731 or permission or instructor.) **Class 4, Credit 4 (offered annually)**

0527-733 Applied Behavior Analysis
This course offers training in the behavioral assessment of students in educational settings. Students apply various techniques for recording and analyzing behavior and programs for behavior management. (Matriculation in the school psychology program or permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-734 PsychoEducational Assessment IV
This is an applied course in the diagnostic evaluation of exceptional children and adolescents. Students select, administer, and integrate test data, and report results and recommendations for intervention to parents, teachers, and to multidisciplinary evaluation teams. An overview of relevant information on theory of exceptionality and current status of diagnosis and treatment of exceptional children and adolescents is provided. (Matriculation in the school psychology program and a grade of B or better in 0527-726, 731, 732) **Class 4, Credit 4 (offered annually)**

0527-742 Biological Basis of Behavior
This course is designed to review the neurophysiological and neuropsychological bases of behavior as it pertains to developmental disorders. Students will identify functional neuroanatomy, neuroimaging techniques, and various neurological and neuropsychological disorders. Students will apply findings and research to contemporary problems and issues facing school psychologists. **Class 4, Credit 4 (offered annually)**

0527-744 Advanced Counseling
This course focuses on the development of counseling skills used with children and adolescents in individual and group settings. Students are given the opportunity to integrate theory, research, and processes relative to individual and group work. Treatment plans are developed. Techniques for facilitating group counseling are emphasized. Crisis intervention is reviewed. (A grade of B or better in 0527-724) **Class 4, Credit 4 (offered annually)**

0527-745 Alternative Assessment
The prime focus of this course is on the assessment of academic problems in the classroom with special emphasis on the collection of data that allow the planning of interventions. Students will learn alternative direct methods of academic or behavioral assessment for both performance and skill deficits. Alternative assessment techniques include curriculum based assessment, curriculum based measurement, and analogue assessment. Emphasis will be on the integration of these assessment techniques, collaborative problem solving, systematic observation, the principles of applied behavior analysis and the psychology of learning for the purposes of intervention development. (0527-726, 731, 732, 733, 749 or permission of instructor) **Class 4, Credit 4 (offered annually)**

0527-749 Advanced Consultation
This course concentrates on the development of consultation skills for the school psychologist. Students acquire an understanding of the basic models of consultation and the stages of the consultation process. Emphasis is on the collaborative problem solving process where the skills of problem identification and analysis will be honed. Extensive laboratory work involves observations of trained consultants, role-play, and first-hand experiences through case consultation. Readings focus on pertinent research in school based consultation. (Matriculation in the school psychology program plus a grade of B or better in 0527-724 or permission from the instructor) **Class 4, Credit 4 (offered annually)**

0527-752 Children and Trauma
This course examines the nature, incidence, demographic distribution, sequelae and appropriate treatment of trauma in children's lives. After defining trauma, it explores how experiences such as parental or sibling death, serious illness or injury, familial alcoholism, emotional, physical and sexual abuse, divorce or parental abandonment, community violence and natural disasters affect children. **Class 4, Credit 4 (offered annually)**

0527-757 Special Topics
This course is designed to allow the student to focus on given specific topic or area of research relevant to school psychology. Such topics or activities may include selected readings, assessment techniques, direct intervention skills, or indirect intervention skills. This course may be offered from 02 to 04 credit hours depending on the specific topic covered. **Class 4, Credit variable (offered occasionally)**

0527-759 Research Methods I
This course explores various types of research methods as well as important methodological issues and concepts. Methodologies studied include experimentation, quasi-experimentation, participant observation, archival methods, content analysis, surveys, interviews, and simulations. Methodological issues covered include philosophical paradigms, research ethics, reliability, threats to internal validity, external validity, demand characteristics, the volunteer subject problem, issues in sampling, and realism. Students will read original and contemporary works on research methodologies, as well as examples of such methodologies, and will write weekly summaries, applications, and criticisms. Course activities rely heavily on seminar-style discussions and presentations. (Matriculation in the school psychology program or permission of the instructor) **Class 4, Credit 2 (offered annually)**

0527-777 Internship School Psychology I
Through direct, supervised 1,200-hour internship experience, the student will practice the various professional roles of a school psychologist in an educational setting. Competency in carrying out these tasks in an ethical and professional manner will be developed as preparation for employment. (Matriculation in the school psychology program plus satisfactory completion of 84 hours in graduate program and qualifying examination) **Class 3, Credit 3 (F, S)**

0527-799 **Independent Study**
A student may register for a graduate independent study project subject to the approval of the director of the student's graduate program, the faculty sponsor, the school psychology graduate committee and the dean of the college of liberal arts. Because of the length of the approval process, students who desire to take independent study should make arrangements several weeks before the quarter begins. An independent study project enables the interested student and his or her faculty sponsor to coordinate their efforts on subjects and topics that range beyond the normal sequence of the graduate course selection. **Credit variable**

0527-890 **Thesis**
Students will register for thesis spring quarter of their first year. Students must continue to register for thesis credit each subsequent quarter until the thesis is completed. Students must make clear their intent to enroll in the thesis option during the quarter prior to registration. Students will submit a proposal to a faculty member who agrees to serve as the student's committee chair. The proposal will describe the basic research question to be investigated and how the student will gain access to subjects. Proposals will be reviewed by the program faculty who will give permission to register for thesis credit.

0527-891 **Project**
This course is used to fulfill the project requirement under the non-thesis option in school psychology. The project may take the form of an original program designed to meet the needs of a specific school related population or a paper in some important or controversial topic. The candidate must obtain prior approval before registering for this course. A formal written paper and an oral presentation of the project are required. **Credit: one-quarter for three quarters**

Science, Technology and Society

0508-740 **Graduate Science and Technology Policy Seminar**
Students in this course will apply basic policy skills, concepts, and methods to a contemporary science and technology policy topic. Topics may vary from year to year or term to term. (Graduate standing in science, technology and public policy, or permission of the instructor) **Class 4, Credit 4 (offered annually)**

0508-770 **Graduate Environmental Studies Seminar**
This course explores a specific, in-depth environmental issue, problem, or topic from multidisciplinary perspectives. Students will read pivotal texts appropriate to the topic with the goal of formulating reasonable and appropriate responses; experiential learning activities such as field trips may also be included. (Graduate standing in science, technology and public policy or environmental science or permission of instructor) **Class 4, Credit 4 (offered occasionally)**

0508-790 **Graduate Biodiversity and Society**
This course explores the problems, issues, and values stemming from the current massive loss of biodiversity. This course also explores why preserving or conserving biodiversity is considered to be important, and what mechanisms have been identified for its maintenance. (Graduate standing in science, technology and public policy or environmental science, or permission of instructor) **Class 4, Credit 4 (offered occasionally)**

0508-791 **Sustainable Communities**
This course uses the concept of sustainability to explore the connections between natural and human communities, between nature and culture, and among environmental, economic, and social systems. The course also encourages learning outside the classroom. In the context of neighborhoods in the city of Rochester, students will observe firsthand the contemporary issues associated with urban communities that are seeking to achieve sustainability. Graduate students will be responsible for leading class discussions and will be required to prepare an in-depth, community based research paper on a topic selected in consultation with the instructor. (Graduate standing in science, technology, and public policy or environmental science or permission of instructor) **Class 4, Credit 4 (offered at least every other year)**

0508-799 **Independent Study**
A student may register for a graduate independent study project subject to the approval of the chair of the Department of Science, Technology and Society/Public Policy and the dean of the College of Liberal Arts. Because of the length of the approval process, students who desire to take independent study should make arrangements several weeks before the quarter begins. An independent study project enables the interested student and his or her faculty sponsor to coordinate their efforts on subjects and topics that range beyond the normal sequence of the graduate course selection. **Credit variable**

Semester Courses

Effective fall 2013

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Communication and Media Technology

COMM-701 **History of Media Technologies**
An introduction to the history of media technologies including, print, telephone, radio and television broadcasting, and digital media. The course will also cover the inventors, landmark events, regulations, and uses of communication media along with their effects on and relationships with people and culture. **Class 3, Credit 3 (F)**

COMM-702 **Communication Theories**
This course focuses on theories of communication as they relate to mass media and other forms of human interaction. Theories based in both the humanities and in the social sciences that explain or predict the effects of interaction and communication technology on audiences will be examined. **Class 3, Credit 3 (F)**

COMM-703 **Research Methods in Communication**
An introduction to and overview of the methods and ethics of scientific, scholarly communication research including quantitative and qualitative approaches. The course focuses on methods of locating, critically analyzing and conducting communication research, and leads to the development of a research proposal suitable for a thesis or project. May be taken as an elective. (COMM-702 theories of communication) **Class 3, Credit 3 (F)**

COMM-704 **Media Law and Ethics**
This course examines major principles and trends in communication law. The course analyzes a broad range of issues related to the First Amendment, intellectual property, and media regulation. Special attention is paid to discussing the major ethical perspectives and issues surrounding contemporary communication behavior. May be taken as an elective. **Class 3, Credit 3 (F)**

COMM-705 **Electronic Communication**
Electronic communication is an inquiry into interactive media and how they exert a powerful influence on communicative practices and society. Positioned at the intersection of technology, identity, and culture, interactive media are altering the ways in which people communicate in a wide range of contexts, including education, marketing, civic discourse, politics and popular culture. Utilizing theories about the relationship between communication technology and culture, this course will explore the current and potential future impact of interactive electronic communication and the social changes that are occurring. May be taken as an elective. **Class 3, Credit 3 (S)**

COMM-706 **Crafting the Message**
This course will focus on the creation of written and visual messages appropriate to a targeted audience and a specific medium including print, broadcast, interactive, digital and online technologies. Case studies of effective and unsuccessful messages from, for example, advertising, public service, education, and technical communication will be examined. Students will create and execute a variety of messages using various writing styles and images, and with varying purposes, and they will plan, create, and execute a communication campaign for an RIT event. May be taken as an elective. **Class 3, Credit 3 (S)**

COMM 707 **International Media**
Evaluation of media technology use in the international setting and in various countries and regions of the world. Major theories about the media, current trends in media, journalism practices, and governmental challenges and restrictions are considered. Special attention is paid to the uses and effects of media technologies within various countries. Special focus on global implications of the Internet and digital technologies on international cooperation, trade, and culture. (COMM-702 communication theories; COMM-701 history of media technologies) **Class 3, Credit 3 (F)**

COMM-708 **Communication Education**
This course examines various aspects of teaching in higher education. Students will explore teaching and learning styles, the role of technology in higher education, and methods of assessing student and teacher performance. Students will create teaching resources and gain experience teaching in a college classroom. May be taken as an elective. **Credit 3, Credit 3 (S)**

COMM-709 **Online Advertising**
A review of the theory and practice of interactive advertising. Topics include digital interactive media used for advertising purposes, interactive advertising theories and models, and the strategies and tactics for developing effective ad campaigns using interactive media, including the Internet, virtual communities, video games and mobile phones. May be taken as an elective. **Class 3, Credit 3 (S)**

COMM-710 **Visual Communication**
This course explores visual communication, the process through which individuals --in relationships, organizations, and societies--create and interpret visual messages. A variety of theories from the disciplines of art history, psychology, communication theory, and graphic design will be discussed to develop methods for analyzing mediated messages. Students will analyze visual messages from the following media: print photography, video, film and the Internet. May be taken as an elective. **Class 3, Credit 3 (F)**

COMM-713 **Readings in Mass Media**
An introduction to the sub-discipline of mass communication via a series of essential texts of twentieth century thought on the subject. Complementing the readings will be a series of films with themes reflecting the times in which the readings were written, the media, and their influence on society. May be taken as an elective. **Class 3, Credit 3 (F)**

COMM-799 **Independent Study in Communication**
A guided study culminating in a research project that allows students to pursue a subject independently with faculty guidance. Focuses on designing, conducting and completing an independent study project. **Class 3, Credit 3 (S, Su)**

COMM-800 **Communication Thesis/Project**
A guided research project that focuses on designing, conducting and completing a research project. The project culminates in a public presentation and defense. **Credit 1–6 (F, S, Su)**

Criminal Justice

CRIM-700 **Pro-Seminar in Criminal Justice Theory**
In this pro-seminar, students examine the theoretical foundation of criminal justice. This course integrates studies of criminal justice systems, enforcement organizations, judicial decision-making, courtroom communities and correctional systems by focusing on the study of governmental social control premised on punishment or blameworthiness. It examines the underlying causes and patterns of official responses to behavior that may be labeled criminal, and the structures, policies and practices of criminal justice. (CRIM-100 seminar in criminal justice or equivalent) **Class 3, Credit 3 (F)**

CRIM-701 **Statistics**
The purpose of this course is to provide students with training in quantitative analysis of social science data. Students will develop a conceptual understanding of techniques, the ability to recognize the appropriate selection of techniques, and the ability to use those statistical measures and interpret their results. Students will gain experience with inferential statistics through the level of commonly used multivariate analyses. The prerequisite for this course will be a strong undergraduate foundation in statistical analysis. With the consent of their adviser and the graduate coordinator, qualified students may substitute more specialized statistics courses or courses in such areas as geographical information systems (GIS). **Class 3, Credit 3 (F)**

CRIM-702 **Pro-Seminar in Research Methods**
This seminar will focus on the principles and techniques of research with a special focus on evaluation research. The course will cover research conceptualization and design, development of appropriate measures, collection and analysis of data using a wide range of methods. Students will gain a thorough understanding of the research process as well as the policy implications and consequences of research and evaluation. Students will also begin to develop a thesis research proposal. (CRIM-400 research methods in criminal justice or equivalent) **Class 3, Credit 3 (F)**

CRIM-703 **Advanced Criminology**
This course will provide students with a detailed understanding of the theories that have guided criminological research and policy. Subject matter will cover the major influences in criminology: the classical school, the Chicago School, strain theories, socialization and learning theories, and conflict theories, among others. This will be a required course for the MS in criminal justice. The prerequisite for this course will be a strong undergraduate foundation in theories of crime and criminality. (CRIM-350 theories crime & criminality or equivalent) **Class 3, Credit 3 (F)**

CRIM-704 **Crime, Justice and Community**
This course provides an overview of the role of communities in crime and criminal justice. The course begins by preparing a foundation in community theory. Students will gain an understanding of the critical dimensions and attributes which define community. **Class 3, Credit 3 (S)**

CRIM-705 **Interventions and Change in Criminal Justice**
This course provides an overview of the role of communities in crime and criminal justice. The course begins by preparing a foundation in community theory. Students will gain an understanding of the critical dimensions and attributes which define community. **Class 3, Credit 3 (S)**

CRIM-710 **Pro-Seminar in Law and Policy**
The course will consider the processes of policy development and analysis in criminal justice with a particular emphasis on the intersection of policy and law. The legal and political environments of criminal justice policy will be examined in study of the development of federal crime policy. Additionally, the roots, development, legal context and impact of major policies such as contemporary policing strategies, problem solving courts and restorative justice will be explored. **Class 3, Credit 3 (S)**

CRIM-800 **Thesis in Criminal Justice**
The master's thesis in criminal justice involves independent research on an approved topic judged by a faculty committee and under the supervision of one faculty member. The thesis requires students to develop, design and complete an original research project; orally defend the thesis before the thesis committee and the public; and submit a bound copy to the library. Students will meet weekly with their thesis chair. (CRIM-700 pro-seminar in criminal justice theory, CRIM-701 statistics, CRIM-702 pro-seminar in research methods, CRIM-703 advanced criminology, CRIM-704 crime, justice and community, CRIM-705 interventions and change in criminal justice) **Class 3, Credit 6 (F, S, Su)**

Experimental Psychology

PSYC-640 **Graduate Statistics**
This course introduces students to advanced inferential parametric and non-parametric data-analysis techniques commonly used in psychological research. The focus is on the conceptual understanding of these statistics, how different statistical procedures are applied in different research methods, how to perform analyses, how to interpret the results in the context of the research question, and how to communicate these results. Topics include one- and two-sample inferential procedures, interval estimation, correlation, nonparametric tests, linear regression, and analysis of variance. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (F)**

PSYC-641 **Applied Psychology Methods**
This course explores various types of applied research methods as well as important methodological issues and concepts in areas of applied psychology. Methodologies studied include experimentation, quasi-experimentation, content analysis, surveys, and interviews. Methodological issues cover research ethics, reliability, threats to internal and external validity, demand characteristics, volunteer participant problems, and issues in sampling. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (F)**

PSYC-642 **Graduate Research Methods**
This course provides students with sufficient background in the skills and knowledge necessary to be able to conduct psychological research on a wide variety of problems. In addition to introducing students to numerous research methods used in the discipline, the course will also assist students in planning their thesis research proposal. In parallel with covering core topics in research methodology (such as varieties of data, the role of theory and models in science, psychophysiological methods, subjective methods, and experimental design) the course is designed to guide students through the process of creating a feasible research proposal. Students will also use data to test their designs and practice their analyses. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-699 **Psychology Co-op**
Co-op in Psychology. Optional for students in the M.Sc. Experimental Psychology. **Credit 0 (F, S)**

PSYC-711 **Graduate Biopsychology**
A graduate level introduction to the field of behavioral neuroscience, the study of neurobiological basis of cognition and behavior. Topics include neuroanatomy and physiology, localization of function, brain injury, research methods in behavioral neuroscience, and biological basis of learning, language, memory, emotion, conscious states, sexual behavior, etc. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-712 **Graduate Cognition**
This course will survey theoretical and empirical approaches to understanding the nature of the mental processes involved in attention, object recognition, learning and memory, reasoning, problem solving, decision-making, and language. The course presents a balance between historically significant findings and current state of-the-art research. Readings that have structured the nature and direction of scientific debate in these fields will be discussed. The course also includes discussions of methodology and practical applications. Students will have opportunities to develop their research skills and critical thinking by designing research studies in cognitive psychology. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-713 **Graduate Developmental Psychology**
This course is designed to enhance students' knowledge and skills with regard to infant, child, and adolescent development. We will examine a variety of topics that relate to the physical, cognitive, and social-emotional development of children and adolescents in the context of classic and current theory. We will also explore issues such as attachment, resiliency, and policy issues that pertain to positive child and adolescent development. Students will gain an enhanced knowledge of the sequence of child development and the processes that underlie it by studying child development from a chronological approach. Theories that discuss the various domains of development will be examined through each age period. This course will emphasize the interdependence of all domains of development and contribute to an appreciation of the interrelatedness of theory, research, and applications. This course is an elective for students in the experimental psychology M.Sc. program. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (F)**

PSYC-714 **Graduate Engineering Psychology**
In this course the students will learn to recognize the integrated (systems) nature of Engineering Psychology, the centrality of human beings in systems design, and to use the topics covered and the available knowledge base to adapt the environment to people. This course will cover several fundamental models of human information processing in the context of human-system interactions. The models may include but are not limited to signal detection theory, information theory, theories of attention, both normative and naturalistic decision-making models, control theory, and the lens model of Brunswick, as well as models of the human as a physical engine, that is, anthropometry, biomechanics, and work physiology. Most topics include readings in addition to the course text as well as a lab exercise with a detailed lab report. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (F)**

PSYC-715 **Graduate Perception**
The course is designed to provide students with a deeper understanding of topics in perception. This course will be organized such that students will work in groups on various projects as well as covering topics through readings and classroom discussion. The topics may include, but are not limited to: spatial frequency perception; aftereffects, visual illusions and their relationship to cortical function and pattern perception; color perception; depth and motion perception; higher order perception such as face and object recognition; and music and speech perception. The goal is to cover current research and theories in perception, looking at current developments and their antecedents. The course will be divided into various modules. Students will be assigned readings relevant to each section of the course, and will be expected to master the major concepts. Group discussion of the readings will complement lectures where the instructor will present relevant background material. There will also be laboratory time for the students, where they will examine empirical findings in perception, and develop their research skills in the field. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-716 **Graduate Social Psychology**
This course explores topics related to understanding individuals in a social context. Topics may include, but are not limited to: social perception and social cognition; attitudes; social identity; prejudice and discrimination; Interpersonal attraction; close relationships; social influence; prosocial behavior; aggression; group behavior; artifacts and methodological issues in social psychology. Course format is seminar focused on reading assigned texts each week, writing reaction papers, and participating in discussion. Students will also conduct a study on the topic of their choice and present their findings both in an oral and written format. (admitted to MS in experimental psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-717 **Advanced Graduate Statistics**
This course introduces students to more advanced inferential parametric and non-parametric data-analysis techniques commonly used in psychological research, but not covered (or not covered in depth) in the Graduate Statistics course. These techniques may include, but are not limited to: reliability analysis, multiple regression, discriminant analysis, logistic regression, factor analysis, analysis of covariance, multivariate analysis of variance, contrast analysis, mediator and moderator variable analysis, non-parametric tests, and multi-level modeling. The focus is on the conceptual understanding of these statistics, how different statistical procedures are applied in different research methods, how to perform analyses, how to interpret the results in the context of the research question, and how to communicate these results. (PSYC-640 graduate statistics) **Class 3, Credit 3 (F or S)**

PSYC-751 **Graduate Research Seminar**
The guiding principle of Graduate Research Seminar is that it provides students the opportunity to begin examining potential thesis topics during the student's first semester in the program. The course will involve faculty presentations of their research offered weekly through the semester. (admission to MS in experimental psychology) **Credit 0 (F)**

PSYC-752 **Thesis Proposal**
The thesis courses will vary widely but will fulfill the work plan agreed by the student and the adviser. The guiding principles of the Thesis Proposal course are to initiate thesis research including selecting a thesis advisor, choosing and defining a topic, surveying relevant research literature, and planning the research. To complete the course, the student will successfully submit and defend a thesis proposal, which is a detailed and complete plan of the thesis research. The thesis proposal should include exhaustive review of relevant literature, statement of the student's thesis, formulation of hypotheses, operational definitions of independent and dependent variables, and a detailed procedure for carrying out the research. The proposal may also include a section on anticipated results with a detailed plan for analysis of data. (permission of instructor) **Credit 3 (S)**

PSYC-753 **Thesis**
The Thesis courses will vary widely but will fulfill the work plan agreed by the student and the thesis adviser. The guiding principle of the Thesis course is to complete the thesis research proposed in Thesis Proposal. The Thesis course consists of carrying out the thesis research, including collection and analysis of data, and completion and public defense of the thesis document for partial fulfillment of the requirements of the degree. (permission of instructor) **Credit 3 (F)**

Public Policy

PUBL-610 **Technological Innovation and Public Policy**
Technological innovation, the incremental and revolutionary improvements in technology, has been a major causal factor in economic, social, military, and political change. This course will introduce generic models of innovation that span multiple sectors including: energy, environment, health, and bio- and information-technologies. The course will then analyze how governments choose policies to spur and shape innovation. Students will be introduced to a global perspective on innovation policy including technology transfer and appropriate technology. **Class 3, Credit 3 (S)**

PUBL-620 **Information and Communications Policy**
This course examines how federal and international policies are developed to influence innovation of Information and Computer Technology. In particular the course will examine such topics as privacy, freedom of speech, intellectual property rights, access to information technology, and regulation of the Internet. (Graduate standing) **Class 3, Credit 3 (F)**

PUBL-630 **Energy Policy**
This course provides an overview of energy resources, technologies, and policies designed to ensure clean, stable supplies of energy for the future. The course evaluates the impacts of fossil fuel, renewable energy, and hydrogen technologies on society and how public policies can be used to influence their development. The development of U.S. energy policy is of particular concern, although a global perspective will be integrated throughout the course. **Course 3, Credit 3 (S)**

PUBL-700 **Readings in Public Policy**
An in-depth inquiry into key contemporary public policy issues with an emphasis on environmental policy and information and communications technology policy (Matriculation in the public policy master's program or permission of the instructor). **Course 3, Credit 3 (F)**

PUBL-701 **Graduate Policy Analysis**
This course provides graduate students with necessary tools to help them become effective policy analysts. The course places particular emphasis on understanding the policy process, the different approaches to policy analysis, and the application of quantitative and qualitative methods for evaluating public policies. (graduate standing) **Class 3, Credit 3 (F)**

PUBL-702 **Graduate Decision Analysis**
This course provides students with an introduction to decision science and analysis. The course focuses on several important tools for making good decisions, including decision trees, cost-benefit analysis, risk analysis, and multi-attribute decision making. Students will apply these tools to contemporary public policy decision making at the local, state, federal, and international levels. **Class 3, Credit 3 (S)**

PUBL-703 **Evaluation and Research Design**
The focus of this course is on evaluation of program outcomes and research design. Students will explore the questions and methodologies associated with meeting programmatic outcomes, secondary or unanticipated effects, and an analysis of alternative means for achieving program outcomes. Critique of evaluation research methodologies will also be considered. (Matriculation in the public policy master's program or permission of the instructor) **Class 3, Credit 3 (S)**

PUBL-705 **Seminar: Advanced Theory and Methods**
This course will cover the major theoretical and applied analytical methods and techniques in both quantitative and qualitative analysis. An emphasis will be placed on integrating empirical and normative concerns. (Matriculation in the public policy master's program or permission of the instructor) **Class 3, Credit 3 (?)**

PUBL-709 **Public Administration and Management**
This course provides an in-depth look at the evolution of public administration theory and practice. Starting with the basic structure of the U.S. Constitution, the course examines how the key tensions facing local, state, and federal public administrators changed over time with both changes in social science and changes in public administration practice. Topics include public organization theory, public budgeting, citizen engagement, e-government, public-private partnerships, and recent innovations in management practice. (Graduate standing) **Class 3, Credit 3 (F)**

School Psychology

SPSY-600 **Field Experience I: Professional School Psychology Foundations**
The purpose of the course is to introduce students to the field of school psychology. The student will participate in field and in-class activities enabling them to obtain firsthand knowledge and familiarity with the roles and functions of school psychologists, along with an introduction to the expected competencies required of school psychologists by state and national accrediting bodies. Field experiences will also give students the opportunity to gain firsthand knowledge and familiarity with school systems, collaborative problem solving, microskills in counseling, classroom management, and relevant professional and legal issues. (aatriculated in school psychology program) **Class 3, Credit 3 (F)**

SPSY-601 **Field Experience II: Professional School Psychology Foundations**
The purpose of the course is to continue to immerse students in the field of school psychology. The student will participate in field and in-class activities enabling them to obtain firsthand knowledge and familiarity with current topics and issues that impact the field of school psychologists. Field experiences will also give students the opportunity to gain firsthand knowledge and familiarity with the necessary competencies required of school psychologists by state and national accrediting bodies. These competencies and topics include but are not limited to: collaborative problem solving, bullying, learning disabilities, evidence based interventions, counseling, consultation, classroom management, applied behavioral interventions, curriculum based measurement, and relevant professional and legal issues. (matriculated in school psychology program) **Class 3, Credit 3 (S)**

SPSY-603 **Ethical and Legal Issues**
This course reviews the laws and ethical principles that affect the practice of school psychologists within a school-community systems context. (completion of 30 semester hours in the school psychology program, or permission from the instructor) **Class 3, Credit 3 (S)**

SPSY-610 **Advanced Developmental Psychology**
This course is designed to enhance students' knowledge and skills with regard to infant, child, and adolescent development. We will examine a variety of topics that relate to the physical, cognitive, and social-emotional development of children and adolescents in the context of classic and current theory. We will also explore issues such as attachment, resiliency, and policy issues that pertain to positive child and adolescent development. Students will gain an enhanced knowledge of the sequence of child development and the processes that underlie it by studying child development from a chronological approach. Theories that discuss the various domains of development will be examined through each age period. This course will emphasize the interdependence of all domains of development and contribute to an appreciation of the interrelatedness of theory, research, and applications. (Matriculation into school psychology program or permission of instructor) **Class 3, Credit 3 (F)**

SPSY-620 **Interpersonal Intervention Skills**
This course presents counseling theories, techniques and strategies for working with children and adolescents and their families. It is designed to develop basic counseling and crisis intervention skills. Three areas that are given the most attention are developing one's counseling knowledge base, developing one's basic psychotherapeutic communication skills and developing one's self-awareness. This course is offered to first-year students matriculating in the school psychology program and may be offered to other interested students by permission of the instructor. **Class 3, Credit 3 (F)**

SPSY-630 **Academic Assessment**
Students of this course will study assessment generally, types of tests and their uses, strengths and weaknesses of specific instruments, principles of reliability and validity, scales, and norms. Students will acquire an understanding of the quantitative and qualitative aspects of measurement. Extensive practice will be given in the administration and scoring of standardized assessment procedures. Emphasis will be placed on the use of various academic assessment procedures in schools and other settings. (Matriculation into the school psychology program) **Class 3, Credit 3 (F)**

SPSY-631 **Cognitive Assessment**
This course concentrates on the development of theory and applied skills in intellectual assessment. Students learn to select and administer individual intelligence tests, to interpret results, to form test-based recommendations for intervention, and to provide written and oral reports. Assessment of persons who are culturally different or disabled is emphasized. (matriculated in school psychology program) **Class 3, Credit 3 (F)**

SPSY-632 **Social-Emotional Assessment**
This course uses interviews, behavioral observations, rating scales, and projective measures for the assessment of child and adolescent personality and adaptive behavior. Students gain experience in administering, interpreting, and reporting results of measures currently used in the practice of psychology in the schools. (cognitive assessment) **Class 3, Credit 3 (S)**

SPSY-640 **Statistics**
This course reviews descriptive and inferential statistics. Basic and advanced conceptual material will be presented to assist students in their understanding of diverse data analytic methods, their appropriate application, and how to interpret statistical analyses. Topics include one- and two-sample inferential procedures, interval estimation, correlation, nonparametric tests, linear regression, and analysis of variance. Students will learn to integrate concepts with computer applications. Course content will be taught through lectures, discussion, and applied data analysis exercises. Student mastery of the material will be evaluated through small group discussion of data set analyses, written results of the analyses following APA style, and two exams. This course is required for all students matriculating in the school psychology program. Non-matriculating students may take the course with instructor approval. **Class 3, Credit 3 (S)**

SPSY-641 **Research Methods**
This course explores various types of research methods as well as important methodological issues and concepts. Methodologies studied include experimentation, quasi-experimentation, content analysis, surveys, and interviews. Methodological issues cover research ethics, reliability, threats to internal and external validity, demand characteristics, volunteer participant problems, and issues in sampling. **Class 3, Credit 3 (F)**

SPSY-650 **Applied Behavior Analysis**
This course reviews scientifically-based principles, concepts, and methods of behavior analysis. Topics covered include behavioral assessment, data analysis, and approaches to behavior change. A special focus is on the functional behavioral assessment process within schools. Students will learn to develop assessment-based behavior intervention plans, which are tailored to the unique needs of individual students, through a collaborative problem-solving process involving families and school staff. This course is offered to students matriculating in the school psychology program and to non-matriculating students with permission of the instructor. **Class 3, Credit 3 (S)**

SPSY-701 **Advanced Practicum I: Issues in Diversity**
The purpose of the course is for students to continue to participate in supervised field experiences in school/clinical settings along with a didactic component emphasizing the development and application of a multicultural and contextual lens within their field experiences. Students will gain knowledge necessary to work effectively with students from a wide variety of contextual, cultural, and linguistic backgrounds. Topics include but not limited to: multicultural theory, culture, cultural identity, social class, race and ethnicity, gender issues, religion and spirituality, and sexual orientation. (matriculated in school psychology program, SPSY-600, SPSY-601) **Class 3, Credit 3 (F)**

SPSY-702 **Advanced Practicum II: Issues in Diversity**
The purpose of the course is for students to continue to participate in supervised field experiences in school/clinical settings along with a didactic component emphasizing the development and application of a multicultural and contextual lens within their field experiences. Students will begin to apply their knowledge and available resources to further develop the skills necessary to work effectively with students from a wide variety of contextual, cultural, and linguistic backgrounds. Topics include but not limited to: ecological models, developmental contextualism, oppression, resilience, privilege and power, immigration and acculturation, and multicultural assessment. (matriculated in school psychology program, SPSY-600 SPSY-601) **Class 3, Credit 3 (S)**

SPSY-710 **Developmental Psychopathology**
This course presents a developmental-systems perspective and disorder-specific models of child and adolescent psychopathology. The course emphasizes (a) a conceptual understanding of specific psychological disorders, (b) the current literature on evidence-based assessment and intervention, (c) service delivery systems, and (d) the school psychologist's role in service delivery and in disseminating information to the schools and families. (SPSY-610) **Class 3, Credit 3 (F)**

SPSY-711 **Graduate Biopsychology**
A graduate level introduction to the field of behavioral neuroscience, the study of neurobiological basis of cognition and behavior. Topics include neuroanatomy and physiology, localization of function, brain injury, research methods in behavioral neuroscience, and biological basis of learning, language, memory, emotion, conscious states, sexual behavior, etc. **Class 3, Credit 3 (F, S)**

SPSY-720 **Advanced Consultation**
This course focuses on the development of beginning competencies in consultation that will help students assist school professionals in building capacity to deliver effective services. Contextual influences on school consultation, models of consultation, and the stages of the consultation process within a problem-solving model will be emphasized. Issues relevant to individual case consultation and systems-level consultation will be covered. (SPSY-620) **Class 3, Credit 3 (F)**

SPSY-721 **Academic Intervention**
Most referrals to school psychologists involve some sort of learning problem. What variables affect school learning? Are some influences more important than others? Which of these influences are alterable and therefore available as interventions to improve learning? What classroom strategies work best? We will examine theories of school learning and the basic psychological principles that apply to teaching and learning. This will be accomplished through the examination of the role of teachers, which includes their responsibility for teaching curriculum, classroom management, and the social and emotional growth of students. Students will learn to critically evaluate the instruction provided to a particular student in a given content area. In addition, students will learn to assess academic functioning within the learning environment, identify specific target areas for intervention, set appropriate goals and objectives, monitor student progress toward those goals and objectives, and evaluate the effectiveness of the intervention(s) in place as a result of the assessment. Students are expected to leave this course with a cursory understanding of the problem-solving process and the development and monitoring of effective interventions, and basic competence in applying this process. (SPSY-630 academic assessment) **Class 3, Credit 3 (S)**

SPSY-722 **Advanced Counseling**
This course focuses on the refinement of counseling skills used with children and adolescents in individual and group counseling. Students will integrate theory, research and processes relative to individual and group work within cognitive-behavioral and solution-focused theoretical models. Students will consult with parents and teachers as they develop treatment plans, counseling interventions, progress monitor interventions, and write recommendations. Crisis intervention and group behavior management will also be addressed. This course is offered to second-year students matriculating in the school psychology program. (Interpersonal intervention, advanced counseling) **Class 3, Credit 3 (S)**

SPSY-730 **Comprehensive Assessment Integration**
This is an applied course in linking the diagnostic assessment of exceptional children and adolescents to recommendations for appropriate interventions. Students learn to select and develop a plan of assessment for a variety of referral questions. Students continue to learn and expand their skills in administering tests. Students primarily learn to interpret, and integrate test data and report the results and recommendations for parents, teachers and multidisciplinary evaluation teams. This course is offered to second-year students matriculating in the school psychology program. (Cognitive assessment, social-emotional assessment) **Class 3, Credit 3 (F)**

SPSY-750 **Internship**
The 1200-hour internship is the culminating experience in the school psychology program. It provides an intensive, supervised training experience in which interns put the knowledge, skills, and attitudes learned during their training program into practice while continuing to develop and expand upon those abilities. The internship year is a broad-based, individualized experience that provides an opportunity to work with a variety of children, parents, teachers, support staff, and administrators. Interns are exposed to a variety of educational meetings, programs, workshops, resources, and conferences through their internship sites. Monthly class seminars supplement the supervised training experience. (All coursework completed and faculty approval) **Class 3, Credit 3 (F, S)**

SPSY-753 **Thesis**
This course provides students with the opportunity to conduct original research. The purpose of the course is for students to apply concepts they learn in research methods and inferential statistic course as well as experience the scientific method at a deeper level. The thesis is an optional requirement for those in the MS school psychology program. However, it is a requirement for the advanced graduate certificate. (Permission from instructor) **Class 3, Credit 3 (F, S)**

Science, Technology and Society

STSO-621 **Graduate Biodiversity and Society**
This course explores the problems, issues, and values stemming from the current massive loss of biodiversity. Various justifications for preserving or conserving biodiversity will be examined. Although principals of conservation biology are presented, the social/cultural dimensions of the issue will be emphasized. (Graduate standing in public policy or environmental science; or permission of instructor) **Class 3, Credit 3 (S)**

STSO-710 **Graduate Science and Technology Policy Seminar**
Examines how Federal and international policies are developed to influence research and development, innovation, and the transfer of technology in the United States and other selected nations. Students in the course will apply basic policy skills, concepts, and methods to contemporary science and technology policy topics. (Graduate standing in public policy, or permission of instructor.) **Class 3, Credit 3 (F)**

Center for Multidisciplinary Studies

James Myers, Director
www.rit.edu/cms

Programs of study

Online learning option available

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The Center for Multidisciplinary Studies offers one master's degree and two advanced certificates.

Oftentimes, students are interested in more than one area of study, making the selection of a traditional master's degree difficult. Through professional studies, students can combine their interests with concentrations from any number of RIT departments to create a singular degree program that relates directly to a student's interests and career aspirations. The program emphasizes professional communications, critical thinking, collaboration, problem solving, and ethical reasoning.

Admission requirements

The college makes all decisions regarding graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarship

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Faculty

The center's faculty is comprised of faculty members from a wide range of disciplines. A core faculty oversees the center and guides students in creating a personalized degree program.

Study options

Most graduate programs offer a variety of study options, including full-time, part-time, and online study. Please refer to each individual program for specific information regarding these options.

Professional Studies, MS

http://www.rit.edu/cms/grad/masters.html
James Myers, Director
(585) 475-4772, jamisr@rit.edu
Samuel McQuade III, Graduate Program Director
(585) 475-5230, scmcms@rit.edu

Program overview

The professional studies program is specifically designed to enable the mature learner to create a customized plan of graduate study tailored to their personal and professional goals. This degree offers students the opportunity to draw on more than 50 graduate programs in order to gain the advanced knowledge and skills necessary to respond successfully to new and emerging career opportunities. The degree also includes a capstone project. The capstone is a practical, hands-on project directly related to the student's individualized plan of study. With certain concentrations, the MS degree in professional studies may be pursued through online learning.

The program requires the completion of 48 quarter credit hours and can be completed through full- or part-time study. Students begin their program of study with Contexts and Trends (3099-705), the program's foundation course. Throughout this course students explore their own career objectives and research RIT's many graduate programs to identify courses that best match their professional and personal goals. Students create concentrations that make up their course work for the degree program. Each concentration is a selection of courses drawn from existing RIT graduate programs and can range between 12 to 24 quarter credit hours. Graduate credits earned in other programs may be used in completing a concentration, upon approval. A number of concentrations may be completed online. These include applied statistics, computer graphics, environmental health and safety management, facility management, general management, health systems administration, human resources, imaging science, information technology, microelectronics manufacturing engineering, project management, security technology management, strategic training, technical information design, and telecommunications engineering technology.

Credit hours not required in a student's concentration areas may be used for electives. All elective and transferred graduate courses need to be integrated into the proposed plan of study.

Curriculum

The program includes two required courses, the choice of two or three concentrations designed by the student and their adviser based on the student's career objectives, and the completion of a capstone project.

Required courses

3099-705 Context and Trends (4 quarter credit hours)
This course introduces students to interdisciplinary thinking, personal self-assessment, problem solving, goal setting, and research techniques using electronic information resources. Students work toward selecting concentrations and finalizing a plan of study for their graduate program.

3099-775 The Capstone Project (4 quarter credit hours)
This course is a supervised, hands-on experience in which students apply the skills and knowledge developed through their individualized plans of study, concluding with oral and written presentations.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Professional studies (two concentrations), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
3099-705	Context and Trends	4
3099-775	Capstone Project	4
Concentration A		
	Concentration A Course 1	4
	Concentration A Course 2	4
	Concentration A Course 3	4
	Concentration A Course 4	4
Concentration B		
	Concentration B Course 1	4
	Concentration B Course 2	4
	Concentration B Course 3	4
	Concentration B Course 4	4
Electives		
	Elective 1	4
	Elective 2	4
Total Quarter Credit Hours		**48**

Professional studies, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
	Context and Trends	3
	Concentration A course	3
	Concentration B course	3
	Concentration A course	3
	Concentration A course	3
	Concentration B course	3
Second Year		
	Concentration A or elective course	3
	Concentration A or elective course	3
	Concentration B course	3
	Concentration B or elective course	3
	Capstone Project	3
Total Semester Credit Hours		**33**

Professional studies (three concentrations), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
Required courses:		
3099-725	Context and Trends	4
3099-775	The Capstone Project	4
Concentration A		
	Concentration A Course 1	4
	Concentration A Course 2	4
	Concentration A Course 3	4
	Concentration A Course 4	4
Concentration B		
	Concentration B Course 1	4
	Concentration B Course 2	4
	Concentration B Course 3	4
	Concentration B Course 4	4
Concentration C		
	Concentration C Course 1	4
	Concentration C Course 2	4
	Concentration C Course 3	4
Total Quarter Credit Hours		**48**

Admission requirements

To be considered for the MS program in professional studies, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at a regionally accredited college or university,
- Have a minimum undergraduate cumulative grade-point average of 3.0, or superior endorsements,
- Submit letters of reference from two individuals who have served recently as either the applicant's supervisor or instructor,
- Submit a statement of career objectives and description of the skills and knowledge sought through graduate study,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a current resume, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 550 (paper-based) or 79 (Internet-based) are required. Scores from the International English Language Testing System (IELTS) are accepted in place of the TOEFL exam. Minimum acceptable scores will vary; however, the absolute minimum score for an unconditional acceptance is 6.5. The TOEFL requirement is waived for native speakers of English or those submitting educational transcripts and diplomas from American colleges and universities.

All applicants are urged to discuss their plans with the professional studies program adviser before submitting a formal application.

Project Management, Adv. Cert.

Program overview

In today's business-oriented society, project-based organizations and project management have become much more than just a way of conducting business. New growth within these organizations has changed the shape of project management to reveal what is becoming an exciting new career path for many individuals. Project managers have quickly become a necessary asset for many businesses.

The goal of a project manager is to successfully plan, organize, and accomplish a specific project or one-time effort. Encountering the challenges of cultural and social differences, along with an assortment of industrial focuses, the project manager must be aware of a project's goals on a daily and, sometimes, hourly basis. Completion of any project is achieved via a well thought-out project plan. The advanced certificate in project management teaches students how to plan, develop, and implement successful projects from initiation to completion.

Curriculum

The program consists of three core courses and two electives, which may be chosen with the approval of the student's adviser.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Project management, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
3081-710	Introduction to Project Management	4
3081-711	Advanced Project Management	4
3081-712	International Project Management	4
	Two electives	8
Total Quarter Credit Hours		**20**

Project management, advanced certificate, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
WMDL-710	Project Management	3
	Graduate Electives	6
WMDL-711	Advanced Project Management	3
WMDL-712	International Project Management (summer)	3
Total Semester Credit Hours		**15**

Electives

Many of these electives are available through online learning. Other electives may be used with an adviser's approval.
3088-732 Managing Technical and Scientific Communications
3088-721 Creating Technical Proposals
0626-703 Facilitation Skills
0626-782 Human Performance Management Practices
0625-844 Breakthrough Thinking: Creativity and Innovation
0102-740 Organizational Behavior and Leadership
0625-849 Service Performance Metrics

Admission requirements

To be considered for admission to the advanced certificate in project management, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a course or background in statistics
- Have a minimum undergraduate GPA of 3.0,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a current resume,
- Submit a personal statement,
- Submit two letters of recommendation, and
- Complete a graduate application.

Additional information

Study options

The three required core courses may be completed either on campus and through online learning.

Technical Information Design, Adv. Cert.

Program overview

Technical information design is a communication field that requires understanding and skills in the development and use of text, graphic design, multimedia, and other techniques to enhance contemporary technical communication. Success demands that the practitioner have superior writing skills, adeptness at selecting and using available and emerging media, and the ability to recognize excellence in the visual aspects of communication design. This program focuses on the information designer's use of technology to create documentation and deliver information to the intended audience.

Curriculum

The advanced certificate includes three required core courses plus a minimum of 12 quarter credit hours of electives, chosen with the approval of the program adviser.

Program deactivated
Effective fall 2013, the advanced certificate in technical information design will no longer admit new students. This change will not affect currently matriculated students.

Technical information design, advanced certificate, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
3088-711	Technical Information Design	4
3088-731	Technical Procedures	4
3088-741	Usability Design and Testing	4
Choose three of the following:*		12
4004-730	Interactive Media Implementation	
4004-741	Fundamentals of Web-based Multimedia	
4004-745	Theories in Interactive Computing	
3088-721	Creating Technical Proposals	
3088-732	Managing Technical and Scientific Communication	
2081-723	Contemporary Publishing	
3088-714	Science Writing	
	Web Design courses (with approval from adviser)	
Total Quarter Credit Hours		**24**

* Other electives from relevant fields of study, such as human-computer interface, computer graphics, or project management may be used with an adviser's approval.

Admission requirements

To be considered for admission to the advanced certificate in technical information design, candidates must fulfill the following requirements:

- Hold a baccalaureate (or equivalent degree) from an accredited institution,
- Have a minimum cumulative GPA of 3.0 (B)
- Submit two professional recommendations, and
- Complete a graduate application.

- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 550 (paper-based) is required. Scores from the International English Language Testing System (IELTS) are accepted in place of the TOEFL exam. Minimum acceptable scores will vary; however, the absolute minimum score for an unconditional acceptance is 6.5. Students with a lower score may be admitted conditionally and may be required to take a prescribed program in English, along with a reduced program course load. Students entering this program also are expected to have basic skills in technical writing and editing, and technical document design.

Students with a lower GPA than required may take courses on a nonmatriculated basis and be admitted after successful completion of two or more courses and permission of the program chair.

Center for Multidisciplinary Studies

James Myers, BS, MS, Rochester Institute of Technology; Ph.D., University of Michigan—Director; Professor

Mary Boyd, BA, Earlham College; MS, University of Iowa—Associate Professor

Thomas Hanney, Certificate, Rochester Institute of Technology; BA, St. John Fisher College; MPA, State University College at Brockport—Lecturer

Samuel McQuade III, BA, Western Washington University; MPA, University of Washington; Ph.D., George Mason University—Graduate Program Director; Associate Professor

Richard Morales, BA, Michigan State University; MA, State University College at Brockport; MSW, Ph.D., Syracuse University—Faculty Emeritus

Thomas F. Moran, BSME, California Polytechnic State College; MSME, California State College at Long Beach—Professor

Carol Romanowski, BA, State University College at Plattsburgh; BS, MS, Ph.D., University at Buffalo—Associate Professor

Quarter Courses

2012–2013 Academic Year

Project Management

3081-710 **Project Management**

Course addresses the qualitative and quantitative facets of project management, as well as techniques required to manage projects. Major topics include project selection, planning, work breakdown structure, conflict resolution and negotiation, budgeting, network scheduling, resource allocation, critical path method, pert, earned value analysis, and risk management. Several software applications are used in the course. Students will complete weekly assignments, a term project, and graduate activities. 0681-410 may not be substituted for 0681-710 in a CMS graduate concentration or advanced certificate. (Introductory course(s) in management; Microsoft Office applications; fundamentals of accounting, finance, statistics, and probability; or permission of instructor) **Credit 4**

3081-711 **Advanced Project Management**

Course covers the advanced project management topics necessary for implementation of and excellence in project management. Deals with turning the principles and theory of project management into practice. Ad-dresses the best practices for project management in the world; project portfolio management; the project office; project risk management; multinational cultures and cultural failures; integrated project teams; and virtual project teams. Incorporates aspects of the Project Management Body of Knowledge (PMBOK). (Project Management 0681-710; or equivalent experience; or by permission of the instructor) **Credit 4**

3081-712 **International Project Management**

With the increasing frequency of globalization, mergers, and acquisitions, international projects are becoming more prevalent and approaching the norm for many organizations. This course addresses a wide range of international projects-based in different industries and multiple countries. Deals with cultural and social differences within firms; cultural and social differences among countries and within countries; languages and dialect variations; different management practices and structures; religious practices; legal, regulatory, and reporting requirements; technology differences in different areas; and time zone differences. Incorporates aspects of the Project Management Body of Knowledge (PMBOK). (Project Management 0681-710 and Advanced Project Management 0681-711;or equivalent experience; or permission of the instructor) **Credit 4**

Quality Management

3084-701 **Warehouse and Inventory Management**

In the world of ever-evolving supply chain technologies, inventory control is now a term of the past. Distribution managers and buyers now need skilled individuals who possess a thorough knowledge of the product supply chain; with an in depth understanding of inventory practices, storage techniques, emerging technology and inventory management strategies. A term project is required; students prepare a long-term plan for a real-life situation using concepts taught in class. Co-listed with 0684-501. Note that students may not receive credit for both 0684-501 and 0684-701. Online course. **Credit 4**

3084-780 **Introduction to Asset Management**

Unscheduled downtime costs businesses millions of dollars each year, but asset management and maintenance is often the last area to attract the attention of managers trying to lower costs. Usually thought of as non-value-added, maintenance and asset management policies can have significant impact on a company's profit. This course introduces the student to the wide range of policies and practices, including capital budget issues related to asset acquisition, cost of ownership, and depreciation; inventory/procurement; maintenance policies such as run-to-failure, preventive maintenance, and reliability centered maintenance; training issues; and developing performance indicators for management programs. Co-listed with 0684-480 Note: Students may not receive credit for both 0684-480 and 0684-780. Online course. **Credit 4**

Technical Communication

3088-711 **Technical Information Design**

Intensive practice in the creation of content for online and multimedia documents with emphasis on the presentation of technical and scientific concepts, products, and processes. A survey of graphic methods for the display of complex technical relationships and ideas. Students will also explore contemporary topics (international technical communication, the future of on-line documentation, ethical considerations in technical information design, etc.) and applications (legal, medical, electronics, environmental, etc.) in Technical Information Design. (0688-333 or equivalent, or permission of instructor). **Credit 4**

3088-712 **Advanced Photoshop Techniques**

This course offers a strategic view of the Photoshop/digital imaging work environment, with an emphasis on preparing high-quality images for print. Instead of specific tools, it will focus on broader techniques and strategies with an emphasis on preparing high-quality images for publication. Topics such as image correction, color models, file formats and additional image types such as duotones will be discussed in detail. **Credit 3**

3088-713 **Introduction to XML**

This course provides an introduction to XML (Extensible Markup Language) and its applications in information management and a variety of fields. Students will learn how to use this flexible text format that is playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. Programming experience is not required for this course. **Credit 3**

3088-714 **Science Writing**

Students learn the special requirements for gathering information and writing articles about changes and new developments in the world of science. Students look at contemporary outlets for science writing, read and study examples of science journalism from a variety of fields and prepare a feature length science article. Class articles are published in an on-line journal. **Credit 4**

3088-721 **Creating Technical Proposals**

The elements of proposal writing, including responsiveness, establishing credibility, and technical clarity. The proposal process as practiced in government and industry, including an understanding of RFPs, RFIs, and the decision process. Specialized proposals including NDAs, on-line and multi-media proposals and technical marketing presentations. (0688-333 or equivalent or permission of instructor) **Credit 4**

3088-731 **Technical Procedures**

Development of task-oriented and process documentation. Procedures complex physical and mental tasks including time-constrained activities, emergencies, diagnostics and troubleshooting, and multiple-path processes. Formats for print, electronic, and multi media instructions. An introduction to the creation of online help including Web-delivered and HTML help. (0688-333 or equivalent or permission of instructor) **Credit 4**

3088-732 **Managing Technical and Scientific Communication**

Course covers the management of technical and scientific projects and organizations, including managerial roles, practices, and responsibilities as well as management strategies for content and audience evolution. Covers management of parallel (print and online) projects, single-sourcing, and documentation localization; technological factors in the production and distribution of technical documentation; and consideration of career options and independent contracting. (Technical Writing and Editing 0688-333 or equivalent or permission of the instructor) **Credit 4**

3088-741 **Usability Design and Test**

The elements of successful electronic and print document design. The use of design concepts and tools to increase usability. Introduction to information mapping. Design and usability test considerations for multi-media and user-centered media. (0688-333 or equivalent or permission of instructor) **Credit 4**

Math and Science

3092-700 **Applied Data Mining**
This course is intended to provide students with the knowledge and expertise to leverage data mining's strengths in various domains. The course will cover the data mining methodology, data cleaning and preparation, unsupervised learning algorithms, supervised learning algorithms, new research in the field, and ethical/privacy issues. The focus is on applying data mining methods to a variety of fields; no computer programming experience is necessary. Students should have a computer capable of running Java-based programs and will make extensive use of an open-source data mining application. (Basic statistics and computer literacy, or permission of instructor) **Credit 4**

Security Technology Management

3096-700 **Security Technology Management**
This four-credit course examines security threats and technologies, associated R&D processes and relationships among technology developers, and numerous management concerns pertaining to the adoption, implementation and utilization of security enhancing technologies throughout society. **Credit 4**

3096-701 **Security Technology Policy, Law and Ethic**
This course will introduce the ethical component of security policies and practices especially those involving security systems, tools and related technologies. Within this general framework several specialized topics are addressed including: scientific misconduct in security technology R&D, regulation construction and ethical enforcement practices, reasonable expectations of privacy established in case law rulings, abusive/illegal use of security technologies, causes of personal and vicarious civil liability, and links between personal integrity and professional ethics. **Credit 4**

3096-702 **Managing Critical Information Infrastructure Threats**
The course explores economic, political, cultural, organizational and technological factors underlying information security threats, conflicts, competitions, and response capabilities, and how these may compromise national, organizational and personal security. (Security Technology Management or with permission of instructor) **Credit 4**

3096-703 **Security Enhancement—Environmental Design**
This course will provide students with an understanding of the integration of technology into security designs. Physical barriers, locks, lighting, alarm, and CCTV systems are just of few of the many relatively low-to-high technologies that will be addressed with regard to public and private facilities, landscaping and architecture planning. (Security Technology Management or with permission of instructor) **Credit 4**

3096-704 **Internal Organizational Security Management**
This course provides an essential overview of internal security theory, fundamentals, laws, regulations and best investigative practices with an emphasis on innovative tools and methods now available to enhance internal security functions in all types of organizations. (Security Technology Management or with permission of instructor. **Credit 4**

Professional Studies

3097-798 **Special Topics**
Special Topics are experimental graduate courses announced quarterly. Watch for titles in the course listing each quarter. **Credit variable**

3099-705 **Context and Trends**
This course introduces students to interdisciplinary thinking, solving and research techniques and also print and electronic information resources appropriate to the student's individualized plan-of-study. **Credit 4**

3099-775 **Capstone Project**
This course is a supervised, hands-on experience in which students apply the skills and knowledge developed through their individualized plans-of-study and concludes with a specific product and an oral and written presentation. **Credit 4**

3099-798 **Independent Study**
This course number should be used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. **Credit 1–12**

National Technical Institute for the Deaf

Gerald Buckley, President, NTID; Vice President and Dean, RIT
www.ntid.rit.edu

Programs

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The National Technical Institute for the Deaf (NTID) is the world's largest technological college for deaf students. Among RIT's more than 17,600 full- and part-time students are more than 1,300 undergraduate and graduate deaf students from the United States and 17 foreign countries.

NTID offers a master of science degree in secondary education of students who are deaf or hard of hearing. All full-time students in the MS program are eligible for scholarships and graduate assistantships.

Students also can pursue master's degrees through RIT's other eight colleges and degree-granting units.

Secondary Education of Students Who Are Deaf or Hard of Hearing, MS

www.rit.edu/NTID/msse
Gerald C. Bateman, Director
(585) 475-6480 (voice/TTY), gcbnmp@rit.edu

Program overview

The master of science degree in secondary education of students who are deaf or hard of hearing prepares students to meet the national need for teachers of secondary students who are deaf or hard of hearing. The program prepares teachers not only as effective and ethical practitioners but also as scholars and leaders in the profession.

Faculty members are international leaders in research and are highly skilled in the education of deaf people. A carefully designed system of faculty advisement is a prominent feature of the program. On-campus facilities, state-of-the-art technology, and a well-established system of educational access services combine to make this a vital program for both deaf and hearing students who desire careers as professional educators of deaf students. Graduates have a 96-percent pass rate on the New York State Teacher Certification examinations.

Curriculum

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Secondary education for students who are deaf or hard of hearing, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
0835-700	History of Deaf Educational Thought	4
0835-701	Psychology and Sociology of Deaf Students	4
0835-702	Deaf Students: Educational and Cultural Diversity	4
0835-703	Special Education in the Social Context	4
0835-704	Teaching Deaf Learners with Secondary Disabilities	4
0835-705	Political/Legal Environment	4
0835-706	Educational Technology and Teaching	2
0835-712	Curriculum Content and Methods of Instruction	4
0835-713	Assessment	4
0835-721	Structure of American Sign Language	4
0835-722	Audition and Spoken Language: Application in Education	4
0835-723	Language Acquisition and Variation	4
0835-724	English Language Development	4
0835-790	Foundations of Educational Research	4
0835-820	Perspectives in Teaching Deaf and Hard-of-Hearing Students	2
0835-860	Student Teaching I†	10
0835-861	Student Teaching II†	10
0835-880	Master's Project Seminar	2
0835-890	Master's Project	8
0835-898	Special Topics	variable
0835-999	Field Experience	0
	Professional Development Seminars	0
	American Sign Language*	8
Total Quarter Credit Hours		**94**

* Course placements and credit by exam for ASL is determined by the department of American Sign Language and interpreting education

† Students are required to complete a minimum of 250 hours of supervised student teaching, working with deaf and hard-of-hearing students at the secondary (7–12 grade) level. In addition 100 hours of field experience are required before the first student teaching placement.

Secondary education for students who are deaf or hard of hearing, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MSSE-700	History of Deaf Educational Thought and Practice	3
MSSE-701	Psychology and Human Development	3
MSSE-703	Foundations of Special Education	3
MSSE-710	General Instructional Methods	3
MSSE-725	Structures of ASL and English	3
MLAS-202	Beginning ASL II	4
MSSE-702	Educational and Cultural Diversity	3
MSSE-714	Curriculum Content and Methods of Instruction	3
MSSE-722	Educational Audiology and Spoken Language Development	3
MSSE-728	Literacy and the Deaf Adolescent	3
MSSE-715	Issues in Mainstreamed Education	3
Second Year		
MSSE-712	Practicum	2
MSSE-704	Teaching Deaf and Hard of Hearing Learners Special Educational Needs	3
MSSE-713	Assessment Principles and Practices	3
MSSE-726	Language Acquisition and Learning	3
MSSE-727	ASL in Instructional Delivery	3
MSSE-785	Foundations of Educational Research	3
MSSE-760	Student Teaching I*	6
MSSE-761	Student Teaching II*	6
MSSE-790	Professional Portfolio	3
MSSE-794	Inquiry in Teaching	3
Total Semester Credit Hours		**66**

* Students are required to complete a minimum of 250 hours of supervised student teaching, working with deaf and hard-of-hearing students at the secondary (7–12 grade) level. In addition 100 hours of field experience are required before the first student teaching placement.

Degree requirements

Course work will require a minimum of six quarters. A cumulative GPA of at least 3.0 must be maintained. Before graduation, students are expected to have at least intermediate-level signing skills as determined by a Sign Language Proficiency Interview.

Admission requirements

To be considered for admission to the MS program in secondary education of students who are deaf or hard of hearing, candidates must fulfill the following requirements:

- Hold a baccalaureate degree at an accredited college or university,
- Have a cumulative grade-point average of 3.0 or higher,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Have a basic knowledge of sign language as measured by a departmental skill assessment, or willingness to take American Sign Language I, or its equivalent, at NTID or another college prior to beginning the program,
- Have a level of writing proficiency appropriate to graduate study as indicated by a review of undergraduate writing-intensive courses and an expository essay.
- Submit letters of reference and an expository essay that indicates evidence of professional commitment and potential for success in the program,
- Participate in an individual interview, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 550 (paper-based) or 213 (Internet-based) are required.

Additionally, 30 semester credit hours in a content area are required by the New York State Education Department for initial certification to teach a secondary (grades 7–12) content area. Students who do not have the required number of hours must complete the additional credits before applying for New York State certification. Secondary academic subjects include American Sign Language, English, mathematics, social studies, or science. Note: The social studies content area includes economics and government, and at least 21 semester hours in the history and geography of the United States and the world.

Additional information

4+2 education program

A 4+2 program designed specifically for RIT students who hope to become teachers of deaf and hard-of-hearing students was created as a bridge between the university's four-year bachelor's degree programs and the two-year MS program in secondary education.

Upon successful completion of a bachelor's degree in an approved program with the required credits and GPA, students are guaranteed admission to the MS program.

Financial Aid

NTID tuition is about one-third of RIT's tuition. Approximately 60 percent of NTID's full-time graduate students receive financial aid awards. A student's need is determined by the analysis of the Free Application for Federal Students Aid (FAFSA). RIT has four general categories of financial aid: scholarships, grants, loans, and employment. RIT has grant funding available to address the financial need of all graduate students. Though funds are limited, RIT strives to meet as much of a student's financial need as possible.

Students who pursue the MS program and plan to teach in the content areas of math or science upon graduation, may be eligible for a scholarship of up to $6,000 per year for two years. Up to 10 such scholarships are offered on an annual basis. Students who plan to teach other content areas such as English and social studies may be eligible for scholarships for up to $4,000 per year for two years.

All full-time students in the MS program are offered opportunities to work as graduate assistants with members of NTID faculty and staff. These paid positions range from teaching and research assistants to program assistants and tutors. Graduate assistants are required to work five hours per week and receive a stipend of $1,000 per quarter ($3,000 per academic year). There also are numerous on-campus student employment opportunities available.

Graduate Faculty

Gerald C. Bateman, BS, MS, State University College at Geneseo; Ed.D., University of Rochester—Professor; Director, Curriculum and Teaching

Jennifer L.B. Adams, BA, Wake Forest University; MS, University of Rochester—Associate Director, NTID Center for Educational Research Partnerships (CERP); Adjunct Professor, Teaching Deaf Learners with Secondary Disabilities

Karen Christie, BS, M.Ed., Lewis and Clark College; Ph.D., University of Pittsburgh—Associate Professor, Education

Jessica A. Cuculick, BS, Rochester Institute of Technology; MSW, East Carolina University—Assistant Professor, Curriculum and Teaching

Carol Lee De Filippo, BA, Newark State College; MS, Purdue University; MS, Ph.D., Washington University—Professor, Communication Sciences: Audiology

Susan Foster, BA, Northwestern University; BS, University of Maine; M.Ed., Bridgewater State College; Ph.D., Syracuse University—Professor, Special Education and Rehabilitation

Ronald Kelly, BS, M.Ed., Ph.D., University of Nebraska at Lincoln—Professor, Educational Psychology and Measurements

Baldev Kaur Khalsa, BA, M.Ed., Western Maryland College—Associate Professor, Education of Deaf Students

Christopher Kurz, BA, Rochester Institute of Technology; MS, Ph.D., University of Kansas—Associate Professor, Special Education: Education of Deaf Students

Susan L. Lane-Outlaw, BA, MA, University of North Florida; Ph.D., Gallaudet University—Assistant Professor, Language and Literacy Development

Ila Parasnis, BA, MS, Nagpur University; MA, Ph.D., University of Rochester—Professor, Psychology

Amanda Picioli, BS, State University College at Geneseo; MES, Smith College; MS, Syracuse University; AuD., University of Florida—Audiologist, Audiology

Thomastine Anne Sarchet, BS, MS, Rochester Institute of Technology— Research Associate, NTID Center for Educational Research Partnerships (CERP); Adjunct Instructor, Assessment

Sara Schley, BA, Reed College; MA, Northeastern University; Ed.D., Harvard University—Associate Professor, Human Development and Language Acquisition

J. Matt Searls, BA, MA, Gallaudet University; Ph.D., American University—Associate Professor, Counseling and Development

Michael S. Stinson, BA, University of California at Berkeley; MA, Ph.D., University of Michigan—Professor, Educational Psychology

Quarter Courses

2012–2013 Academic Year

Secondary Education of Students Who Are Deaf or Hard of Hearing

0835-700 History of Deaf Educational Thought

A historical analysis of change and continuity in educational history from colonial through contemporary America. Special emphasis will be given to the development of the field of deaf education in the United States. Lectures, seminar discussions, and readings offer comprehensive coverage of the salient intellectual themes of American deaf educational history. **Class 4, Credit 4 (F)**

0835-701 Psychology and Sociology of Deaf Students

The purpose of this course is to examine the psychological and social development of deaf and hard-of-hearing students in childhood and adolescence. The ways that family, school, and community affect the student's development, including effects on cognitive processes, identity formation, and peer relationships, are considered. Psychological and sociological perspectives on the students' experience in general are used to provide a framework for understanding the development of deaf and hard-of-hearing students. Educational implications of the theories and research presented are discussed. **Class 4, Credit 4 (F, W)**

0835-702 Deaf Students: Educational and Cultural Diversity

This course introduces the concepts underlying cultural anthropology and uses a cross-cultural approach to examine issues that include transmission and preservation of culture, cultural change and transformation, concepts of marginality, and majority and minority cultures. Deaf culture is examined and compared with other cultures, using comparative studies and cultural constructs such as norms, values, and beliefs. The relationship between education and culture is discussed, and the nature of this relationship with respect to Deaf culture is studied. **Class 4, Credit 4, (F, S)**

0835-703 Special Education in the Social Context

This course takes a sociological approach to disability and special education. Three models of disability are introduced: clinical, social interactionist, and political. The models provide a foundation for the course and guide study of three major aspects of disability and special education. First, students explore how each of the models has guided and continues to guide service and social institutions for persons with disabilities including educational and rehabilitation services. Second, students examine the process through which people with disabilities are so labeled and the interaction between these individuals and others (family, school, community). Third, students analyze the role of the human service professional (including teachers) and the ways in which training programs reflect the various models of disability. The course draws heavily on a variety of philosophical, theoretical, conceptual and methodological perspectives, including phenomenology, symbolic interactions, and human ecology. **Class 4, Credit 4 (F)**

0835-704 Teaching Deaf Learners with Secondary Disabilities

This course focuses on providing students with basic information regarding the needs of deaf learners with disabilities, including (1) developmental disability, (2) emotional or behavioral disorder, (3) learning disability, attention deficit disorder or attentional deficit hyperactivity disorder, or (4) visual impairment. Topics include incidence, identification, assessment, and teaching strategies. The goal is to enable students to see students in a holistic fashion, and incorporates the perspectives of parents, teachers, and students themselves through site visits, interviews, and panel discussion. The course regularly incorporates guest lecturers who have specialized expertise in teaching or research in one or more topic areas. (0835-703) **Class 4, Credit 4 (S)**

0835-705 Political/Legal Environment

The relationship of the goals and processes of deaf education to those of special education and education in general is explored. The course provides a detailed examination of historical and current demographic, economic, political, legal, and social trends that affect the education of deaf and hard-of-hearing students. Current federal and state legislation affecting students with disabilities is analyzed and critiqued. **Class 4, Credit 4 (S)**

0835-706 Educational Technology and Teaching

This introductory course provides an overview of the use of educational technologies to enhance the learning experiences of deaf students. The use of productivity software and educational software including Web-based instruction and resources are explored. The selection, development, implementation, and evaluation of technology-based solutions are addressed. Instructional materials are created following a simplified model of instructional development. **Class 2, Credit 2 (F)**

0835-712 Curriculum Content and Methods of Instruction

Note: There are five discipline-specific courses here, designated by section: 01 (English), 02 (Mathematics), 03 (Science), 04 (Social Studies), and 05 (American Sign Language). Students will take only the section focusing on the content area in which they will be certified.

0835-712 Section 01 English

This course examines issues and methods related to teaching English in the secondary level to students who are deaf or hard-of-hearing. Students investigate and analyze current approaches to curriculum, instruction and materials in the area of English instruction through readings, observations, and seminars. Students design content area projects to demonstrate a variety of methodological philosophies. **Class 4, Credit 4 (W)**

0835-712 Section 02 Mathematics

This course examines issues and methods related to teaching mathematics at the secondary level to students who are deaf or hard-of-hearing. Current instructional methods, curriculum and professional resources in mathematics are studied through seminars, readings, special projects, observations and work with content-area specialists and teachers in secondary-level mathematics courses. **Class 4, Credit 4 (W)**

0835-712 Section 03 Science

This course examines issues and methods in teaching secondary-level science to deaf or hard-of-hearing students, including the selection, modifications, and use of curriculum materials in science. Discussions will be concerned with instructional strategies, classroom managements, cognitive development, testing and evaluation, lab report writing and theories of science teaching. Students will be required to observe teachers in secondary level science courses. **Class 4, Credit 4 (W)**

0835-712 Section 04 Social Studies

This course examines issues and methods related to teaching social studies at the secondary level to students who are deaf or hard of hearing. Through seminars, readings, special projects, and work with content area specialists/teachers, current instructional methods, curriculum and professional resources in social studies are examined. Students will be required to observe teachers of secondary level social studies courses at public schools, residential schools for deaf students or in mainstream programs. **Class 4, Credit 4 (W)**

0835-712 Section 05 American Sign Language

This course examines issues and methods related to teaching American Sign Language at the secondary level. Students investigate and analyze current approaches to ASL curriculum, instruction, and materials through readings, observations, and seminars. Students design content area projects to demonstrate their understanding of teaching theories and methods, curriculum design and evaluation techniques. **Class 4, Credit 4 (W)**

0835-713 Assessment

This course addresses assessment as a process involving the choice and interpretation of assessment measures to diagnose the need for and aid in planning for services, referrals, and placement of secondary students who are deaf and hard of hearing, including students with other secondary disabilities. The respective roles of the classroom teacher, school psychologist, parents, and support service providers are addressed. Assessment and educational planning for a student are viewed from an ecological perspective, including the family, the school, the community, the support services, and the legal systems. This course also addresses the development and interpretation of assessment measures of learning through teacher-made, criterion referenced, curriculum-based, and norm-referenced methods. (0835-802, 0835-860) **Class 4, Credit 4, (F)**

0835-721 Structure of American Sign Language
This course concentrates on the linguistic structures of American Sign Language (ASL). Students examine all levels of structure from phonology (sublexical) through morphology and syntax to semantics and discourse. ASL structures will be elucidated through comparison and contrast with English and other spoken languages or dialects, as well as with other sign languages. ASL literacy, language variation, and code switching in the deaf population are also examined. **Class 4, Credit 4 (F)**

0835-722 Audition and Spoken Language: Applications in Education
This course focuses on the ways individuals comprehend and produce spoken English. It provides a functional understanding of auditory physiology, speech perception and deafness, hearing aids and other assistive listening devices. Procedures for audiological and speech/language assessment are examined with their implications for auditory training, speechreading, and speech/language instruction. Models of collaboration among teachers, speech/language pathologists, and audiologists to enhance students' communication using spoken English are discussed and observed. **Class 4, Credit 4 (W)**

0835-723 Language Acquisition and Variation
This course is designed to familiarize students with the processes involved in learning English with a focus on reading and writing. The course concentrates on those aspects of English language development that pertain to teaching deaf and hard-of-hearing students in grades 7 to 12. Students investigate deaf learners' attainments in reading and writing, patterns of English language performance observed in deaf learners, relationships between spoken and written English performance, bilingual/bicultural issues related to English learning and use, second language teaching strategies, and reading and literacy questions. (0835-721 or permission of instructor) **Class 4, Credit 4 (W)**

0835-724 English Language Development
This course is designed to familiarize students with the processes involved in learning English with a focus on reading and writing. The course concentrates on those aspects of English language development that pertain to teaching deaf and hard-of-hearing students in grades 7 to 12. Students investigate deaf learners' attainments in reading and writing, patterns of English language performance observed in deaf learners, relationships between spoken and written English performance, bilingual/bicultural issues related to English learning and use, second language teaching strategies, and reading and literacy questions. **Class 4, Credit 4 (F)**

0835-790 Foundations of Educational Research
This course is an introduction to research and inquiry in education. Perspectives on and issues related to research in the education of people who are deaf and hard of hearing are examined. Students are introduced to the research process, including design, theoretical perspectives, methods of data collection, validity/reliability, data analysis, and interpretation. Students leave this course with a preliminary proposal for the master's thesis or project. **Class 4, Credit 4 (F)**

0835-820 Perspectives on Teaching Deaf and Hard-of-Hearing Students
This course reviews fundamental principles of teaching and learning in light of the recently completed student teaching assignment. Students analyze examples of theoretical applications in teaching this class and from viewing videotapes of their actual lessons used during the student teaching experience. Students propose a plan for change and skill development. (Student Teaching I, 0835-860) **Class 2, Credit 2 (S)**

0835-860 Student Teaching I
This first practicum consists of 10 weeks (250 hours) of teaching and observation. Student teachers are placed with cooperating teachers in residential schools for the deaf. Students develop lesson and unit plans and teach in the content area in which they plan to receive New York State certification. (0835-712, 999) **Credit 10 (S)**

0835-861 Student Teaching II
This is an eight-week practicum done in conjunction with an itinerant or resource room cooperating teacher at the middle or secondary level in a mainstream setting with students who are deaf or hard of hearing. Students develop and deliver support for instruction, participate in student assessment, and, where appropriate, prepare lesson plans and teach to specific IEP objectives. (Student Teaching I, 0835-860; Perspectives on Teaching Deaf and Hard-of-Hearing Students, 0835-820) **Credit 10 (W)**

0835-880 Master's Project Seminar
Students finalize their project proposal and begin research and development. Students also finalize the selection of their project adviser. Format for the seminar is full group meetings in the early part of December followed by individual or small group consultation with project advisers. (Foundations of Educational Research, 0835-790) **Class 2, Credit 2 (W)**

0835-890 Master's Project
This is the capstone experience of the master's degree program. Students must have already submitted an acceptable proposal in order to enroll. Project development, presentation, and/or reporting or research and the preparation of the written thesis are completed in this course. The course work and project must be completed within a seven-year period; register for one credit of Master's Project Continuation (0835-891) each school term after all required coursework/student teaching assignments have been met and until the final project is completed. **Variable credit 0-8 (S)**

0835-891 Master's Project Continuation
Students who register for this course are those who have not completed their Master's Project during their final quarter in the Master of Science in Secondary Education of Students Who are Deaf or Hard of Hearing program. (0835-890). **Class 0, Credit 1. (F, W, S, Su)**

0835-898 Special Topics
Special topics courses will be developed based on student interest and demand as well as faculty interest and availability. They may include electives in speech, audiology, and comparative linguistics, among others. **Variable credit**

0835-999 Field Experience
As required by the New York State Education Department, each MSSE student is required to complete 100 hours of field experience before their first student teaching assignment during the spring quarter. At the beginning of their first year in the program, the students attend a required meeting where they are given the field experience guidelines that specify the number of hours that have to be met in various settings (classroom observations at both schools for the deaf and mainstreamed programs, attending Deaf culture events, course-specific observations, etc). After completion of all of the required observations, the students are required to submit a field experience portfolio following the specifications stated in the guidelines. This course must be completed with a satisfactory grade before taking Student Teaching I (0835-860). **Credit 0 (W)**

0886-199 American Sign Language I
Designed for students who have no previous knowledge of American Sign Language. ASL I includes the linguistic features, cultural protocols and core vocabulary for students to function in basic ASL conversations that include ASL grammar for asking and answering questions while introducing oneself; exchanging personal information; talking about family, friends and surroundings; and discussing activities. Classroom and lab activities include practicing conversations and videotaping. (SIPI/LCBQ:1) **Class 4, Credit 4 (F, W)**

0886-200 American Sign Language II
Expands the basic principles presented in ASL I. The course teaches students to use linguistic features, cultural protocols, and core vocabulary to function in additional basic ASL conversations including ASL grammar for giving directions; describing others; making requests; talking about family, occupations and routines; and attributing qualities to others. Classroom and lab activities include practicing conversations and videotaping. (0886-199 or equivalent) **Class 4, Credit 4 (F, W, S)**

0886-201 American Sign Language III
This course is a continuation of ASL II expanding the emphasis on ASL grammar, syntax, spatial referencing and vocabulary development. ASL III teaches further communicative competencies in ASL conversations beyond the basic level that include telling life events, describing events in time, asking for clarification, correcting, conforming, elaborating on information, agreeing and disagreeing, resolving conflicts, and giving directions. Classroom and lab activities include practicing dialogues, short stories, narratives and short conversations. (0886-200 or equivalent) **Class 4, Credit 4 (F, W, S)**

Professional Development Seminars
Variety of topics: second-year students present research topics and ideas to all program faculty and students; child abuse and substance abuse; the code of ethics for interpreters; using educational support personnel effectively; identifying and using community resources. **Credit 0**

Semester Courses

Effective fall 2013

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Secondary Education of Students Who Are Deaf or Hard of Hearing

MSSE-700 History of Deaf Educational Thought and Practice

A historical analysis of change and continuity in educational history from colonial through contemporary America. Special emphasis will be given to the development of the field of Deaf education in the United States. Lectures, seminar discussions, and readings offer comprehensive coverage of the salient intellectual themes. **Class 3, Credit 3, (F)**

MSSE-701 Psychology and Human Development

The purpose of this course is to examine the psychological and social development of deaf and hard-of-hearing students in childhood and adolescence. The ways that family, school, and community affect the student's development, including effects on cognitive processes, identity formation, and peer relationships, are considered. Psychological and sociological perspectives on students' experience in general are used to provide a framework for understanding the development of deaf and hard-of-hearing students. Educational implications of the theories and research presented are discussed. **Class 3, Credit 3, (F)**

MSSE-702 Educational and Cultural Diversity

This course focuses upon knowledge and understanding of existing diversities within the Deaf and Hard-of-Hearing communities, and ways in which teaching can most effectively meet the needs and interests of these students for effective learning. Readings and discussions will explore the educational needs of Deaf and Hard-of-Hearing students with variations of experience related to culture, race/ethnicity, language, educational and socio-economic backgrounds and settings, communication skills, and learning styles. These concepts will be applied to effective teaching and curriculum development. **Class 3, Credit 3, (F)**

MSSE-703 Foundations of Special Education

This course takes a sociological approach to disability and the historical foundations of special education. Three models of disability are introduced: medical, social, and political. These three models provide a foundation for the course, and guide study of three major aspects of disability and special education. First, the class will explore how each of these models has historically guided and, in some cases, continues to guide services and social institutions for persons with disabilities, including educational and rehabilitation services. Second, the course will examine the process through which people with disabilities are so labeled and the interaction between these individuals and others (family, peers, school, community). Third, the course will analyze the changing role of the human service professional (including teachers) and the ways in which professional preparation programs reflect the various models of disability. The course will draw heavily on a variety of philosophical, theoretical, conceptual and methodological perspectives, including phenomenology, symbolic interaction, and human ecology. **Class 3, Credit 3, (F)**

MSSE-704 Teaching Deaf and Hard-of-Hearing Learners with Special Educational Needs

This course focuses on providing students with basic information regarding the needs of deaf and hard of hearing learners with special educational needs, including (1) developmental disability, (2) emotional or behavioral disorder, (3) learning disability, attention deficit disorder or attention deficit hyperactivity disorder, or (4) visual impairment. Topics include incidence, identification, assessment, teaching strategies, and working with parents. The goal is to enable students to see students in a holistic fashion, and thus will include the perspectives of parents, teachers and deaf and hard of hearing learners with special educational needs. Learning strategies may include site visits, presentations, films, and interactive workshop style classes offered by experienced teachers, psychologists, counselors, disability advocates, and parents of learners with special educational needs. The course will regularly incorporate guest lecturers who have specialized expertise in teaching or research in one or more of the topic areas covered in the course. (MSSE-703) **Class 3, Credit 3 (S)**

MSSE-710 General Instructional Methods

This introductory course provides an overview of the current theories of assessment, curriculum, instruction, and learning across diverse educational settings in the field of deaf education. The course covers the use of educational technologies to enhance the learning experiences of deaf students and options for classroom management, learning environment appropriate to K-12 classrooms, and methods for assessment. Reflection and application of effective instructional practices are demonstrated through microteaching and field-based experiences. To progress to MSSE-714 Practicum, the student must obtain a grade of at least B in this course. **Class 3, Credit 3, (F)**

MSSE-712 Practicum

As required by the New York State Education Department, each MSSE student is required to complete 100 hours of practicum experience during their first year in the program. This practicum experience provides students with opportunities to observe and reflect on their content, professional, pedagogical knowledge, skills and disposition in classroom settings at both schools for the deaf and mainstreamed programs. There will also be course-related observations. Students will also be required to attend selected Deaf culture events. After completion of all of the required observations, the students are required to submit a practicum experience portfolio. Guidelines will be provided to the student. The practicum experience must be completed with a grade of at least a B before the first student teaching assignment. (MSSE-710 with a minimum grade of B) **Credit 2 (S)**

MSSE-713 Assessment Principles and Practices

This course addresses assessment as educational decision-making, involving the selection and interpretation of assessment tools as applied to classroom-based student learning. The course focuses on students who are deaf and hard of hearing; including students with diverse learning needs. Assessment and educational planning for students are discussed as part of a cooperative model, including the relevant stakeholders in the decision-making process. This course also addresses the development and interpretation of both formative and summative assessment strategies in light of acceptable criteria of validity and reliability, and the absence of assessment bias. Criteria for evaluating the appropriateness of standardized tests, with emphasis on deaf and hard-of-hearing students, are discussed and practiced. Collection and interpretation of assessment information are applied to the development and revision of Individualized Education Plans (IEPs). **Class 3, Credit 3 (S)**

MSSE-714 Curriculum Content and Methods of Instruction

Note: There are five discipline-specific courses here, designated by section: 01 (English), 02 (Mathematics), 03 (Science), 04 (Social Studies), and 05 (American Sign Language). Students will take only the section focusing on the content area in which they will be certified.

Section 01 English. This course examines issues and methods related to teaching English in the secondary level to students who are Deaf or Hard-of-Hearing. Students investigate and analyze current approaches to curriculum, instruction and materials in the area of English instruction through readings, observations, and seminars. Students design content area projects to demonstrate a variety of methodological philosophies.

Section 02 Mathematics. This course examines issues and methods related to teaching mathematics at the secondary level to students who are Deaf or Hard-of-Hearing. Current instructional methods, curriculum and professional resources in mathematics are studied through seminars, readings, special projects, observations and work with content-area specialists and teachers in secondary-level mathematics courses.

Section 03 Science. This course examines issues and methods in teaching secondary-level science to Deaf or Hard-of-Hearing students, including the selection, modifications, and use of curriculum materials in science. Discussions will be concerned with instructional strategies, classroom managements, cognitive development, testing and evaluation, lab report writing and theories of science teaching. Students will be required to observe teachers in secondary-level science courses.

Section 04 Social Studies. This course examines issues and methods related to teaching social studies at the secondary level to students who are Deaf or Hard-of-Hearing. Through seminars, readings, special projects, and work with content area specialists/teachers, current instructional methods, curriculum and professional resources in social studies are examined. Students will be required to observe teachers of secondary level social studies courses at public schools, residential schools for Deaf students or in mainstream programs.

Section 05 American Sign Language. This course examines issues and methods related to teaching American Sign Language at the secondary level. Students investigate and analyze current approaches to ASL curriculum, instruction, and materials through readings, observations, and seminars. Students design content area projects to demonstrate their understanding of teaching theories and methods, curriculum design, and evaluation techniques. To progress to MSSE-760, students must obtain a minimum grade of B in this course. (MSSE-710 & MSSE-712 with minimum grades of B) **Class 3, Credit 3, (F)**

MSSE-715 Issues in Mainstreamed Education
This course will prepare students to work with Deaf and Hard-of-Hearing children and youth with a broad range of disabilities and educational needs in mainstreamed school settings. The course is designed to foster acceptance of diversity among individuals as well as to develop skills in writing appropriate Individualized Education Programs (IEPs), including behavior modification methods, communication strategies, and psycho-educational approaches. **Class 3, Credit 3, (F)**

MSSE-722 Educational Audiology and Spoken Language Development
This course provides a basic understanding of the mechanisms of hearing and speech and causes of hearing loss. Emphasis is placed on development of a functional understanding of speech perception, speech development, hearing aids, cochlear implants, and assistive listening devices. Procedures for audiological and speech/language assessment are examined, together with strategies for supporting use and development of spoken language in the classroom. **Class 3, Credit 3, (F)**

MSSE-725 Structures of American Sign Language and English
This course concentrates on the linguistic structures of American Sign Language (ASL) and English. This course introduces students to the structural description of ASL and English languages at various levels (phonology, morphology, syntax, semantics, and discourse/pragmatics). Issues related to language change and variation, language use in contact situations (for example, code-mode switching), and language use in education will be discussed. **Class 3, Credit 3, (F)**

MSSE-726 Language Acquisition and Learning
This course introduces students to current theories of language acquisition and learning in educational settings. The stages of acquisition and learning, and variables that influence these processes will be included. Bilingual and second language acquisition and learning will also be addressed. Implications for instruction with Deaf students will be discussed. (MSSE-725) **Class 3, Credit 3 (S)**

MSSE-727 American Sign Language in Instructional Delivery
This course is designed to improve the ASL proficiencies of classroom teachers. It provides students strategies and skill building to teach content areas in and through ASL. Students will enhance their ASL skills for the purpose of conveying concepts to Deaf students accurately. Topics include ASL instructional strategies, curriculum development in ASL, assessment modifications, student products in ASL, and vocabulary/phrases for effective communication and instructional delivery. (MSSE-725) **Class 3, Credit 3 (S)**

MSSE-728 Literacy and the Deaf Adolescent
This course is designed to familiarize students with the process involved in English literacy development. Particular emphasis is placed on the literacy development of deaf and hard-of-hearing students in grades 7-12. Students learn about various language and literacy instructional methods and how to incorporate literacy instruction into all secondary content area classrooms. (MSSE-726) **Class 3, Credit 3, (F)**

MSSE-760 Student Teaching I
This first assignment consists of 8 weeks (40 days or 250 hours) of teaching and observation. Teacher candidates are placed with cooperating teachers in residential schools for the Deaf or mainstreamed programs. They develop lesson and unit plans and teach in the content area in which they plan to receive New York State certification. To progress to MSSE-761, students must pass this student teaching assignment with a minimum grade of B and submit a student teaching portfolio. (MSSE-714 with a minimum grade of B) **Credit 6 (S)**

MSSE-761 Student Teaching II
This second assignment consists of 8 weeks (40 days or 250 hours) of teaching and observation. Student teachers are placed with cooperating teachers in residential schools for the Deaf or mainstreamed program. They develop lesson and unit plans and teach in the content area in which they plan to receive New York State certification. Students must pass this student teaching assignment with a minimum grade of B and submit a student teaching portfolio. (MSSE-760 with minimum grade of B) **Credit 6 (S)**

MSSE-785 Foundations of Educational Research
This course is an introduction to research and inquiry in education. The course includes the evaluation of selected Deaf education research studies, including methodologies, data collection and analyses, and implications of the studies to teaching and learning. Action research in the classroom is examined in depth. Students will prepare a review of literature and an action research plan related to a specific curriculum topic or problem in the learning/teaching of their content areas. The focus of the course is upon the student as a consumer rather than a practitioner of research, however the student will exit the course with basic practitioner knowledge, especially in the area of teacher research. **Class 3, Credit 3 (S)**

MSSE-789 Special Topics: MSSE
Special topics courses will be developed based on student interest and demand as well as faculty interest and availability. These courses are usually taken on an elective basis. **Class 1–3, Credit 1–3 (F, S, Su)**

MSSE-790 Professional Portfolio
The professional portfolio presents a clear picture of pre-service professional growth and accomplishments in the complex teaching field. It demonstrates a teacher candidate's reflective and constructive professional performance. The performance includes, but is not limited to, the teacher candidate's actual teaching, reflecting on learning and teaching, developing and implementing lessons, conducting qualitative and quantitative research projects, and applying theory and research to practice. The portfolio includes extensive evidence of teaching and learning experience, including teaching philosophy, pedagogy, classroom management, and the integration of research and teaching. Professional portfolios will be reviewed by a committee of program faculty for approval. (MSSE-714, 785) **Class 3, Credit 3 (S)**

MSSE-794 Inquiry in Teaching
This is an elective enrichment course that facilitates development of scholarship skills in conjunction with the completion of an independent project on an important educational topic. The project may be an experimental study that creates new knowledge, curriculum development that results in a novel and tangible product, a comprehensive review and analysis of a body of literature, or a grant proposal suitable for submission to funding sources. Students will seek a project mentor by the end of their first semester and will work independently under the guidance of that mentor. A committee of program faculty will evaluate the final written report for level of critical thinking, integration of concepts, clarity of expression, and adherence to the principles of scientific inquiry. (MSSE-785) **Credit 3 (S)**

MSSE-799 Independent Study: MSSE
Independent study courses will be developed based on student interest and demand as well as faculty interest and availability. These courses are usually taken on an elective basis. **Credit 1–3 (F, S, Su)**

College of Science

Sophia Maggelakis, Dean
www.rit.edu/cos

Programs of study

Online learning option available

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The College of Science offers a unique complement of graduate programs featuring curricula designed with sufficient flexibility to prepare students for direct entry into a variety of careers or further study toward a more advanced graduate degree in a chosen discipline. The college also houses three doctorate programs featuring internationally-recognized, cutting-edge research activities. Whether the focus is on the foundations of matter, the origins of the universe, applications of mathematics, the role of chemists in our daily lives, the encoding of life within DNA, the specialized properties of advanced materials, our impact on the environment, or the science and technology of advanced imaging systems, the college's graduate faculty provide a valuable and integrated understanding of today's most important fundamental problems, applied research issues, and industrial applications.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarship

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Bioinformatics, MS

http://bioinformatics.rit.edu/
Michael V. Osier, Director
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Program overview

The master of science degree in bioinformatics is offered on a full- or part-time basis to fulfill the needs of traditional students and those currently employed in the field. Students develop a strong foundation in biotechnology, computer programming, computational mathematics, statistics, and database management, and are well-prepared for careers in the biotechnology, bioinformatics, pharmaceutical, and vaccine industries.

Based on consultation with individuals within the industry nationwide, the job market is rich with opportunities for those who obtain a master of science degree in bioinformatics, particularly when coupled with industry-sponsored research as thesis work. This research will provide exposure to real-world problems—and their solutions—not otherwise attainable in an academic setting.

The program provides students with the capability to enter the bioinformatics workforce and become leaders in the field. The curriculum is designed to fulfill the needs of students with diverse educational and professional backgrounds. Individuals entering an MS program in bioinformatics typically have degrees in biology, biotechnology, chemistry, statistics, computer science, information technology, or a related field. The MS program accommodates this diversity in two ways. First, a comprehensive bridge program exists for students who need to supplement their education before entering the MS program. Second, the program itself consists of two tracks, one for students with backgrounds in the life sciences and one for those with backgrounds in the computational sciences. Regardless of the track pursued, students are prepared to become professional bioinformaticists upon graduation.

Curriculum

A minimum of 45 quarter credit hours, including seven or eight core courses, is required for completion of the program. Two tracks—computational science and life science—are available. A number of professional graduate electives are offered for students to pursue areas of personal or professional interest. In addition, every student is required to complete a research project that addresses a relevant and timely topic in bioinformatics, culminating in a thesis. Graduate electives may be chosen from any relevant RIT graduate courses.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Bioinformatics (computational science track), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1001-700	Cell and Molecular Genetics I	3
1001-701	Cell and Molecular Genetics II	3
4002-762	Introduction to Bioinformatics Computing	4
4002-763	Advanced Bioinformatics Computing	4
1001-705	Bioinformatics Resources	3
1001-722	Bioinformatics Seminar	2
1001-725	Ethics in Bioinformatics	3
1001-794	Molecular Modeling and Proteomics	4
1016-715	Statistical Models for Bioinformatics	4
	Graduate electives/Thesis	15
Total Quarter Credit Hours		**45**

Bioinformatics, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
BIOL-635	Bioinformatics Seminar	3
BIOL-630	Graduate Bioinformatics Resources	3
BIOL-625	Graduate Ethics in Bioinformatics	3
Choose one of the following:		3
CSCI-620	Data Exploration and Management	
BIOL-700	Cell and Molecular Genetics	
	Graduate Elective*	3
MATH-695	Statistical Models for Bioinformatics	3
BIOL-694	Graduate Molecular Modeling and Proteomics	3
	Graduate Elective*	3
Second Year		
BIOL-790	Thesis	3
BIOL-790	Thesis	3
Total Semester Credit Hours		**30**

* Any graduate level course deemed related to the field of bioinformatics by the program director.

Bioinformatics (life science track), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
4002-720	Data Object Development	4
	Computer Science course to be determined with Director	
4002-762	Introduction to Bioinformatics Computing	4
4002-763	Advanced Bioinformatics Computing	4
1001-705	Bioinformatics Resources	3
1001-722	Bioinformatics Seminar	2
1001-725	Ethics in Bioinformatics	3
1001-794	Molecular Modeling and Proteomics	4
1016-715	Statistical Models for Bioinformatics	4
	Graduate electives/Thesis	13
Total Quarter Credit Hours		**45**

Admission requirements

To be considered for the MS program in bioinformatics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in biology, biotechnology, biochemistry, chemistry, computer science, information technology, statistics, or related disciplines,
- Have an undergraduate GPA of 3.2 or higher (on a 4.0 scale),
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Examination (GRE), and
- Complete a graduate application.
- International applicants whose primary language is not English are required to submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 213 (computer-based), 570 (paper-based), or 79-80 (Internet-based) are required. International English Language Testing System (IELTS) scores are accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.0-6.5. For additional information about the IELTS, please visit www.ielts.org.

Environmental Science, MS

http://www.rit.edu/cos/environmental/
Christy Tyler, Director
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Program overview

Habitat loss, global climate change, water and air pollution, ozone depletion, species invasions, loss of biodiversity, and the accumulation of toxic wastes are among the many environmental dilemmas our society faces.

These complex problems pit environmental limits against economic development, diverse cultures, ethics, values, and social stability and therefore require an understanding of science, policy, society, history, and economics. Environmental scientists must use integrated and holistic approaches to understand and find sustainable solutions to these problems. Graduates of the environmental science program are well prepared for a variety of environmental careers including consulting, research, policy and outreach, or further graduate work towards a doctoral degree.

Curriculum

Built on the concept that environmental issues are inherently interdisciplinary, the program is offered jointly by the School of Life Sciences in the College of Science and by the department of science, technology, and society in the College of Liberal Arts. The curriculum is designed to provide students with a deep understanding of the science behind our environmental problems, along with the complex set of circumstances that impact environmental issues, and how environmental decisions and policies must attempt to find a balance between environmental conservation and economic development. Students augment their hands-on classroom work with in-depth experiential learning through an individual thesis or project. The curriculum gives students the chance to work on real-world environmental problems under the guidance of skilled environmental scientists.

The program includes a core curriculum and electives chosen to reflect the student's background and career goals. A minimum of 51 quarter credit hours beyond the bachelor's degree is required. All students must propose, conduct, and report on an original research thesis or project.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Environmental science (thesis option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1001-760	Advanced Conservation Biology	4
1006-450	Raster Applications of GIS	4
1006-711, 712, 713	Environmental Science Graduate Study I, II, III	5
1006-710	Environmental Science Graduate Readings Seminar	3
1015-720	Environmental Chemistry	3
0307-712	Fundamentals of Statistics II (or equivalent)	4
Second Year		
1006-879	Environmental Science Graduate Research	3
	Environmental Science Core Graduate Elective	4
	Environmental Policy Core Graduate Elective	4
	Environment and Society Core Graduate Elective	4
	Graduate Professional Electives	4-8
1006-890	Thesis	5-9
Total Quarter Credit Hours		**47-55**

Environmental science (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ENVS-601	Environmental Science Graduate Studies	3
MATH-696	Biostatistics or Equivalent Course	3
	Graduate Public Policy Core Elective	3
	Graduate Science Core Elective	3
ENVS-670	Advanced Concepts of Environmental Chemistry	3
BIOL-675	Advanced Conservation Biology	3
STSO-621	Graduate Biodiversity and Society	3
ENVS-650	Advanced Applications of GIS	4
Second Year		
	Professional Elective	3
ENVS-790	Environmental Science Thesis	3
ENVS-790	Environmental Science Thesis	3
Total Semester Credit Hours		**30**

Environmental science (project option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1001-760	Adv. Conservation Biology	4
1006-450	Raster Applications of GIS	4
1006-711, 712, 713	Environmental Science Graduate Study I, II, III	5
1006-710	Environmental Science Graduate Readings Seminar	3
1015-720	Environmental Chemistry	3
0307-712	Fundamentals of Statistics II (or equivalent)	4
Second Year		
1006-879	Environmental Science Graduate Research	3
	Environmental Science Core Graduate Elective	4
	Environmental Policy Core Graduate Elective	4
	Environment and Society Core Graduate Elective	4
	Graduate Professional Electives	4-8
1006-891	Project	5-9
Total Quarter Credit Hours		**47-55**

Environmental science (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ENVS-601	Environmental Science Graduate Studies	3
MATH-696	Biostatistics or Equivalent Course	3
	Graduate Public Policy Core Elective	3
	Graduate Science Core Elective	3
ENVS-670	Advanced Concepts of Environmental Chemistry	3
BIOL-675	Advanced Conservation Biology	3
STSO-621	Graduate Biodiversity and Society	3
ENVS-650	Advanced Applications of GIS	4
Second Year		
	Professional Elective	3
ENVS-780	Environmental Science Project	3
Total Semester Credit Hours		**31**

Admission requirements

To be considered for admission to the MS program in environmental science, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in environmental science, biological sciences, or a related field of study,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a minimum GPA of 3.0 (overall and in science/math),
- Submit a statement outlining the candidate's research/project interests, career goals, and suitability to the program,
- Submit three letters of recommendation, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 550 (paper-based) or 213 (computer-based) is required. International English Language Testing System (IELTS) scores are accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org.

Students are strongly encouraged to contact program faculty before applying to discuss thesis topics and research projects.

Additional information

Facilities and equipment

The program provides a wide range of research opportunities. Many environmental science faculty members are engaged in field-based projects. The college also boasts excellent laboratory facilities that support field research. These include wet laboratories and computer facilities (traditional and geographic information systems). For a list of past and present projects, and faculty research interests, please visit the program website.

Monitoring, mapping, and field equipment: ArcGIS 9.3 and IDRISI Andes GIS software, Garmin and Trimble GPS receivers, pocket PCs with ArcPad software, soil sampling equipment, soil analysis equipment, digital clinometer, water sampling devices, multisonde water quality probes, dissolved oxygen meter, SCT meter, ponar dredges, light meter, plankton samplers, macro-invertebrate nets/samplers, and a library of field reference texts.

Other equipment: Fluorimeter, Raman Spectrometer, UV-Vis, GC-MS, ICP, atomic absorption, polarimeter, TGA's Micro-extruder, centrifuge, electrochemical equipment, gas chromatography, HPLC detectors, viscometer, ESR (built in-house), infrared carbon dioxide analyzer, microelectrode system, autoanalyzer, incubators, infrared spectrophotometers, capillary electrophoresis, DSCs, DMA, Asher, 300 MHz NMR, drying oven, and a Wiley mill.

Applied and Computational Mathematics, MS

http://www.math.rit.edu/Academics/smag.html

Tamas Wiandt, Graduate Program Director
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Program overview

The ideas of applied mathematics pervade several applications in a variety of businesses and industries as well as government. Sophisticated mathematical tools are increasingly used to develop new models, modify existing ones, and analyze system performance. This includes applications of mathematics to problems in management science, biology, portfolio planning, facilities planning, control of dynamic systems, and design of composite materials. The goal is to find computable solutions to real-world problems arising from these types of situations.

The School of Mathematical Sciences offers an interdisciplinary master of science degree in applied and computational mathematics. The objective of the program is to provide students with the capability to apply mathematical models and methods to study various problems that arise in industry and business, with an emphasis on developing computable solutions that can be implemented. Since this is an interdisciplinary program, students have the opportunity to choose from a wide variety of courses.

Curriculum

The program consists of 48 quarter credit hours of study. Four core courses, usually completed in the first three quarters, provide a focus on some of the ideas of applied mathematics. A concentration and a corresponding course of study are formulated by the student in consultation with an advisory committee. The student completes a total of 20 quarter credit hours by taking a set of five specialized courses offered in the School of Mathematical Sciences, as well as other departments. Concentrations include dynamical systems, discrete mathematics, computational biomathematics, and scientific computing. Other concentrations may be created with approval of the program director.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Applied and computational mathematics (discrete mathematics option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1016-713	Mathematical Methods in Scientific Computing	4
1016-725	Stochastic Processes	4
1016-802	Methods of Applied Mathematics	4
1016-767	Combinatorics	4
1016-768	Graph Theory	4
1016-785	Number Theory	4
1016-764	Topics in Logic, Sets, and Computability	4
Choose one of the following electives:		4
1016-711	Numerical Analysis	
1016-720	Complex Variables	
1016-789	Mathematics of Cryptography	4
1016-879	Thesis	12
Total Quarter Credit Hours		**48**

Applied and computational mathematics (discrete mathematics option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MATH-611	Numerical Analysis	3
MATH-651	Combinatorics and Graph Theory I	3
MATH-671	Number Theory	3
MATH-601	Methods of Applied Mathematics	3
MATH-605	Stochastic Processes	3
MATH-652	Combinatorics and Graph Theory II	3
Second Year		
MATH-771	Mathematics of Cryptography	3
	Electives	6
MATH-790	Thesis	9
Total Semester Credit Hours		**36**

Applied and computational mathematics (dynamical systems option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1016-713	Mathematical Methods in Scientific Computing	4
1016-725	Stochastic Processes	4
1016-802	Methods of Applied Mathematics	4
1016-767	Combinatorics	4
1016-706	Advanced Differential Equations	4
1016-707	Dynamical Systems	4
1016-807	Boundary Value Problems	4
Choose two of the following electives		8
1016-711	Numerical Analysis	
1016-720	Complex Variables	
1016-709	Chaotic Dynamical Systems	
1016-879	Thesis	12
Total Quarter Credit Hours		**48**

Applied and computational mathematics (dynamical systems option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MATH-611	Numerical Analysis	3
MATH-651	Combinatorics and Graph Theory I	3
MATH-631	Dynamical Systems	3
MATH-601	Methods of Applied Mathematics	3
MATH-605	Stochastic Processes	3
MATH-731	Advanced Dynamical Systems	3
Second Year		
MATH-741	Partial Differential Equations I	3
	Electives	6
MATH-790	Thesis	9
Total Semester Credit Hours		**36**

Applied and computational mathematics (scientific computing option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1016-713	Mathematical Methods in Scientific Computing	4
1016-725	Stochastic Processes	4
1016-802	Methods of Applied Mathematics	4
1016-767	Combinatorics	4
1016-712	Numerical Linear Algebra	4
1016-807	Boundary Value Problems	4
1016-811	Numerical Partial Differential Equations	4
1016-711	Numerical Analysis	4
1016-720	Complex Variables	4
1016-879	Thesis	12
Total Quarter Credit Hours		**48**

Applied and computational mathematics (scientific computing option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MATH-611	Numerical Analysis	3
MATH-651	Combinatorics and Graph Theory I	3
MATH-xxx	Elective	3
MATH-601	Methods of Applied Mathematics	3
MATH-605	Stochastic Processes	3
MATH-612	Numerical Linear Algebra	3
Second Year		
MATH-711	Advanced Methods in Scientific Computing	3
MATH-712	Numerical Methods for PDEs	3
	Elective	3
MATH-790	Thesis	9
Total Semester Credit Hours		**36**

Applied and computational mathematics (computational biomathematics option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1016-713	Mathematical Methods in Scientific Computing	4
1016-725	Stochastic Processes	4
1016-802	Methods of Applied Mathematics	4
1016-767	Combinatorics	4
1016-707	Dynamical Systems	4
1016-719	Biostatistics	4
1016-862	Mathematical Biology	4
1016-711	Numerical Analysis	4
1016-720	Complex Variables	4
1016-879	Thesis	12
Total Quarter Credit Hours		**48**

The program includes a thesis, which requires the student to present original ideas and solutions to a specific mathematical problem. The proposal for the thesis work and the results must be presented and defended before the advisory committee.

Admission requirements

To be considered to admission to the MS program in applied and computational mathematics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution in mathematics or any related field. The prerequisite courses are multivariable calculus, differential equations, matrix theory, and probability and statistics. Knowledge of a programming language is required.
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a personal statement of educational objectives,
- Have an undergraduate cumulative GPA of 3.0 or higher,
- Submit two letters of recommendation, and
- Complete a graduate application.
- International applicants whose primary language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 550 (paper-based), 213 (computer-based), or 79-80 (Internet-based) is required. International
  English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org. Those who cannot take the TOEFL will be required to take the Michigan Test of English Proficiency at RIT and obtain a score of 80 or higher.

Although Graduate Record Examination (GRE) scores are not required, submitting them may enhance a candidate's acceptance into the program.

A student may also be granted conditional admission and be required to complete bridge courses selected from among RIT's existing undergraduate courses, as prescribed by the student's adviser. Until these requirements are met, the candidate is considered a nonmatriculated student. The graduate program director evaluates the student's qualifications to determine eligibility for conditional and provisional admission.

Additional information

Student's advisory committee

Upon admission to the program, the student chooses an adviser and forms an advisory committee. This committee will oversee the academic aspects of the student's program, including the selection of a concentration and appropriate courses to fulfill the program's requirements.

Cooperative education

The optional cooperative education program enables the student to alternate periods of study on campus with periods of full-time, paid professional employment. Students may pursue a co-op position after their first quarter.

Part-time study

The program is ideal for practicing professionals who are interested in applying mathematical methods in their work and enhancing their career options. Most courses are scheduled in the late afternoon or early evening. The graduate program may normally be completed in two years of part-time study.

Nonmatriculated students

A student with a bachelor's degree from an approved undergraduate institution, and with the background necessary for specific courses, may take graduate courses as a nonmatriculated student with the permission of the graduate program director and the instructor. Courses taken for credit may be applied toward the master's degree if the student is formally admitted to the graduate program at a later date. However, a maximum of 12 credit hours may be transferred to the degree program from courses taken at RIT as a nonmatriculated student.

Chemistry, MS

http://www.rit.edu/cos/chemistry/

Joseph P. Hornak, Graduate Program Director
(585) 475-2904, jphsch@rit.edu

Program overview

The master of science degree in chemistry is offered on a full- or part-time basis. The program is designed to fill the needs of the traditional student or the practicing chemist who is employed full time and wishes to pursue a graduate degree on a part-time basis.

The department of chemistry has research- and teaching-oriented faculty, as well as excellent equipment and facilities that enable full-time graduate students to carry on a program of independent study and develop the ability to attack scientific problems at the fundamental level. The research can result in either a thesis or a project report.

Through course work and research activities, the program strives to increase the breadth and depth of the student's background in chemistry. Students in the program will develop the ability to attack scientific problems with minimal supervision.

Curriculum

The program offers concentrations in organic, analytical, inorganic, and physical chemistry. In addition, concentrations in polymer chemistry, materials science, and biochemistry are available. Customized program options are available to accommodate specific student interests and needs relating to graduate study in chemistry.

Each student, together with an adviser, will arrange a program best suited to their interests and needs. This program will be subject to the approval of the director of the graduate program.

A deliberate effort will be made to strengthen any areas of weakness indicated by the student's undergraduate records and the placement examinations. The MS degree consists of the following requirements:

1. A minimum of 45 quarter credit hours beyond the bachelor's degree.

Courses in chemistry will generally be chosen from 700- and 800-level courses and should include one or more courses in analytical, organic, and physical chemistry. The core requirement is one course each in organic, physical, and analytical chemistry, plus one course in inorganic chemistry, if an appropriate undergraduate course was not taken. Specifically, each student must select core courses (subject to approval by the student's adviser and the graduate committee) that include the following: Analytical Chemistry (1008-621 and 1008-711); Organic Chemistry (1013-737 or 1013-739); and Physical Chemistry (1014-741, 1014-742, 1014-743, or 1014-744). The inorganic core course is 1012-764. As part of the required credits, each student must have one or two quarter credit hours in seminar (1010-870), and three to four quarter credit hours from outside of the department of chemistry. A maximum of 9 quarter credits may be taken in undergraduate-level courses.

2. Nine credit hours in research (minimum) for the MS thesis option

A minimum of 4 and a maximum of 8 quarter credit hours are required with the project option. The program also offers a course-work-only MS option. With this option, the student must complete a 4 quarter credit hour capstone course.

3. Passage of an oral defense of the MS thesis

Students enrolled in the program full time are expected to complete 45 quarter credit hours of course work, including up to 21 quarter credit hours of research leading to the submission of an independent research thesis, and pass an oral defense of the thesis. A full-time student normally takes six to nine graduate credits per quarter, including thesis work. Typically, all requirements are met within two years. No more than eight credit hours of research are allowed in the non-thesis MS option.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Chemistry (thesis option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
Choose one of the following organic chemisty courses:		4
1013-737	Advanced Organic Chemistry	
1013-739	Advanced Organic Chemistry	
Choose one of the following physical chemistry courses:		3-4
1014-741	Advanced Chemical Thermodynamics	
1014-742	Survey of Physical Chemistry	
1014-743	Advanced Chemical Kinetics	
1014-744	Advanced Quantum Mechanics	
1008-621, 711	Analytical Chemistry	5
1012-764	Inorganic Chemistry*	4
1010-870	Research Seminar	1-2
	Graduate Elective	3-4
Choose one of the following:		
	Thesis	9
	Course-work only option†	
Total Quarter Credit Hours		**45**

* This course may be waived if the student completed an inorganic chemistry course as part of their undergraduate curriculum.
† Please consult the program director.

Chemistry (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CHEM-771	Graduate Chemistry Seminar 1	1
	Graduate Chemistry Focus Course 1	3
	Graduate Chemistry Focus Course 2	3
CHEM-670	Graduate Chemistry Writing	1
CHEM-772	Graduate Chemistry Seminar 2	1
	Graduate Chemistry Focus Course 3	3
	Graduate Chemistry Focus Course 4	3
CHEM-790	Research and Thesis Guidance	1
CHEM-790	Research and Thesis Guidance (summer)	4
Second Year		
CHEM-773	Graduate Chemistry Seminar 3	1
	Graduate Chemistry Focus Course 5	3
CHEM-790	Research and Thesis Guidance	2
CHEM-774	Graduate Chemistry Seminar 4	1
CHEM-790	Research and Thesis Guidance	3
Total Semester Credit Hours		**30**

Chemistry (project option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
Choose one of the following organic chemisty courses:		4
1013-737	Adv. Organic Chemistry	
1013-739	Adv. Organic Chemistry	
Choose one of the following physical chemistry courses:		3-4
1014-741	Adv. Chemical Thermodynamics	
1014-742	Survey of Physical Chemistry	
1014-743	Adv. Chemical Kinetics	
1014-744	Adv. Quantum Mechanics	
1008-621, 711	Analytical Chemistry	5
1012-764	Inorganic Chemistry*	4
1010-870	Research Seminar	1-2
	Graduate Elective	3-4
Choose one of the following:		
	Project	4-8
	Course-work only option†	
Total Quarter Credit Hours		**45**

* This course may be waived if the student completed an inorganic chemistry course as part of their undergraduate curriculum.
† Please consult the program director.

Chemistry (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
CHEM-771	Graduate Chemistry Seminar 1	1
	Graduate Chemistry Focus Course 1	3
	Graduate Chemistry Focus Course 2	3
CHEM-670	Graduate Chemistry Writing	1
CHEM-772	Graduate Chemistry Seminar 2	1
	Graduate Chemistry Focus Course 3	3
	Graduate Chemistry Focus Course 4	3
Second Year		
CHEM-773	Graduate Chemistry Seminar 3	1
	Graduate Chemistry Focus Course 5	3
	Graduate Chemistry Focus Course 6	3
CHEM-774	Graduate Chemistry Seminar 4	1
	Graduate Chemistry Focus Course 7	3
	Graduate Chemistry Focus Course 8	3
CHEM-780	Chemistry Project	1
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in chemistry, a candidate must fulfill the following requirements:

- Hold a baccalaureate degree in chemistry from an accredited college or university. Applicants with an undergraduate degree in another scientific discipline and the equivalent of a full year's course work in analytical chemistry, organic chemistry, physical chemistry, physics, and calculus also will be considered for admission
- Submit official transcripts (in English) for all previously completed undergraduate or graduate course work
- Submit scores from the Graduate Record Exam (GRE). The chemistry GRE is also recommended
- Submit two letters of reference
- Complete a graduate application
- International applicants whose native langauge is not English must submit scores from the Test of English as a Foreign Language (TOEFL). International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org. This requirement may be waived for students who submit transcripts from universities at which the language of instruction is English. Foreign students with English language deficiencies may be required to take the Michigan Test of English Language Proficiency, given by the RIT English Language Center. If a student's score is below standard, additional course work may be recommended. Successful completion of this work is a requirement of the program. This may mean that the student will need additional time and financial resources to complete the degree program.

As a supplement to the normal application process, it is strongly recommended that students visit RIT.

Additional information

Assistantships

All candidates for teaching assistantships must have a personal interview with the department head and/or the chair of the Chemistry Graduate Committee. International students can complete the interview by phone.

Nonmatriculated students

An applicant with a bachelor's degree from an approved undergraduate institution and the background necessary for specific courses is permitted to take graduate courses as a nonmatriculated student. If the student is subsequently admitted to the graduate program, courses taken for credit usually can be applied toward the master's degree. A maximum of 9 quarter credit hours (from courses taken at RIT as a nonmatriculated student) may be transferred to the degree program.

Any applicant who wishes to register for a graduate course as a nonmatriculated student must obtain permission from the chair of the graduate program and the course instructor.

Part-time study

The department of chemistry offers courses in the late afternoon and evenings to encourage practicing chemists to pursue the MS degree without interrupting their employment. Part-time students may take the course-work-only option with the capstone project, 1010-800. Students employed full time normally take one course each quarter. At this pace, course work can be completed within four to five years.

Equipment

The department of chemistry has modern instrumentation in the areas of spectroscopy (NMR, IR, UV-vis, fluorescence, atomic absorption, fluorimetry), chromatography (gas chromatography, high-performance liquid chromatography, capillary electrophoresis, etc.), mass spectrometry (high-performance lc- and gc-mass spectrometry and electrospray mass spectrometry), and materials characterization (rheometry, thermal gravimetric analysis, differential scanning calorimetry, hot-stage microscopy and contact angle goniometry). Visit the chemistry department's website for a complete list of equipment and instrumentation.

External research credit

The department of chemistry recognizes that the experience of a number of chemists employed in industry includes independent, creative research. A maximum of 16 hours of research credit, conducted during employment, may be applied toward the completion of the master of science degree in chemistry on either a full- or part-time basis.

Cooperative education option

The cooperative education option accommodates students at the master's level who have, or are able to obtain, industrial employment. Quarters of co-op can be interspersed with quarters of full-time academic work. If industrial employment permits research, up to 16 of the 45 required quarter credit hours may be obtained through the external research credit option. If industrial employment does not permit research, then research credits may be obtained within the department of chemistry.

Materials Science and Engineering, MS

http://www.rit.edu/cos/cmse/
K. S. V. Santhanam, Director
Center for Materials Science and Engineering
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Program overview

The master of science degree in materials science and engineering, offered jointly by the College of Science and the Kate Gleason College of Engineering, is designed with a variety of options to satisfy individual and industry needs in the rapidly growing field of materials.

The objectives of the program are threefold:

- With the advent of new classes of materials and instruments, the traditional practice of empiricism in the search for and selection of materials is rapidly becoming obsolete. Therefore, the program offers a serious interdisciplinary learning experience in materials studies, crossing over the traditional boundaries of such classical disciplines as chemistry; physics; and electrical, mechanical, and microelectronic engineering.
- The program provides extensive experimental courses in diverse areas of materials-related studies.
- The program explores avenues for introducing greater harmony between industrial expansion and academic training.

Curriculum

The program consists of five required core courses specially designed to establish a common base of materials-oriented knowledge for students with baccalaureate degrees in chemistry, chemical engineering, electrical engineering, mechanical engineering, physics, and related disciplines, providing a new intellectual identity to those involved in the study of materials.

The program has an emphasis on experimental techniques, with one required experimental course as part of the core. Additional experimental courses are available for students who wish to pursue course work in this area. These courses are organized into appropriate units covering many aspects of the analysis of materials. This aspect of the program will enhance a student's confidence when dealing with materials-related problems.

A minimum of 45 quarter credit hours is required for the completion of the program. This includes the five core courses, the seminar course (1028-890), and 24 quarter credit hours that may be completed in one of three ways: (1) a research thesis and elective courses, (2) external research and elective courses, (3) or elective courses. The third option is only available through the 2012-2013 academic year.

Elective courses may be selected from advanced courses offered by the Center for Materials Science and Engineering or, upon approval, from courses offered by other RIT graduate programs. Elective courses are scheduled on a periodic basis. Transfer credit may be awarded based on academic background beyond the bachelor's degree or by examination, based on experience.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Materials science and engineering, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1028-701	Introduction to Materials Science	4
1028-702	Introduction to Polymer Science	4
1028-703	Solid State Science	4
1028-704	Introduction to Theoretical Methods	4
1028-717	Material Degradation	4
1028-890	Seminar	1
	Research Thesis/External Research/Electives	24
Total Quarter Credit Hours		**45**

Materials science and engineering (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
MTSE-601	Materials Science	3
MTSE-617	Material Degradation	3
MTSE-703	Solid State Science	3
MTSE-702	Polymer Science	3
MTSE-790	Research and Thesis Guidance	6
	Graduate Elective	3
Second Year		
MTSE- 704	Theoretical Methods	3
	Graduate Elective	3
MTSE-790	Research and Thesis Guidance	3
Total Semester Credit Hours		**30**

Materials science and engineering (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
First Year		
MTSE-601	Materials Science	3
MTSE-617	Material Degradation	3
MTSE-703	Solid State Science	3
MTSE-702	Polymer Science	3
MTSE-777	Graduate Project	2
	Graduate Electives	6
Second Year		
MTSE- 704	Theoretical Methods	3
	Graduate Electives	6
MTSE-777	Graduate Project	1
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in materials science and engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in chemistry, physics, chemical engineering, electrical engineering, mechanical engineering, or a related field from an accredited college or university,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL) and the Test of Written English (TWE). A minimum score of 575 (paper-based), 230 (computer-based), or 88-89 (Internet-based) is required on the TOEFL. A 4.0 is required on the TWE. International English Language Testing System (IELTS) scores are accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org. In addition, upon arrival at RIT, international students are required to take the English language exams, administered by the English Language Center. Individuals scoring below an established minimum will be referred to the center for further evaluation and assistance. These students are required to follow the center's recommendations regarding language course work. It is important to note that this additional course work may require additional time and financial resources to complete the degree requirements. Successful completion of this course work is a requirement for the program.

Candidates not meeting the general requirements may petition for admission to the program. In such cases, it may be suggested that the necessary background courses be taken at the undergraduate level. However, undergraduate credits that make up deficiencies may not be counted toward the master's degree.

Any student who wishes to study at the graduate level must first be admitted to the program. However, an applicant may be permitted to take graduate courses as a nonmatriculated student if they meet the general requirements mentioned above.

Thesis and the external research options

The inclusion of a research thesis as a formal part of the MS degree program is optional. The research thesis option carries a minimum of 9 and a maximum of 16 quarter credit hours, subject to the review and approval of the project. In place of a thesis, a project option is available that carries a minimum of 4 and a maximum of 8 quarter credit hours.

The external research option allows participants to continue their studies in their work environment, thus enhancing job satisfaction. In-plant work experience in materials-related areas may include independent study and creative research. This external research option may be applied, for a minimum of 4 and a maximum of 8 quarter credit hours, toward the completion of the master of science degree.

Additional information

Part-time study

The program offers courses in the late afternoon and evenings to encourage practicing scientists and engineers to pursue the degree program without interrupting their employment. (This may not apply to courses offered off campus at selected industrial sites.) Students employed full time are normally limited to a maximum of two courses, or 8 quarter credit hours, each quarter. A student who wishes to register for more than 8 quarter credit hours must obtain the permission of his or her adviser.

Advanced certificate

An advanced certificate in materials science and engineering is available primarily for part-time students. It requires the completion of 24 quarter credit hours of course work.

Maximum limit on time

The required credits for the master's degree must be completed within seven years of the oldest credits applied toward the degree.

Astrophysical Sciences and Technology, Ph.D.

http://www.rit.edu/cos/astrophysics/
Andrew Robinson, Graduate Program Director
(585) 475-2726, axrsps@rit.edu

Program overview

There has never been a more exciting time to study the universe beyond the confines of the Earth. A new generation of advanced ground-based and space-borne telescopes and enormous increases in computing power are enabling a golden age of astrophysics. The doctorate program in astrophysical sciences and technology focuses on the underlying physics of phenomena beyond the Earth and on the development of the technologies, instruments, data analysis, and modeling techniques that will enable the next major strides in the field. The multidisciplinary emphasis of this program, jointly offered by the department of physics, the School of Mathematical Sciences, and the Center for Imaging Science, sets it apart from conventional astrophysics graduate programs at traditional research universities.

Curriculum

The doctoral degree comprises 99 quarter credit hours. The curriculum consists of 27 quarter credit hours of core courses (including a three research credit graduate seminar sequence), a minimum of 36 quarter credit hours of graduate elective courses, a master's-level research project (12 quarter credit hours), and doctoral-level research culminating with a dissertation (15 quarter credit hours). Thus, there are a minimum of 60 total graduate course credits required and 30 research credits. An additional 9 credits of either course or research credit must be taken to meet the required 99 total quarter credit hours for the degree.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Astrophysical sciences and technology, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
1060-701, 702, 703	Graduate Research Seminar I, II, III	3
1060-710	Mathematical and Statistical Methods for Astrophysics	4
1060-711	Astronomical Observational Techniques and Instrumentation	4
1060-720	Stellar Structure and Evolution I	4
1060-730	Radiative Processes I	4
1060-740	Galactic Astrophysics and the Interstellar Medium I	4
1060-750	Extragalactic Astrophysics I	4
Choose one of the following:		9
	Research	
	Graduate Courses	
	Graduate Electives	36
	Master's-level Research Project	12
	Doctoral-level Research and Thesis	15
Total Quarter Credit Hours		**99**

Astrophysical sciences and technology, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ASTP-613	Astronomical Observational Techniques and Instrumentation	3
ASTP-617	Astrophysical Dynamics	3
	Elective or Specialty track course	3
ASTP-601	Graduate Seminar I	1
ASTP-615	Radiative Processes for Astrophysical Sciences	3
Choose one of the following:		3
ASTP-610	Mathematical Methods for the Astrophysical Sciences	
ASTP-611	Statistical Methods for Astrophysics	
	Specialty track course	3
ASTP-602	Graduate Seminar II	1
Second Year		
	Specialty track course	3
	Elective	3
ASTP-890	Research and Thesis	4
	Specialty track course	3
	Elective or Specialty track course	3
ASTP-890	Research and Thesis	4
Third Year		
ASTP-890	Research and Thesis	5
ASTP-890	Research and Thesis	5
Fourth Year		
ASTP-890	Research and Thesis	5
ASTP-890	Research and Thesis	5
Total Semester Credit Hours		**60**

Tracks (semesters)

Astrophysics

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
ASTP-730	Stellar Structure and Atmospheres	3
ASTP-740	Galactic Astrophysics	3
ASTP-750	Extragalactic Astrophysics	3

Astro-informatics and computational astrophysics

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
ASTP-611	Statistical Methods for Astrophysics	3
ASTP-720	Computational Methods for Astrophysics	3

Astro-informatics and computational astrophysics—general relativity concentration

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
Choose one of the following:		3
ASTP-611	Statistical Methods for Astrophysics	
ASTP-720	Computational Methods for Astrophysics	
ASTP-760	Introduction to Relativity and Gravitation	3
ASTP-861	Advanced Relativity and Gravitation	3
PHYS-611	Classical Electrodynamics I	3
PHYS-612	Classical Electrodynamics II	3

Astronomical instrumentation

COURSE	QUARTER CREDIT HOURS
Not available in quarters.	

COURSE		SEMESTER CREDIT HOURS
IMGS-739	Principles of Solid State Imaging	3
IMGS-742	Testing of Focal Plane Arrays	3
IMGS-728	Design and Fabrication of Solid State Camera	3

Electives

Elective courses that can be taken to meet the minimum total of 60 quarter credit hours of course work include additional courses in astrophysics, detector development, digital image processing, computational techniques, optics, and entrepreneurship, among others. Each of the core courses listed is followed by a second, one-quarter course (e.g., Radiative Processes II) and additional domain specific astrophysics electives are offered on a rotating basis. Many additional elective courses offered in other RIT graduate programs (e.g. imaging science, computer science, engineering) are available.

Master's level research project

Typically following the first year, but sometimes initiated during the first year for well prepared students, candidates will begin a master's level research project under the guidance of a faculty member who will not necessarily be the dissertation research adviser. The topic will frequently be different from the dissertation topic. The project will normally be worth 12 quarter credit hours. Assessment will be a combination of the written project report and an oral presentation of the report.

Admission to candidacy

Students must pass a qualifying examination after completing the core curriculum and prior to embarking on the Ph.D. dissertation project. The purpose of the examination is to ensure the student has the necessary background knowledge and intellectual skills to carry out doctoral-level research in the subject areas of astrophysical sciences and technology. The examination consists of two parts: a written examination based on the core courses and an oral examination based on a research portfolio consisting of a written report on the master's-level research project and a record of graduate research seminar activities.

A committee chaired by the astrophysical sciences and technology director, which includes the student's research adviser and two additional faculty members, will assess the student's overall qualifications. Students must pass the qualification examination to continue in the program.

Dissertation research adviser

After passing the qualifying examination, the student chooses a dissertation research adviser who is approved by the program's director. The choice of adviser is based on the student's research interests, faculty research interests, and available research funding.

Research committee

After passing the qualifying examination, a four-member dissertation committee is appointed for the duration of the student's tenure in the program. One of the committee members must be a faculty member in a program other than astrophysical sciences and technology. This committee member, who is approved by the dean of graduate studies, acts as the institutional chair of the final dissertation examination. The committee must also include the student's dissertation research adviser and at least one other member of the program's faculty. The fourth member may be an RIT faculty or staff member, a professional affiliated in industry, or a representative from another institution. The program director must approve committee members who are not RIT faculty.

Ph.D. project validation

Within six months of the appointment of the dissertation committee, the student will give an oral defense of their chosen research project to faculty, who will provide constructive feedback on the project plan.

Annual review

During each fall quarter, the program director conducts an annual review. Students are interviewed, concerns (if any) are raised, and progress is reported on the student's work toward meeting the requirements for either the qualifying examination (during the first two years), or the Ph.D. (after passing the qualifying examination).

In addition, as part of the Graduate Research Seminar, the student will give an annual presentation summarizing progress made during the preceding year.

Final examination of the dissertation

Once the dissertation has been written, distributed to the dissertation committee, and the committee agrees to administer the final examination, the doctoral candidate can schedule the final examination. The candidate must distribute a copy of the dissertation to the committee and make the dissertation available to interested faculty at least four weeks prior to the dissertation defense.

The final examination of the dissertation is open to the public and is primarily a defense of the dissertation research. The examination consists of an oral presentation by the student, followed by questions from the audience. The dissertation committee will privately question the candidate following the presentation. The dissertation committee will caucus immediately following the examination and thereafter notify the candidate and the program director of the results.

Admission requirements

To be considered for admission to the Ph.D. program in astrophysical sciences and technology, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in physical science, mathematics, computer science, or engineering at a regionally accredited college or university (for students with a bachelor's degree in another area or those lacking adequate academic preparation, bridge and foundation course work may be necessary prior to full admission),
- Have a minimum undergraduate GPA of 3.2 (out of 4.0) in course work in mathematical, science, engineering, and computer subject areas,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation,
- Submit scores from the Graduate Record Exam (GRE), and
- Complete a graduate application.
- For international applicants whose native language is not English scores from the Test of English as a Foreign Language (TOEFL) must be submitted. Minimum scores of 550 (paper-based), 213 (computer-based), or 79 (Internet-based) are required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org.

Additional information

Residency
All students in the program must spend at least three consecutive quarters (summer quarter excluded) in residence as full-time students to be eligible to receive the doctorate degree. A full-time academic course load is defined as a minimum of nine quarter credit hours or an equivalent amount of research as certified by the graduate coordinator.

Time limitations
All candidates for the Ph.D. must maintain continuous enrollment during the research phase of the program. Normally, full-time students complete the course of study for the doctorate in approximately four to five years. A total of seven years is allowed to complete the requirements after first attempting the qualifying examination.

MS to Ph.D. transfer
Depending on each student's progress in their course work and the research project, students may be allowed to attempt the Ph.D. qualifying examination. On successfully passing the exam, students may choose to proceed to Ph.D. candidacy rather than accepting a terminal master of science degree. This is contingent on the availability of an adviser and research funding.

Astrophysical Sciences and Technology, MS

Andrew Robinson, Graduate Program Director
(585) 475-2726, axrsps@rit.edu

Program overview
There has never been a more exciting time to study the universe beyond the confines of the Earth. A new generation of advanced ground-based and space-borne telescopes and enormous increases in computing power are enabling a golden age of astrophysics. The MS program in astrophysical sciences and technology focuses on the underlying physics of phenomena beyond the Earth, and on the development of the technologies, instruments, data analysis, and modeling techniques that will enable the next major strides in the field. The multidisciplinary emphasis of this program, jointly offered by the Department of Physics, the School of Mathematical Sciences, and the Center for Imaging Science, sets it apart from conventional astrophysics graduate programs at traditional research universities.

Curriculum
The MS program comprises a minimum of 45 quarter credit hours of study. The curriculum consists of 27 quarter credit hours of core courses (including a 3 credit research graduate seminar sequence), a minimum of 12 quarter credit hours of graduate elective courses, and a research project culminating in a thesis (12 research credits).

Electives
Elective courses available to fulfill the minimum total of 27 quarter credit hours of course work include additional courses in astrophysics, detector development, digital image processing, computational techniques, optics, and entrepreneurship, among others. These may be courses offered by the astrophysical sciences and technology program or by other RIT graduate programs (e.g. imaging science, computer science, engineering).

Master's thesis
Typically following the first year, but sometimes initiated during the first year for well-prepared students, candidates begin a research project under the guidance of a faculty research adviser. A thesis committee is appointed by the program director, consisting of the student's adviser and at least two additional members, one of whom must be a program faculty member. The final examination of the thesis consists of a public oral presentation by the student, followed by questions from the audience. The thesis committee will privately question the candidate following the presentation. The committee will caucus immediately following the examination and thereafter notify the candidate and the program director of the results.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Astrophysical sciences and technology, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1060-701, 702, 703	Graduate Research Seminar I, II, III	3
1060-710	Mathematical and Statistical Methods for Astrophysics	4
1060-711	Astronomical Observational Techniques and Instrumentation	4
1060-720	Stellar Structure and Evolution I	4
1060-730	Radiative Processes I	4
1060-740	Galactic Astrophysics and the Interstellar Medium I	4
1060-750	Extragalactic Astrophysics I	4
	Graduate Elective	4
	Graduate Elective	4
	Graduate Elective	4
	Thesis	12
Total Quarter Credit Hours		**45**

Astrophysical sciences and technology, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ASTP-613	Astronomical Observational Techniques and Instrumentation	3
ASTP-617	Astrophysical Dynamics	3
ASTP-760	Introduction to Relativity and Gravitation	3
ASTP-601	Graduate Seminar I	1
ASTP-615	Radiative Processes for Astrophysical Sciences	3
Choose one of the following:		3
ASTP-610	Mathematical Methods for the Astrophysical Sciences	
ASTP-611	Statistical Methods for Astrophysics	
ASTP-730	Stellar Structure and Atmospheres	3
ASTP-602	Graduate Seminar II	1
Second Year		
ASTP-740	Galactic Astrophysics	3
ASTP-790	Research and Thesis	3
ASTP-750	Extragalactic Astrophysics	3
ASTP-790	Research and Thesis	3
Total Semester Credit Hours		**32**

Admission requirements
To be considered for admission to the MS program in astrophysical sciences and technology, a candidate must fulfill the following requirements:
- Hold a baccalaureate degree in physical science, mathematics, computer science, or engineering at an accredited college or university,
- Have a minimum undergraduate GPA of 3.2/4.0 in course work in mathematical, science, engineering, and computer subject areas,
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation,
- Submit scores from the Graduate Record Exam (GRE), and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 550 (paper-based), 213

(computer-based), or 79 (Internet-based) is required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org.

For candidates with a bachelor's degree in another area than those listed above, or lacking in adequate academic preparation, bridge and foundation course work may be necessary prior to full admission.

Additional information

MS to Ph.D. transfer

Depending on each student's progress in their course work and the research project, students may be allowed to attempt the Ph.D. Qualifying Examination. On successfully passing the exam, students may choose to proceed to Ph.D. candidacy rather than accepting a terminal master of science degree. This is contingent on the availability of an adviser and research funding.

Color Science, Ph.D.

http://www.cis.rit.edu/GraduateColor
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Program overview

Color has been a topic of intense interest and inquiry for hundreds if not thousands of years. As a generalization, color science can be defined as the quantification of our perception of color. Its mastery requires an interdisciplinary educational approach encompassing physics, chemistry, physiology, statistics, computer science, and psychology. Color science is used in the design and control of most man-made colored materials including textiles, coatings, and polymers and to specify such diverse materials as soil and wine. It is used extensively in color reproduction including digital photography, desktop and projection display, and printing. As we begin the 21st century, color science is ubiquitous.

Color science research at RIT encompasses such diverse fields as medical data visualization, computer graphics and animation, art conservation, spectral and spatial measurements of materials, color printing, digital photography, motion picture and television, and modeling of our perceptions for use in defining color quality. RIT has a long history of scholarship in color science.

The program is designed for students whose undergraduate degrees are in physics, chemistry, mathematics, computer science, engineering, experimental psychology, imaging, or any applied discipline pertaining to the quantitative description of color, for example, textiles, graphic arts, animation, material science, and polymer science. All students must earn 99 quarter credit hours as a graduate student. For full-time students, entering with a baccalaureate degree, the program requires three or more years of study at the graduate level. The curriculum is a combination of required courses in color science, elective courses appropriate for the candidate's background and interests, a three quarter research project during the second year of study, and a research dissertation. Students must pass a qualifying examination during their second year of study and a candidacy examination at least one year prior to completing their dissertation. Candidates who wish to enter the program, but lack adequate preparation, may be required to complete as many as 36 quarter credit hours of undergraduate foundation courses in mathematics, statistics, computer science, and general science before matriculating with graduate status.

Curriculum

The degree requires 99 quarter credit hours of course work and research, which includes a minimum of 60 quarter credit hours of course work, including the core curriculum; a minimum of 27 quarter credit hours of research, including the second-year research project; and three years of full-time study (or an equivalent of part-time study).

Core courses

The following core courses are completed during the first year of study: Human Visual System (1051-720), Applied Colorimetry (1050-702), Color Appearance (1050-703), Color Measurement Laboratory I (1050-721), Color Measurement Laboratory II (1050-722), Color Science Seminar (1050-801), and Color Modeling (1050-813).

Electives

Elective courses are selected depending on the student's interests and background. The program director or the student's dissertation research adviser must approve all electives. Typically, 4 quarter credit hours of electives are taken each quarter in years one through three, until 36 quarter credit hours are completed.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Color science, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1051-720	Human Visual System	4
1050-702	Applied Colorimetry	4
1050-801	Color Science Seminar	1
1050-703	Color Appearance	3
1050-721	Color Measurement Lab I	3
1050-801	Color Science Seminar	1
1050-813	Color Modeling	4
1050-722	Color Measurement Lab II	3
1050-801	Color Science Seminar	1
	Graduate Elective	4
	Graduate Elective	4
	Graduate Elective	4
Second Year		
	Research and Thesis	9
	Graduate Elective	4
	Graduate Elective	4
	Graduate Elective	4
Third Year		
	Research and Thesis	9
	Graduate Elective	4
	Graduate Elective	4
	Graduate Elective	4
Total Quarter Credit Hours		**78**

Color science, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IMGS-620	Human Visual System	3
CLRS-700	Colorimetry	3
CLRS-710	Colorimetry Lab	1
CLRS-720	Computational Vision Science	3
CLRS-750	Historical Research Perspectives	1
CLRS-800	Color Systems Engineering	3
CLRS-820	Modeling Visual Perception	3
CLRS-711	Material Appearance Lab	2
CLRS-751	Research and Publication Methods	2
Second Year		
	Research and/or Electives	9
	Research and/or Electives	9
Third Year		
	Research	9
	Research	9
Fourth Year		
	Research	9
	Research	9
Total Semester Credit Hours		**60**

Years four and beyond
Students will follow their study plan consisting of research credits, thesis credits, and elective courses.

Second year project
During the second year, the student will engage in graduate-level research. The topic may or may not be the same as the dissertation topic. Nine credit hours are normally taken. One of the purposes of this research project is to evaluate the student's research capabilities and suitability for doctorate-level research.

Qualifying examination
All students must pass a qualifying examination, which determines whether the student has a sufficient depth of knowledge in color science and the ability to perform research at the doctoral level.

The qualifying exam consists of a written test and an evaluation of the second-year research project. The written test is given twice each year, during the first and sixth weeks of spring quarter. The written test is based on the core curriculum in color science and any material deemed appropriate by the committee. Note that these courses' required readings include textbooks and current literature. An evaluation of the second-year research project includes depth of research, productivity, quality, analytical skills, and the ability to communicate results. A written document is submitted in the style of a published proceeding.

The student must successfully pass the qualifying examination to continue in the Ph.D. program. Students who do not pass the qualifying examination may request, in writing, to the color science graduate coordinator to change their program to the MS program. Requests must be received before the end of the quarter in which the second written test is taken. Students with permission to enter the MS program will use their second year research project as an MS research thesis topic. A written thesis is required. Students can graduate with an MS in color science. Note that they will have completed the identical degree requirements as students matriculated into the MS program (except for having completed additional elective courses).

Dissertation research adviser and committee
After the student passes the qualifying examination, a dissertation research adviser will be selected based on the student's research interests, faculty research interests, and discussions with the color science graduate coordinator. A dissertation committee of four members is appointed for the duration of the student's tenure in the program. The committee will include the dissertation research adviser, one member of the color science faculty, and an external chair appointed by the dean of graduate studies. The external chair must be a member of the RIT faculty who is not a current member of the color or imaging science faculty, preferably with tenure. The fourth member may be an RIT faculty member, or affiliated with industry or another institution. The color science graduate coordinator must approve committee members who are not RIT faculty.

The dissertation committee will prepare and administer the examination for admission to candidacy; assist in planning and coordinating research; provide research advice; supervise the writing of the dissertation; and conduct the final examination of the dissertation.

Study plan
During the first quarter of study, the student and the color science graduate program director will develop a study plan. This plan may be revised as necessary, subject to approval by the graduate coordinator. For example, the dissertation research adviser or the dissertation committee may recommend a revised study plan to include specific graduate electives.

Admission to candidacy
When the student thoroughly understands the dissertation research topic, the dissertation committee will administer an examination to determine if the student can be admitted to candidacy for the doctoral degree in color science. The purpose of the examination is to ensure the student has the necessary intellectual skills and background knowledge to carry out their specific doctoral-level research project. The dissertation research adviser will define the type of examination and any requirements prior to the examination. Requirements include a dissertation proposal and may additionally include a review of literature, preliminary experiments, and the preparation of an oral presentation. The examination must be administered no later than one year prior to defending the dissertation.

Final examination of dissertation
Once the dissertation has been written, distributed to the dissertation committee, and the committee agrees to administer the final examination, the doctoral candidate can schedule the final examination.

The final examination of the dissertation is open to the public and is primarily a defense of the dissertation research. The examination consists of an oral presentation by the student, followed by questions from the audience. The dissertation committee may also elect to privately question the candidate following the presentation. The dissertation committee will immediately notify the candidate and the color science graduate program director of the result of the examination.

Teaching experience
All candidates for the Ph.D. must serve as a teaching assistant for a minimum of one course before scheduling the final examination of the dissertation. Candidates are encouraged to serve as a teaching assistant for two courses.

Public presentation experience
All candidates for the Ph.D. must present research in a public forum before scheduling the final examination of the dissertation. The preferred public forum is a technical conference.

Admission requirements
To be considered for admission to the Ph.D. program in color science, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited university,
- Submit scores from the Graduate Record Examination (GRE),
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work,
- Have a GPA of 3.0 or higher (or a minimum GPA of 3.0 in foundation course work),
- Submit two professional recommendations,

- Participate in an on-campus interview (when possible), and
- Complete a graduate application,
- For international applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 240 (computer-based), 587 (paper-based), or 94 (Internet-based) are required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org.

Candidates without adequate undergraduate work in related sciences must take foundation courses prior to matriculation into the graduate program. Such students may be required to take as many as 36 quarter credit hours in these subjects. A written agreement between the candidate and the program coordinator will identify the required foundation courses. Foundation courses must be completed with an overall B average before a student can matriculate into the graduate program. A maximum of nine graduate-level credit hours may be taken prior to matriculation into the graduate program.

The required undergraduate-level foundation courses as are follows: one year of calculus, one year of college physics, one year of college physics laboratory, one course in computer programming, one course in matrix algebra, one course in statistics, and one course in introductory psychology.

Additional information

Assistantships

Students receiving fully funded assistantships tend to have minimum undergraduate cumulative grade point averages of 3.5 and exceptional GRE scores. International applicants who must submit TOEFL scores, must have scores above 250 (computer-based), 600 (paper-based), or 100 (Internet-based). Students who submit IELTS scores must have a minimum IELTS score is 7.0. Applicants seeking financial assistance must submit all application documents to the Office of Graduate Enrollment Services by January 15 for the following academic year.

Residency

All students in the program must spend at least three consecutive quarters (summer quarter may be excluded) as resident full-time students to be eligible to receive the Ph.D. A full-time academic course load is defined as a minimum of nine academic credits per quarter or an equivalent amount of research as certified by the color science graduate coordinator.

Time limitations

All candidates for the Ph.D. must maintain continuous enrollment during the research phase of the program. The maximum number of research credits that apply to the degree does not limit such enrollment. Normally, full-time students complete the course of study for the doctorate in approximately four to five years. Requirements for the degree must be completed within seven years of the date students pass the qualifying examination.

Color science MS graduates

Graduates from the MS program in color science, who are interested in the doctoral program, should contact the color science graduate program director to discuss their suitability for doctoral-level research. Before matriculating into the program, students must pass the qualifying examination. Once the examination has been passed successfully, students can be admitted into the doctoral program. Up to 45 quarter credit hours can be applied toward the degree, including 24 quarter credit hours of core courses, 12 quarter credits hours of graduate elective courses, and 9 quarter credit hours of master's-level research. The doctoral degree can be completed on a full- or part-time basis as long as the residency requirements are met.

MS and MA graduates from related disciplines

Because of the interdisciplinary nature of color science, it is anticipated that students with MS and MA degrees will apply to the Ph.D. program. Graduate courses in related disciplines can be used as elective courses toward the degree. Furthermore, for degrees that required a research thesis, the second year research project may be waived. Thus, it may be possible for students with graduate degrees in a related discipline to take the qualifying examination during their first year of study. The total number of graduate credits that can be applied to the Ph.D. in color science cannot exceed 45 quarter credit hours, limited to 36 quarter credit hours of course work and 9 quarter credit hours of master's-level research. The color science graduate coordinator determines the specific courses and credit hours that can be applied toward the Ph.D. in color science.

Munsell advisory board

The Munsell Color Science Laboratory advisory board ensures that research activities surrounding the degree program are relevant to current industrial needs. Board members have expertise in color vision, color measuring instrumentation, psychophysics, color imaging, instrument-based color matching, lighting, art, and applied color technology. The advisory board is an excellent resource for students in the selection of both a thesis topic and future employment opportunities.

Color Science, MS

http://www.cis.rit.edu/GraduateColor

James A. Ferwerda, Graduate Program Director
(585) 475-4923, jaf@cis.rit.edu

Program overview

Color science is broadly interdisciplinary, encompassing physics, chemistry, physiology, statistics, computer science, and psychology. The curriculum, leading to a master of science degree in color science, educates students using a broad interdisciplinary approach. This is the only graduate program in the country devoted to this discipline and it is designed for students whose undergraduate majors are in physics, chemistry, imaging science, computer science, electrical engineering, experimental psychology, physiology, or any discipline pertaining to the quantitative description of color.

Graduates are in high demand and have accepted industrial positions in electronic imaging, color instrumentation, colorant formulation, and basic and applied research. Companies that have hired graduates include Apple Inc., Benjamin Moore, Canon Corp., Dolby Laboratories, Eastman Kodak Co., Hallmark, Hewlett Packard Corp., Microsoft Corp., Pantone, Qualcomm Inc., Ricoh Innovations Inc., Samsung, and Xerox Corp.

The color science degree provides graduate-level study in both theory and practical application. The program gives students a broad exposure to the field of color and affords them the unique opportunity of specializing in an area appropriate for their background and interest. This objective will be accomplished through the program's core courses, selection of electives, and completion of a thesis or graduate project.

The degree program in color science revolves around the activities of the Munsell Color Science Laboratory within the Center for Imaging Science. The Munsell Laboratory is the pre-eminent academic laboratory in the country devoted to color science. Research is currently under way in color appearance models; image-quality, data-visualization, and color-tolerance psychophysics; spectral-based image capture, archiving, and reproduction of artwork; analytical and empirical multi-ink printing models; spectral color rendering, color management, computer graphics; and material appearance.

Since the inauguration of the program in 1984, a number of conferences have drawn participants from around the world. Industrial seminars are held each summer on a wide range of color topics, including color perception and appearance, colorimetry, color-difference equations, instrumental tolerances, spectrophotometry, instrument-based color matching, color- and image-appearance models, color management, psychophysics, visualization and rendering, and spectral imaging. The Munsell Laboratory has many contacts that provide students with summer and full-time job opportunities across the United States and abroad.

Curriculum

Students must earn 45 quarter credit hours as a graduate student, 36 of which must be taken at RIT, to earn the master of science degree. For full-time students, the program requires four to six quarters of study at the graduate level. Part-time students generally require two to four years of study at the graduate level. The curriculum is a combination of required courses in color science, elective courses appropriate for the candidate's background, and either a research thesis or graduate project. Students must enroll in either the research thesis or graduate project option at least one year before completion of required course work.

Prerequisites: The foundation program

The color science program is designed for the candidate with an undergraduate degree in a scientific or nonscientific discipline. Candidates with adequate undergraduate work in related sciences start the program as matriculated graduate students.

Candidates without adequate undergraduate work in related sciences must take foundation courses prior to matriculation into the graduate program. Such students may be required to take as many as 36 quarter credit hours in these subjects. A written agreement between the candidate and the program coordinator will identify the required foundation courses.

Foundation courses must be completed with an overall B average before a student can matriculate into the graduate program. A maximum of nine graduate-level credit hours may be taken prior to matriculation into the graduate program.

The foundation courses, representative of those often required, are as follows: one year of calculus, one year of college physics (with laboratory), one course in computer programming, one course in matrix algebra, one course in statistics, and one course in introductory psychology.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Color science, MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1051-720	Human Visual System	4
1050-702	Applied Colorimetry	4
1050-801	Color Science Seminar	1
1050-703	Color Appearance	3
1050-721	Color Measurement Lab I	3
1050-801	Color Science Seminar	1
1050-722	Color Measurement Lab II	3
1050-813	Color Modeling	4
1050-801	Color Science Seminar	1
	Graduate Electives	12
	Research Thesis or Project	9
Total Quarter Credit Hours		**45**

Color science, MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IMGS-620	Human Visual System	3
CLRS-700	Colorimetry	3
CLRS-710	Colorimetry Lab	1
CLRS-720	Computational Vision Science	3
CLRS-750	Historical Research Perspectives	1
CLRS-800	Color Systems Engineering	3
CLRS-820	Modeling Visual Perception	3
CLRS-711	Material Appearance Lab	2
CLRS-751	Research and Publication Methods	2
Second Year		
	Research	6
	Elective	3
Total Semester Credit Hours		**30**

During the second year, full-time students enroll in research and thesis, to total 9 quarter credits.

Elective courses

Appropriate elective courses should be selected to bring course work to 36 quarter credit hours for the research thesis option or 41 quarter credit hours for the graduate project option. Approval by the color science coordinator is required. (Some courses might require special permission for enrollment.)

Research thesis option

Students without research experience are encouraged to select the research thesis option (9 quarter credit hours). The thesis is performed during the second year of study. Topics are chosen that complement the candidate's undergraduate education and career interests. The technical advisory board of the Munsell Color Science Laboratory, as well as the program coordinator, can aid in the selection of a thesis topic. Full-time students receiving full-time assistantships are required to perform a research thesis.

Graduate project option

Students with research experience may select the graduate project option (4 quarter credit hours). The project has the same intellectual level as a research thesis but is less lengthy. It might take the form of an experiment, demonstration, research project, or critical review. The graduate project is normally performed during the last quarter of study. Part-time students often select this option.

Admission requirements

To be considered for admission to the MS program in color science, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Submit scores from the Graduate Record Examination (GRE),
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work,
- Submit two professional recommendations,
- Complete an on-campus interview (when possible),
- Have an average GPA of 3.0 or higher,
- Have completed foundation course work with GPA of 3.0 or higher (if required), and
- Complete a graduate application.
- International applicants who native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of of 587 (paper-based), 240 (computer-based), or 94 (Internet-based) are required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. Minimum scores will vary; however, the absolute minimum score required for unconditional acceptance is 7.0. For additional information about the IELTS, please visit www.ielts.org.

Additional information

Scholarships and assistantships

The scholarships and assistantships available for qualified color science applicants include the Macbeth-Engel Fellowship, Grum Memorial Scholarship, Saltzman Memorial Scholarship, Munsell Color Science Laboratory Assistantship, and research assistantships associated with ongoing grants and contracts. Students receiving fully funded assistantships tend to have undergraduate cumulative grade point averages of 3.5 and higher and exceptional GRE scores. Applicants whose native language is not English must submit TOEFL, TSEA, or IELTS scores. (Please see admission requirements for minimum scores.) Applicants seeking financial assistance from the center must submit all application documents to the Office of Graduate Enrollment Services by January 15 for the next academic year.

Imaging Science, Ph.D.

http://www.cis.rit.edu/node/401
John Kerekes, Graduate Program Director
(585) 475-6996, kerekes@cis.rit.edu

Program overview

The doctor of philosophy degree in imaging science signifies high achievement in scholarship and independent investigation in the diverse aspects of imaging science. Candidates for the doctoral degree must demonstrate proficiency by:

- Successfully completing course work, including a core curriculum, as defined by the student's plan of study;
- Passing a series of examinations; and
- Completing an acceptable dissertation under supervision of the student's research adviser and dissertation committee.

Curriculum

All students must complete a minimum of 60 quarter credit hours of course work. The courses are defined by the student's study plan and must include the completion of the core sequences, plus at least two three-quarter sequences in topical areas. Some examples of topical areas are remote sensing, digital image processing, color imaging, digital graphics, electro-optical imaging systems, medical imaging, and microlithographic imaging technologies.

Students may take a maximum of 16 quarter credit hours in other departments and must complete research credits to bring the total quarter credit hours earned to 99. Three credits of research are associated with the research seminar course (1051-706, 707, 708).

The core curriculum includes courses that span and integrate a common body of knowledge essential to an understanding of imaging processes and applications.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Imaging science, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1051-716	Fourier Methods for Imaging	4
1051-718	Digital Imaging Mathematics	4
1051-719	Radiometry	4
1051-720	Human Visual System	4
1051-733	Optics	4
1051-713	Probability, Noise and System Modeling	4
1051-782	Digital Image Processing	4
1051-706, 707, 708	Imaging Science Research Seminar	3
Second Year		
	Graduate Course Sequences	24
	Graduate Electives	8
1051-890	Research and Thesis	36
Total Quarter Credit Hours		**99**

Imaging science, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IMGS-616	Fourier Methods for Imaging	3
IMGS-619	Radiometry	3
IMGS-620	The Human Visual System	3
IMGS-609	Graduate Laboratory I	1
IMGS-606	Graduate Seminar I	1
IMGS-682	Digital Image Processing	3
IMGS-633	Optics for Imaging	3
	Specialty Track Course 1	3
IMGS-610	Graduate Laboratory II	1
IMGS-607	Graduate Seminar II	1
Second Year		
IMGS-613	Probability, Noise and System Modeling	3
	Specialty Track Course 2	3
	Graduate Electives	6
IMGS-890	Research and Thesis	1
Third Year		
IMGS-890	Research and Thesis	5
IMGS-890	Research and Thesis	5
Fourth Year		
IMGS-890	Research and Thesis	5
IMGS-890	Research and Thesis	5
Fifth Year		
IMGS-890	Research and Thesis	5
Total Semester Credit Hours		**60**

Advancement to candidacy
Advancement to candidacy will proceed through the following steps:
- Adviser selection
- Submission and approval of preliminary study plan
- Passing a written comprehensive exam
- Study plan revision based on outcome of comprehensive exam and adviser recommendation
- Research committee appointment
- Candidacy exam based on thesis proposal

If the faculty decision, following the comprehensive exam, is not to permit the candidate to continue in the doctoral track, the adviser and graduate program director will counsel the student about options that may include pursuit of an MS degree. If the faculty decision is to permit the candidate to continue in the doctoral track, the program continues with the study plan revision, research committee appointment, candidacy/proposal exam, and, finally, dissertation defense.

Research committee
Prior to the candidacy exam, the student, in consultation with the adviser, must present a request to the graduate program director for the appointment of a research committee. The committee will be composed of at least four people: the adviser, at least one faculty member who is tenured (or tenure-track) and whose primary affiliation is the Carlson Center for Imaging Science (excluding research faculty), a person competent in the field of research who is an RIT faculty member or affiliated with industry or another university and has a doctorate degree, and the external chair. The external chair must be a tenured member of the RIT faculty who is not a faculty member of the center and who is appointed by the dean of graduate studies. The research committee will supervise the student's research, beginning with a review of the research proposal and concluding with the dissertation defense.

Research proposal
The student and the research adviser select a research topic for the dissertation. The proposed research must be original and publishable. Although the topic may deal with any aspect of imaging, the research is usually concentrated in an area of current interest within the center.

Final examination of the dissertation
The research adviser, on behalf of the student and the student's research committee, must notify the graduate program director of the scheduling of the final examination of the dissertation by forwarding to the graduate program director the title and abstract of the dissertation and the scheduled date, time, and location of the examination. The final examination of the dissertation may not be scheduled within six months of the date on which the student passed the candidacy exam (at which the thesis proposal was presented and approved). Barring exceptional circumstances (requiring permission from the graduate program director), the examination may not be scheduled sooner than four weeks after formal announcement (i.e. center-wide hallway postings and email broadcast) has been made of the dissertation title and abstract, and the defense date, time, and location.

The final examination of the dissertation is open to the public and is primarily a defense of the dissertation research. The examination consists of an oral presentation by the student, followed by questions from the audience. The research committee may also elect to privately question the candidate following the presentation. The research committee will immediately notify the candidate and the graduate program director of the examination result.

Admission requirements
To be considered for admission to the Ph.D. program in imaging science, candidates must fulfill the following requirements:
- Hold a baccalaureate degree in engineering, computer science, applied mathematics, or one of the natural sciences,
- Have completed courses in calculus, university physics (one year), modern physics, and a computer language,
- Submit scores from the Graduate Record Exam (GRE),
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit two letters of recommendation from individuals well-qualified to judge their abilities for graduate study, and
- Complete a graduate application.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 600 (paper-based), 250 (computer-based), or 100 (Internet-based) are required. Students may also submit scores from the International English Langauge Testing System (IELTS). A minimum score of 7.0 is required.

Imaging science encompasses a wide variety of scientific disciplines. Exceptional candidates from other fields and with diverse backgrounds are accepted into the program.

Admissions decisions are made by a committee comprised of graduate faculty of the Center for Imaging Science.

Students with an MS degree in a related field may be granted up to 36 quarter credit hours toward the doctoral degree after successful completion of the comprehensive examination and approval of their study plan. The required research credits may not be waived by experience or examination.

Additional information

Residency

All students in the program must spend at least three consecutive quarters (summer quarter excluded) as resident full-time students to be eligible to receive the doctoral degree. A full-time academic workload is defined as a minimum of nine academic credits per quarter or an equivalent amount of research, as certified by the graduate coordinator. If circumstances warrant, the residency requirement may be waived via petition to the graduate program director, who will decide on the student's petition in consultation with the adviser and graduate faculty. The request must be submitted at least nine months prior to the thesis defense.

Maximum time limit

All candidates must maintain continuous enrollment during the research phase of the program. Such enrollment is not limited by the maximum number of research credits that apply to the degree. Normally, full-time students complete the course of study for the doctorate in approximately three to five years. A total of seven years is allowed to complete the degree after passing the comprehensive exam.

Financial aid, scholarships, and assistantships

Graduate assistantships and tuition remission scholarships are available to qualified students. Applicants seeking financial assistance from the center must have all application documents submitted to the Office of Graduate Enrollment Services by January 15 for the next academic year. Students whose native language is not English are advised to obtain as high a TOEFL or IELTS score as possible if they wish to apply for a teaching or research assistantship. These candidates also are encouraged to take the Test of Spoken English in order to be considered for financial assistance.

Imaging Science, MS

http://www.cis.rit.edu/node/401
John Kerekes, Graduate Program Director
(585) 475-6996, kerekes@cis.rit.edu

Program overview

The objective of this program is to prepare students holding a bachelor's degree in science or engineering for positions in research in the imaging industry, or in the application of various imaging modalities to problems in engineering and science. Formal course work includes consideration of the physical properties of radiation-sensitive materials and processes, the applications of physical and geometrical optics to electro-optical systems, the mathematical evaluation of image forming systems, digital image processing, and the statistical characterization of noise and system performance. Technical electives at the graduate level may be selected from courses offered in imaging science, color science, engineering, computer science, science, and mathematics. Both thesis and project options are available. In general, full-time supported students are required to pursue the thesis option, with the project option targeted to part-time and online students who can demonstrate that they have sufficient practical experience through their professional activities.

Faculty within the Center for Imaging Science supervise thesis research in areas of the physical properties of radiation-sensitive materials and processes, digital image processing, remote sensing, nanoimaging, electro-optical instrumentation, medical imaging, color imaging systems, and astronomical imaging. Interdisciplinary efforts are possible with the Kate Gleason College of Engineering and the College of Science.

The degree requirements can be completed on a full- or a part-time basis. An online version of the MS program is available in the areas of color science, remote sensing, medical imaging, and digital image processing. Interested students should consult the website (www.cis.rit.edu) or contact the graduate program director.

Curriculum

The degree may be completed on a full- or part-time basis. All students must earn 45 quarter credit hours as a graduate student, 37 of which must be taken at RIT, to earn the master of science degree. The curriculum is a combination of required core courses in imaging science, elective courses appropriate for the candidate's background and interests, and either a research thesis or graduate paper/project. Students must enroll in either the research thesis or graduate paper/project option at the beginning of their studies.

Core courses

Students are required to complete five of the seven graduate program core courses, with the only required course being Fourier Methods for Imaging (1051-716). All non-imaging science courses must be approved by the graduate program director as acceptable for credit.

Tracks

Students may choose from a variety of tracks, such as: digital image processing, medical imaging, electro-optical imaging systems, remote sensing, color imaging, optics, hard copy materials and processes, and nanoimaging. Tracks may be created for students interested in pursuing additional fields of study.

Research thesis option

Full-time students who elect this option begin their thesis work during the first year of study. Part-time students may defer the beginning of their thesis work until their second or subsequent years. Full-time students receiving funding assistance are required to choose the research thesis option. Students will take 36 credit hours of course work (including the core) and nine credit hours of thesis/research, three of which are associated with the graduate research seminar course (1051-706, 707, 708).

The thesis is based on experimental evidence obtained by the candidate in an appropriate field, as arranged between the candidate and his or her adviser. The minimum number of thesis credits required is nine and may be fulfilled by experiments in the university's laboratories. In some cases, the requirement may be fulfilled by work done in other laboratories. An example might be the candidate's place of employment, under the following conditions:

1. The results must be fully publishable.
2. The candidate's adviser must be approved by the graduate program director.
3. The thesis must be based on the candidate's independent, original work, as it would be if the work were done in the university's laboratories.

A student's thesis committee is composed of a minimum of three people: the student's adviser and two additional members who hold at least an MS in a field relevant to the student's research. Two committee members must be from the graduate faculty of the center.

Graduate paper/project option

Students with demonstrated practical or research experience, approved by the graduate program director, may choose the graduate project option (5 quarter credit hours) in addition to 40 quarter credit hours of core and elective courses. This option takes the form of a systems course and an associated project/paper. The graduate paper is normally performed during the final quarter of study. Both part- and full-time students may choose this option, with the approval of the graduate program director.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Imaging science (thesis option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1051-716	Fourier Methods for Imaging	4
Choose four of the following:		16
1051-713	Probability, Noise, and System Modeling	
1051-718	Digital Imaging Mathematics	
1051-719	Radiometry	
1051-720	The Human Visual System	
1051-733	Optics	
1051-782	Digital Image Processing	
	Electives	16
Second Year		
	Research/Thesis	9
Total Quarter Credit Hours		**45**

Imaging science (thesis option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IMGS-616	Fourier Methods for Imaging	3
Choose one of the following:		3
IMGS-619	Radiometry	
IMGS-620	The Human Visual System	
	Elective	3
IMGS-606	Imaging Science Seminar I	1
IMGS-682	Digital Image Processing	3
IMGS-633	Optics for Imaging	3
	Specialty track course #1	3
IMGS-607	Imaging Science Seminar II	1
Second Year		
	Specialty track course #2	3
IMGS-790	Research and Thesis	2
IMGS-790	Research and Thesis	2
Total Semester Credit Hours		**30**

Imaging science (graduate paper/project option), MS degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
1051-716	Fourier Methods for Imaging	4
Choose four of the following:		16
1051-713	Probability, Noise, and System Modeling	
1051-718	Digital Imaging Mathematics	
1051-719	Radiometry	
1051-720	The Human Visual System	
1051-733	Optics	
1051-782	Digital Image Processing	
	Systems Course	4
	Electives	20
	Graduate Paper/Project	1
Total Quarter Credit Hours		**45**

Imaging science (project option), MS degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
IMGS-616	Fourier Methods for Imaging	3
Choose one of the following:		3
IMGS-619	Radiometry	
IMGS-620	The Human Visual System	
	Elective	3
IMGS-682	Digital Image Processing	3
IMGS-633	Optics for Imaging	3
	Specialty track course #1	3
Second Year		
	Specialty track course #2	3
	Elective	3
	Elective	3
	Imaging Systems Course	2
	MS Project Paper	1
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS in imaging science, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution (undergraduate studies should include the following: mathematics, through calculus and including differential equations; and a full year of calculus-based physics, including modern physics. It is assumed that students can write a common computer program),
- Submit a one- to two-page statement of educational objectives,
- Submit official transcripts (in English) of all previously completed undergraduate or graduate course work,
- Submit letters of recommendation from individuals familiar with the applicant's academic or research capabilities,
- Submit scores from the Graduate Record Exam (GRE) (requirement may be waived for those not seeking funding from the Center for Imaging Science), and
- Complete a graduate application.
- International applicants, whose native language is not English, must submit scores from the Test of English as a Foreign Language. Minimum scores of 600 (paper-based), 250 (computer based), or 100 (Internet-based) are required. Students may also submit scores from the International English Language Testing System. The minimum IELTS score is 7.0. International students who are interested in applying for a teaching or research assistantship are advised to obtain as high a TOEFL or IELTS score as possible. These candidates also are encouraged to take the Test of Spoken English in order to be considered for financial assistance.

Applicants seeking financial assistance from the center must have all application documents submitted to the Office of Graduate Enrollment Services by January 15 for the next academic year.

Additional information

Bridge courses

Candidates who wish to enter the program but lack adequate preparation may have to take bridge courses in mathematics or physics before matriculating with graduate status.

Maximum time limit

Typically, two years are required for the MS degree, if pursued on a full-time basis. Whether a student pursues the thesis or project/paper option, all degree requirements must be completed within seven years of the first course taken for the degree.

Graduate Faculty

Sophia A. Maggelakis, BS, MS, Ph.D., Old Dominion University—Dean

Thomas H. Gosnell School of Life Sciences

Gary R. Skuse, BA, University of Rochester; Ph.D., Syracuse University—Interim Head, School of Biomedical and Medical Sciences; Professor, Bioinformatics

Larry Buckley, BA, University of Missouri; MS, Southern Illinois University at Edwardsville; Ph.D., Southern Illinois University at Carbondale—Associate Professor, Biology: herpetology, evolution of iguanas, biogeography, systemics

Jean A. Douthwright, BA, Skidmore College; MS, Pennsylvania State University; MS, Ph.D., University of Rochester—Professor, Biology: DNA repair and mutagenesis in microbial organisms

Irene Evans, AB, University of Rochester; MS, Wesleyan University; Ph.D., University of Rochester—Professor, Biology: microarray and 2D electrophoresis analysis of prions in yeast; blood vessel growth, anti-angiogenesis drugs

Maureen Ferran, BA, Fordham University; MS, Ph.D., University of Connecticut—Associate Professor, Biology: virus-host interactions, viral genetics

G. Thomas Frederick, BS, MS, Ph.D., The Ohio State University—Professor, Biology: immunology, job search techniques, career development, co-op, forensics science, MBA option

Elizabeth Hane, BA, Rice University; MA, University of Kansas; Ph.D., Brown University—Associate Professor, Biology: plant community ecology, ecosystem biology, conservation biology

Anne M. Houtman, BA, Pomona College; MA, University of California at Los Angeles; D.Phil., University fo Oxford (United Kingdom)—Head, Thomas H. Gosnell School of Life Sciences; Professor, Biology: avian behavioral ecology, hummingbird song, STEM education research

André Hudson, BS, Virginia Union University; Ph.D., Rutgers University—Assistant Professor, Biology: amino acid metabolism, bacteria-plant interactions

Karl F. Korfmacher, BA, Carleton College; MS, Ph.D., Duke University—Associate Professor, Environmental Science: mapping and monitoring aquatic habitats, geographic information system models, land cover analysis

David A. Lawlor, BA, University of Texas; MS, Ph.D., University of Texas Health Science Center at San Antonio—Associate Professor, Biotechnology: immunology

Jeffrey S. Lodge, BA, University of Delaware; Ph.D., University of Mississippi—Associate Professor, Biology: bioremediation of oil-contaminated sites and industrial waste streams

Douglas Merrill, BS, Ph.D., State University of New York College of Environmental Science and Forestry—Professor, Biology

Dina L. Newman, BS, Cornell University; MS, Ph.D., University of Chicago—Assistant Professor, Biology: human genetics, hearing loss, mitochondria, undergraduate research, educational research

Michael V. Osier, BS, University of Vermont; Ph.D., Yale University—Associate Professor; Graduate Program Director, Bioinformatics: database design, implementation, tuning, analysis; genetic algorithms, human genetics

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Robert H. Rothman, BA, Ph.D., University of California, Berkeley; MA, California State University at San Diego—Professor, Biology: history and phiosophy of science, dinosaurs, Darwin, Andean history and culture

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School of Mathematical Sciences

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Physics

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Scott V. Franklin, BA, University of Chicago; Ph.D., University of Texas—Professor, Physics: theoretical and experimental investigations of nonlinear dynamics, granular materials, and dislocation phenomena, physics education research (PER) and curriculum development, especially for non-science majors

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Center for Materials Science and Engineering

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Linda Barton, BS, Massachusetts Institute of Technology; MS, Ph.D., University of Illinois—Associate Professor, Physics: magnetic materials and magnetic measurements, calorimetry, bulk transport measurements, properties of materials at or near phase transitions, critical phenomena

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Astrophysical Sciences and Technology

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James Fewerda, BA, MS, Ph.D., Cornell University—Associate Professor, Color Science: high dynamic range imaging, perceptually-based rendering, material appearance, display systems, low vision and assistive technologies

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Jeff Pelz, BFA, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Professor, Imaging Science: visual perception and cognition, understanding high-level visual processing by examining eye movements in the execution of complex tasks in natural environments

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Harvey E. Rhody, BS, University of Wisconsin; MS, University of Cincinnati; Ph.D., Syracuse University—Professor, Imaging Science: imaging algorithms

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John Schott, BS, Canisius College; MS, Ph.D., Syracuse University and the State University of New York College of Environmental Science and Forestry—Frederick and Anna B. Wiedman Professor, Imaging Science: quantitative radiometric remote sensing, synthetic image generation, spectroscopy, calibration and atmospheric correction of satellites imaging systems, remote assessment of the Great Lakes water resources

Grover Swartzlander, BS, Drexel University; MSEE, Purdue University; Ph.D., Johns Hopkins University—Associate Professor, Joint Appointment with Department of Physics: optical vortices, optical coronagraphs and high contrast imaging, pattern formation in linear and nonlinear optics, optical tweezers, optical coherence, solar sailing, metamaterials

Jan van Aardt, BSc, University of Stellenbosch; MS, Ph.D., Virginia Polytechnic Institute—Associate Professor, Imaging Science: remote sensing of natural resources, application of hyperspectral, light detection and ranging for spectral-structural characterization of natural systems, integrated modeling approaches, scaling of natural resources remote sensing solutions through sensor interoperability

Anthony Vodacek, BS, University of Wisconsin; MS, Ph.D., Cornell University—Associate Professor, Imaging Science: imaging spectrometry applications environmental characterization and monitoring; remote sensing data assimilation in environmental models; thermal and non-thermal techniques for wildland fire detection; coastal remote sensing and aquatic optics

Graduate Program Faculty

Peter Bajorski, BS, MS, University of Wroclaw; Ph.D., Technical University of Wroclaw—Associate Professor, Center for Quality and Applied Statistics: target detection and unmixing in hyperspectral images, multiwave analysis, regression analysis

Mishkat Bhattacharya, B.Tech., Indian Institute of Technology; MA, Ph.D., University of Rochester—Assistant Professor, Physics: quantum optics, nanoscience, superconductivity

Nathan Cahill, BS, MS, Rochester Institute of Technology; D.Phil., University of Oxford—Associate Professor, School of Mathematical Sciences: image alignment and stitching, 3-D medical image registration, variational techniques and partial differential equations for image processing

Sohail A. Dianat, BS, Aria-Mehr University (Iran); MS, Ph.D., George Washington University—Professor, Electrical Engineering: digital communication, signal processing and image processing

Marcos Esterman, BS, MS, Massachusetts Institute of Technology; Ph.D., Stanford University—Associate Professor, Industrial and Systems Engineering: systems engineering, product development, design robustness, sustainable print systems, addictive manufacturing

Roger S. Gaborski, BS, MS, State University of New York at Buffalo; Ph.D., University of Maryland—Professor, Computer Science: visual and acoustic scene understanding, computer vision, video processing, artificial intelligence, blind source separation, machine learning

Joseph Geigel, BS, Manhattan College; MS, Stevens Institute of Technology; D.Sc., George Washington University—Associate Professor, Computer Science: computer graphics, multimedia storytelling, functional sound synthesis for computer generated animations, virtual reality and theater

Andrew Herbert, BS, McGill University; MA, Ph.D., University of Western Ontario—Associate Professor, Department of Psychology

Matthew Hoffman, BA, Williams College; MS, Ph.D., University of Maryland—Assistant Professor, Mathematical Sciences: data assimilation, applied mathematics, ocean and ecosystem modeling, Martian atmosphere and climate, breeding, ensemble Kalman filter, scientific computation

Seth Hubbard, BS, Drexel University; MS, Case Western Reserve University; Ph.D. University of Michigan—Assistant Professor, Physics: next generation photovoltaic devices, nanomaterials, novel and wide bandgap semiconductors, semiconducting polymers and devices

Michael Kotlarchyk, BS, MS, Ph.D., Massachusetts Institute of Technology—Professor, Physics: radiation scattering techniques, laser light scattering, small-angle neutron and x-ray scattering, photon correlation spectroscopy, structure and interactions in complex fluids, optics and photonics

Eli Saber, BS, State University of New York at Buffalo; MS, Ph.D., University of Rochester—Associate Professor, Electrical and Microelectronic Engineering: signal, image and video processing; computer vision

Andreas Savakis, BS, MS, Old Dominion University; Ph.D., North Carolina State University—Associate Professor, Computer Engineering: digital image processing, computer vision

Bruce Smith, BS, MS, Ph.D., Rochester Institute of Technology—Professor, Microelectronic Engineering: immersion lithography, high NA and polarization, aberration metrology, UV/VUV thin films, high index fluids, optical extension and imaging theory

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan—Professor, Chemistry and Microsystems Engineering: synthesis and device applications of block polymer systems and nano composites

Brian Tomaszewski, BA, University of Albany; MA, University of Buffalo; Ph.D., Pennsylvania State University—Assistant Professor, Information Sciences and Technologies: geographic information science and technology, visual analytics, contet modeling and representation, disaster management

Richard Zanibbi, BA, MSc, Ph.D., Queen's University—Assistant Professor, Computer Science: pattern recognition, machine learning, document recognition, CAPTCHAs, human-computer interaction, and programming languages

Carlson Fellow

Robert MacIntyre, BS, Boston University; MA, University of Rochester—Carlson Fellow: geometrical optics

Affiliate Faculty

Vince Calhoun, BS, University of Kansas; MA, MS, Johns Hopkins University; Ph.D., University of Maryland—Director, Image Analysis and MR Research, The MIND Institute; Associate Professor, Department of Nuerosciences, University of New Mexico; Associate Professor, Department of Computer Science, University of New Mexico

Vikram Dogra, MD, JIPMER Medical School—Professor of Diagnostic Radiology, Urology and Biomedical Engineering, Department of Imaging Sciences, University of Rochester School of Medicine

Franziska Frey, BS, College of Fine Arts; MS, University of Zurich; Ph.D., Swiss Federal Institute of Technology—Head of Preservation and Digital Imaging Services, Harvard Library

Alfred Garrett, BS, Texas A&M University; MS, Massachusetts Institute of Technology; Ph.D., University of Texas—Savannah River National Laboratory: remote sensing, computational fluid dynamics, thermodynamics, meteorology

Garrett Johnson, BS, MS, Ph.D. Rochester Institute of Technology—Apple Computer: high dynamic range imaging, color appearance modeling, image appearance modeling

Noboru Ohta, BS, MS, Ph.D., Tokyo University—Fuji Film (retired): color science, digital color imaging, color reproduction

Quarter Courses

2012–2013 Academic Year

Biological Sciences

1001-700 Cell and Molecular Genetics I

This course will introduce cellular and molecular biology to graduate students with limited background in the biological sciences. The approach taken entails the use of empirical data to support the basic concepts presented. Upon completion of this course, students will not only be familiar with cellular and molecular biology, but will also be acquainted with the theoretical foundations of modern laboratory techniques. Topics covered in this course include cellular evolution, small molecules, energy and biosynthesis, macromolecules, protein functions, genetic mechanisms, recombinant DNA technologies, the nucleus, regulation of gene expression, membrane structure and function, and intracellular protein trafficking. (1001-251, 252, 1011 211-213, 1011-205-207, or equivalent) **Class 3, Credit 3 (F)**

1001-701 Cell and Molecular Genetics II

This course will introduce cellular and molecular biology to graduate students with limited background in the biological sciences. The approach to be taken entails the use of empirical data to support the basic concepts presented. Upon completion of this course, students will not only be familiar with cellular and molecular biology, but will also be acquainted with the theoretical foundations of modern laboratory techniques. Topics covered in this course include energy conversion in mitochondria and chloroplasts, cell signaling, the cytoskeleton, the cell cycle, cell division, intercellular interactions, germ cells and development, cellular differentiation, immunity and cancer. (1001-700) **Class 3, Credit 3 (W)**

1001-703 Animal Behavior

This course is a comparative study of animal behavior from an evolutionary perspective. Lectures examine the physiological organization of behaviors, survival behaviors, social dynamics, and human behavior. Discussion section focuses on analysis of primary literature. (Graduate standing, one year of introductory biology or equivalent, 1001-365, 1016-319, or permission of instructor) **Class 4, Credit 4 (S)**

1001-705 Bioinformatics Resources

Bioinformatics Resources will focus on the types of analyses, tools, and databases that are available and commonly used in bioinformatics. The labs will apply the lecture material in the analysis of real data. (Graduate student standing; permission of instructor) **Class 2, Lab 3, Credit 3 (F)**

1001-715 Genetic Diseases and Disorders Seminar

The identification of genetic causes of disease has been one of the major scientific breakthroughs of recent history. In this course, we will examine a range of inherited diseases, how causative genetic variations were identified, and what this means for the treatment of diseases. Scientific literature will be utilized, both current and historical. (1001-421) **Class 3, Credit 3 (S, alternating years) (offered 2008–2009)**

1001-722 Bioinformatics Seminar

Sufficient opportunities will be afforded for students and faculty to develop and share professional interests while discussing current trends and developments in bioinformatics through readings, presentations, and the development of scientific writing skills. Material for this course will be drawn from the current scientific literature including, but not limited to, journals such as *Bioinformatics, Genome Research, Biology Direct,* and the *Journal of Computational Biology*, among others. Students from outside the Bioinformatics MS program may take this course with permission of the instructor. **Class 2, Credit 2 (F)**

1001-725 Ethics in Bioinformatics

This course will be focused on individual and organizational responsibilities in bioinformatics research and product development and commercialization. Students from outside the Bioinformatics MS program may take this class with permission of the instructor. **Class 3, Credit 3 (W)**

1001-759 Special Topics

1001-760 Advanced Conservation Biology

This course concentrates on the application of ecological principles to conservation issues. Human impact on species diversity will be emphasized as it relates to agricultural, forest, coastal and wetland ecosystems. Case studies of management practices used to manage and restore disturbed ecosystems will be included. Laboratory exercises will concentrate on methodologies for assessing human impacts on ecosystems using advanced field techniques and statistical methods, in addition to the GIS technology to conservation issues. (1001-340 or comparable General ecology course, 1016-319 or equivalent) **Class 3, Lab 3, Credit 4 (W)**

1001-765 Case Studies in Genomics

This course will focus on the field of genomics by reviewing the current state of the art in relevant laboratory and computer applications. Topics to be discussed include, but are not limited to, the application of genomics to infectious and genetic diseases, diagnosis and treatment of cancer, production of biopharmaceuticals, development of new therapeutic chemicals, gene and cell therapies. Students will be asked to develop written case studies featuring genomics and biotechnology companies that will be discussed in class and considered as part of their evaluation for this course. They will be encouraged to select both successful and unsuccessful companies in order to identify viable strategies for applying genomics technologies in an industrial setting. (Permission of instructor) **Class 3, Credit 3 (W)**

1001-767 Environmental Microbiology

This is an advanced course in the principles of soil microbiology, groundwater microbiology, wastewater microbiology, composting microbiology, and bioremediation. The class will also focus on practical applications of microorganisms isolated from various types of environments. Examples of commercial use of microorganisms will also be presented. The lab consists of a series of experiments looking at the microbial flora of soils, plant surfaces, air particles, and water. Students will attempt to isolate microorganisms from soil samples that are capable of degrading organic compounds. Students will use various methods to determine degradative capabilities of soil microorganisms such as carbon dioxide evolution and oxygen depletion. Students will do an independent lab project selecting an oil contaminated site and attempt to isolate various oil degrading bacteria. (1001-404) **Class 3, Lab 3, Credit 4 (S)**

1001-794 **Molecular Modeling and Proteomics**
This course will explore two facets of protein molecules: their structure and their expression. The structure component will build upon information from the bioinformatics course and will add further sophistication with analysis of intermolecular interactions and ligand/receptor pairing. Software that permits molecular docking experiments will be employed. Tissue-specific protein expression will be addressed in lectures with description of microarray technology and, in the laboratory, with two-dimensional protein gel electrophoresis. Each student will be assigned a project designed to integrate salient principles in each course and provide an opportunity for each student to give an oral presentation to his or her peers. (4002-763) **Class 3, Lab 3, Credit 4 (S)**

1001-799 **Independent Study**

1001-879 **Graduate Independent Research**

1001-890 **Bioinformatics MS Thesis**
Each student's experience in this course will be different. The individual student's thesis project will be tailored to fit his or her interests under the guidance of a faculty mentor. That mentor will be identified as the individual within our faculty who has professional interests most closely aligned with those of the student. Typically a mentor will be identified and a thesis proposal will be prepared and approved by the student's thesis advisory committee before the start of the second year of study. Thesis work and the preparation and defense of the written thesis will take place during the second year of study. **Credit variable (F, W, S)**

1001-899 **Independent Study**

1001-999 **Grad Coop**

Environmental Science

1006-710 **Graduate Readings Seminar**
This course helps graduate and upper-level undergraduate students learn how to assess journal articles, government reports, whitepapers, and essays as well as other relevant sources of information. Students will also refine their discussion and presentation skills and gain experience in clarifying their comments and responding to questions by an audience. **Class 3, Credit 3 (W)**

1006-711 **Environmental Science Graduate Study I**
This is the first course of a three course sequence (1006-711, 712, 713) designed to introduce new graduate students in the Environmental Science program to the entire process of graduate study that will culminate in their completion of all required coursework as well as a research project under the direct supervision of a member of the faculty. This first course will introduce students to careers in environmental science, to graduate studies in environmental science at RIT and to the process of proposing, conducting, presenting, and defending a research project in partial fulfillment of the requirements for the Master of Science degree in environmental science. (Graduate status in Environmental Science) **Class 2, Credit 2 (F)**

1006-712 **Environmental Science Graduate Study II**
This is the second of a three course sequence (1006-711, 712, 713) designed to introduce new graduate students in the Environmental Science program to the entire process of graduate study that will culminate in their completion of all required coursework as well as a research project under the direct supervision of a member of the faculty. This course will focus on the creation of a carefully researched and written draft of their thesis or project proposal. Students will learn modern conventions for analyzing and reporting scientific data. Peer review and editing of scientific writings will be emphasized. (1006-711) **Class 2, Credit 2 (W)**

1006-713 **Environmental Science Graduate Study III**
This is the third course of a three course sequence (1006-711, 712, 713) designed to introduce new graduate students in the Environmental Science program to the entire process of graduate study that will culminate in their completion of all required coursework as well as a research project under the direct supervision of the program faculty. This course will focus on developing and practicing techniques for making oral presentations of research proposals to an audience of peers in environmental science, and to providing peer review of oral presentations. (1006-712) **Class 2, Credit 1 (S)**

1006-750 **Ecological and Environmental Applications of GIS**
Aerial photography, satellite imagery, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) are extremely useful tools in ecological and environmental applications such as biological monitoring, environmental assessment, habitat restoration, change analysis, resource management, and risk assessment. This course will: 1) introduce students to spatial analysis, theories, techniques and issues associated with ecological and environmental applications; 2) provide hands-on training in the use of spatial tools while addressing a real problem; 3) provide experience linking GIS analyses to field assessments and monitoring activities; and 4) enable students to solve a variety of spatial and temporal ecological and environmental problems. (1006-350 or 1006-450, or permission of instructor) **Class 3, Lab 3, Credit 4 (S)**

1006-759 **Special Topics: Environmental Science**
Special topics courses are courses that are of current interest and/or logical continuations of courses already offered. These courses are structured as ordinary courses and may have specified prerequisites, contact hours, and examination procedures. **Class variable, Credit variable (F, W, S, Su)**

1006-799 **Independent Study**
Independent study is a faculty directed study of appropriate topics on a tutorial basis. Independent study enables an individual to pursue studies of existing knowledge available in literature. **Class variable, Credit variable (F, W, S, Su)**

1006-879 **Environmental Science Graduate Research**
This course is taken by graduate students in the Environmental Science MS and BS/MS programs to begin the process of developing an environmental research (thesis or project) plan under the guidance of an RIT faculty mentor, who will become the student's graduate thesis/project advisor. This process will culminate with the completion and defense of a graduate research proposal. Graduate students are required to complete a total of 3 quarter credit hours of this course to fulfill the requirements of the Master of Science degree in Environmental Science. (Graduate status in the Environmental Science MS program.) **Credit variable 1–3 (F, W, S, Su)**

1006-890 **Environmental Science Graduate Thesis**
The thesis option will be available to environmental science graduate students only with prior written approval of program faculty. Students will submit a proposal to a faculty member who agrees to serve as the student's thesis committee chair. The proposal will describe the basic research question to be investigated and the experimental protocols to be employed. Proposals will be reviewed by the program faculty who will give permission to register for thesis credit. This course may be taken several times over the course of a student's graduate program, for variable credits totaling no fewer than 5 credit hours and no more than 9 credit hours as determined by the program faculty. A written thesis and oral defense are required at the completion of the thesis research. (Graduate status in the Environmental Science MS program.) **Credit variable 1–9 (F, W, S, Su)**

1006-891 **Environmental Science Graduate Project**
This course is used to fulfill the project requirement under the non thesis option in environmental science. The project may take the form of original research designed to address a specific environmental issue or a paper on some important or controversial topic in environmental science. Students will submit a proposal to a faculty member who agrees to serve as the student's project committee chair. Proposals will be reviewed by the program faculty who will give permission to register for project credit. This course may be taken several times over the course of a student's graduate program, for variable credits totaling no fewer than 5 credit hours and no more than 9 credit hours as determined by the program faculty. A written report and oral presentation are required at the completion of the project. (Graduate status in the Environmental Science MS program.) **Credit variable 1–9 (F, W, S, Su)**

1006-899 **Independent Study**
Independent study is a faculty directed study of appropriate topics on a tutorial basis. Independent study enables an individual to pursue studies of existing knowledge available in literature. **Class variable, Credit variable (F, W, S, Su)**

Chemistry

1008-711 **Instrumental Analysis**
Theory, applications and limitations of selected instrumental methods in qualitative, quantitative and structural analysis are discussed. Possible topics include electrochemistry, surface analysis, NMR spectroscopy, mass spectroscopy, ICP, and other modern instrumentation. A term paper and oral presentation will be required based on an analytical technique agreed upon by instructor and student. (1014-441) **Class 3, Credit 3 (F, W-X*)**

1008-759 **Special Topics**

1008-780 Theory of Microsensors and Actuators
This course gives a broad background to the theory and development of sensors at molecular and ionic levels. The mechanistic details of operation of the sensors and actuators limited to selected examples will be considered. Fundamental aspects related to chemical, biochemical, piezo resistive, magnetic, thermal and luminescent sensors will be discussed with an orientation towards development of innovative products. Control systems based on ion selectivity for biomedical applications will be dealt with rigorously. Special topics to be covered will be neuro transmitters, neural network and directional selectivity using conducting polymers. (Baccalaureate degree in chemistry or permission of instructor) **Class 4, Credit 4 (F, W)**

1008-785 Lab Techniques for Microsensors and Actuators
This course is designed on practical aspects of fabrication measurement. It will discuss the construction and characterization of a few sensors and actuators. The practical limitation of the microsensors will be evaluated. (Baccalaureate degree in chemistry or permission of instructor) **Lab variable, Credit 2–4**

1009-702 Biochemistry: Biomolecular Conformation and Dynamics
This is the first course in our graduate sequence in biochemistry. Molecular transport and enzymatic catalysis are related to the three dimensional structures of biomolecules and the laws of thermodynamics. Also provides an introduction to membrane structure as preparation for 1009-703 Biochemistry: Metabolism. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor) **Class 3, Credit 3 (F, W, S)**

1009-703 Biochemistry: Metabolism
Metabolic processes involved in energy consumption and production as well as the synthesis and degradation of biomolecules are discussed. Metabolic pathways are described in terms of thermodynamic principles, cellular localization and regulation mechanisms. Finally, the metabolic basis of several diseases is presented. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor. **Class 3, Credit 3 (F, W, S)**

1009-704 Biochemistry: Nucleic Acids
Nucleic acid structures, including the classical Watson-Crick model for DNA are introduced. The flow of genetic information by replication (DNA to DNA), transcription (DNA to RNA) and translation (RNA to protein) as well as gene expression and regulation in prokaryotes are discussed. The methodology of new techniques, such as DNA sequencing and recombinant DNA, and their role in medicine and forensics are presented. The genetic aspects of viruses and oncogenes are also reviewed. (Baccalaureate degree or permission of instructor) **Class 3, Credit 3 (F, W, S)**

1009-705 Biochemistry: Experimental Techniques
An introduction to the theory and practice of modern experimental biochemical laboratory techniques and concepts. The weekly one-hour lecture provides a theoretical framework for the various experimental techniques and includes a discussion of the properties of biomolecules and how those properties are exploited in the separation and characterization of the molecules. Practical laboratory techniques include the preparation of buffers, centrifugation, gel exclusion chromatography, electrophoretic methods, and UV/visible and fluorescence spectrophotometry as applied to the isolation and characterization of proteins and nucleic acids, the manipulation of genetic material in E. coli will also be examined. (Baccalaureate degree or permission of instructor) **Class 1, Lab 3, Credit 2 (F, W)**

1009-710 Advanced Protein Biochemistry: Structure and Function
In this course, we will analyze protein structure-function relationships. We will investigate how proteins function and how the structure relates to that function. The principles that explain enzyme rate enhancements, mechanistic enzymology will be examined. We will also explore protein superfamilies for phylogenetic relationships to enhance our understanding of protein structure function relationships. We will do this by reading and discussing current scientific literature and classic papers. (1009-702) **Class 3, Credit 3 (S)**

1009-794 Molecular Modeling and Proteomics
The course will explore two facets of protein molecules: their structure and their expression. The structure component will build upon information from the biochemistry prerequisite course and will add further sophistication with analysis of inter-molecular interactions and ligand/receptor pairing. Software that permits molecular docking experiments will be employed. Tissue-specific protein expression will be addressed in lectures with description of micro-array technology and, in the laboratory, with two-dimensional protein gel electrophoresis. The course will include student initiated discussions and presentations on late-breaking developments in molecular visualization and proteomics. Course cannot be taken by students who have credit for 1009-594, 1001-494 or 1001-794. (1009 702, 1009-503 or 1009-703, or equivalent) **Class 3, Lab 3, Credit 4 (S)**

1010-772 Special Topics
Advanced courses which are of current interest and/or logical continuations of the courses already being offered. These courses are structured as ordinary courses and have specified prerequisites, contact hours and examination procedures. Recent courses taught as Special Topics have included nuclear chemistry, polymer morphology, advanced chromatographic methods and applications of computer interfacing. **Class variable, Credit variable**

1010-800 Capstone Project
A capstone course for non-thesis students that fulfills the graduate project requirement of the MS Chemistry program. Guidance and credits to be arranged with faculty project advisor before approval by the department will be given for registration. **Credit variable 1–8 (F, W, S, Su)**

1010-870 Chemistry Seminar
Matriculated students are required to attend the weekly chemistry seminar series and to present one-hour seminars on their thesis or project research. **Credit 1**

1010-877 External Research
Industrial internship research. **Credit 1–16**

1010-879 Research and Thesis
Guidance hours and credits to be arranged. Chemical research in a field chosen by the candidate, subject to approval of the department head and advisor. (1010-879-99 Continuation of Thesis, **Credit 0**) **Credit 1–16**

1010-899 Chemistry Independent Study: Graduate
Credit variable

1010-999 Chemistry Graduate Co-Op

1012-764 Modern Inorganic Chemistry
This course introduces the more sophisticated tools with which an inorganic chemist investigates inorganic molecules and materials. These physical methods are applied to inorganic reactions that distinguish the chemistries of the elements and to current research directions in the field. An oral presentation is required. Literature project required for graduate credit. (1014-441) **Class 4, Credit 4 (offered alternate years) (S)**

1012-765 Preparative Inorganic Chemistry Laboratory
In this laboratory, the chemistries of different elements in the periodic table are examined, and advanced synthetic and characterization methods are utilized. (Inorganic chemistry or permission of instructor) **Class 1, Lab 7, Credit 3 (W, S)**

1013-710 Literature Exploration of Organic Synthesis
This course will be a survey of the recent literature in organic chemistry with a focus on the chemistry concerning those that synthesize natural products and/or methodology towards synthesizing natural products. During each week of the course a student is selected to lead a discussion based on an article from a premier journal. Repeatable for credit. (1013-537 or 1013-757 or permission of instructor) **Class 1, Credit 1 (F, W, S)**

1013-736 Spectrometric Identification of Organic Compounds
This course discusses the theory and application of proton, carbon and 2-D nuclear magnetic resonance, infrared and mass spectrometry as applied to organic structure determination. (1013-433) **Class 4, Credit 4 (W-X*)**

1013-737 Advanced Organic Chemistry
Advanced topics in organic synthesis, novel reagents and synthetic strategies such as retrosynthetic analysis are covered. In addition, previously studied reactions will be revisited with the added focus on stereospecificity. Protecting groups are covered in depth as well as sigmatropic rearrangements. Several classics in total synthesis are included with a strong emphasis on syntheses published in the current chemical literature. Time permitting, a survey of the most widely used organo-palladium couplings will be introduced.(1013-433 or equivalent) **Class 4, Credit 4 (F)**

1013-739 Advanced Organic Chemistry
This course covers topics in physical organic chemistry including techniques for elucidation of mechanism: kinetics, linear free, energy relationships, isotope effects, thermodynamics, molecular orbital theory, electrocyclic reactions. (1013-433, 1014-443) **Class 4, Credit 4 (offered alternate years) (S)**

1014-730 Magnetic Resonance Imaging
This course is an introduction to the principles of magnetic resonance imaging (MRI). The course covers spin physics, Fourier transforms, basic imaging principles, Fourier imaging, imaging hardware, imaging techniques, image processing, image artifacts, safety and advanced imaging techniques. (1008-311, 1014-442, Calculus) **Class 4, Credit 4 (S-X*)**

1014-740 **Basics of Pulsed NMR**
This course is an introduction to the principles of pulsed nuclear magnetic resonance (NMR) spectroscopy. Lectures on instrumentation, pulse sequences, Fourier transforms and artifacts are presented. (1008-311) **Class 1, Credit 1 (F)**

1014-741 **Advanced Chemical Thermodynamics**
This course is a study of the basic fundamentals of thermodynamics, including an introduction to statistical mechanics and their use in deriving the interrelationships of thermodynamic functions. Thermodynamic properties of gases are calculated based on spectroscopic data. Theory of solutions and phase equilibria are discussed. (1014-443, 1016-306) **Class 4, Credit 4 (W-X*) (offered upon sufficient request)**

1014-742 **Survey of Physical Chemistry**
This course is a study of the fundamental principles of physical chemistry. Kinetic molecular theory, quantum mechanics, spectroscopy, thermodynamics and kinetics are presented. This course provides a high-level, comprehensive survey of essential topics in physical chemistry. **Class 3, Credit 3 (W)**

1014-743 **Advanced Chemical Kinetics-**
Methods of investigating the kinetics of chemical reactions and the theories used to interpret their results are presented with a focus on homogeneous reactions in gas and liquid phases. Discussions of references from recent chemical literature are provided. (1014-443) **Class 4, Credit 4 (offered upon sufficient request) (W-X*)**

1014-744 **Advanced Quantum Mechanics**
This course provides a review of basic quantum theory and models; variation and perturbation methods, atomic and molecular orbital theory, emphasis on relationship of spectroscopy and quantum chemistry. (1014-442) **Class 4, Credit 4 (offered upon sufficient request) (S-X*)**

1014-747 **Principles of Magnetic Resonance**
This course is a series of lectures designed to introduce the principles of magnetic resonance spectroscopies with emphasis on pulsed nuclear magnetic resonance (NMR) spectroscopy. Topics covered include classical and quantum mechanical theory, Fourier transform techniques, pulse sequences, instrumentation, instrumental techniques and modern applications such as 2-D NMR and solid-state NMR. (1014 443; 1014-740) **Class 4, Credit 4 (offered alternate years) (W-X*)**

1014-750 **Chemical Energetics**
This course is designed to explore the fundamental concepts of energy flow using a systems approach. Foundation will be offered with respect to how molecular systems communicate using the flow of energy. This foundation will then be expanded and applied to the understanding of how energy transfer may be harnessed to achieve device function. Molecular wires, optical and thermal switches and sensors will all be built from the understanding of function on the molecular level. Application will be the focus of the course. The course is designed for the individual with only a basic exposure to chemistry who desires to know how molecules can be exploited to provide work. (Baccalaureate in chemistry or permission of instructor) **Class 4, Credit 4 (F)**

1014-759 **Special Topics**

1029-701 **Organic Chemistry of Polymers**
The synthesis and chemistry of high molecular weight organic polymers is broadly surveyed. Chemistry relating to the formation of carbon chain polymers and polymers containing heteroatoms in-chain is detailed. Kinetics, thermodynamics and mechanisms of step growth and chain growth polymerization reactions are reviewed with particular attention being given to stereospecific and living polymerization processes, block and graft copolymers, functional polymers and polymeric reagents. (1013-433) **Class 4, Credit 4 (W)**

1029-702 **Polymer Chemistry: Chains and Solutions**
Although most polymeric materials find utility as solids, polymer fabrication and characterization techniques are generally liquid phase processes. This course is concerned with the fundamental physical chemistry of polymers in liquid solutions. Topics to be addressed include: polymerization kinetics and chain structure, molecular weight distributions and determination, polymer solution thermodynamics and transport phenomena, and solution phase transitions. The study of polymeric solids is the focus of 1029-703. (Baccalaureate degree in science or engineering, or permission of instructor) **Class 4, Credit 4 (S-X*)**

1029-703 **Polymer Chemistry: Properties of Bulk Materials**
This course is designed to give the student with a chemistry or materials science background a thorough grounding in the main concepts which describe bulk polymer structure, behavior and properties and to give the student practical tools to predict them. Basic to the understanding of polymer behavior is the fact that it is time-dependent. To emphasize this idea, the course is designed to build up to a study of the thermo-mechanical behavior of viscoelastic materials. (Baccalaureate degree in a science or engineering, or permission of instructor) **Class 4, Credit 4 (F-X*)**

1029-704 **Polymer Characterization Laboratory**
Many students in the Chemistry and Materials Science and Engineering graduate programs are involved in polymer research. This course gives these students an opportunity to acquire proficiency in using the tools of polymer characterization. Techniques for studying 1) molecular weight distributions, 2) spectroscopic analysis of chemical structure, 3) thermal stability, 4) morphology and phase transitions, and 5) mechanical properties will be introduced and mastered. Techniques may concentrate on particular research topics. (Baccalaureate degree in a science or engineering discipline, or permission of instructor) **Lab 6, Credit 2 (S) (offered alternate years)**

1029-705 **Preparative Polymer Chemistry Laboratory**
Students will carry out about eight experiments. About half of the experiments conducted will be step-growth polymerizations; the other half will be chain-addition polymerizations. The polymers produced will include: Nylon 6-10, Nylon 11, a polyurethane, polystyrene, high density polyethylene, and a copolymer of styrene and methyl methacrylate. More specifically, the types of polymerizations and reactions introduced will be crosslinking of polymers, interfacial and bulk step-growth polymerizations, cyclopolymerization, radical, ionic, and coordinative chain polymerizations. Instructors may add and/or delete polymer related experiments of their choice. The students in this course will also analyze the polymers produced and use literature data to confirm structural features. (Baccalaureate degree in a science or engineering discipline, or permission of instructor, 1013-437) **Lab 6, Credit 2 (offered alternate years) (F)**

Mathematics

1016-705 **Difference Equations**
This course is an introduction to the basic theory of difference equations. It begins by solving linear difference equations with constant coefficients and examining the long-term behavior of solutions for convergence, periodicity and boundedness. Other difference equations are studied by analyzing the behavior of the transient term, convergence, periodic and eventually periodic solutions and unbounded solutions. The course also includes techniques such as transformation from nonlinear to linear difference equations, inequalities, and invariant and attracting intervals. (1016-432 or permission of instructor) **Class 4, Credit 4 (S)(offered upon sufficient enrollment)**

1016-706 **Advanced Differential Equations**
This course provides a study of first order, linear higher order differential equations and systems of differential equations and their applications in the physical sciences. Mathematical modeling will be used to illustrate the concepts. Applications and computer projects will be used to involve students in intense problem solving experiences. Topics such as existence, uniqueness, theory and methods of solutions, linear systems, stability, Sturm-Liouville problems and asymptotic methods of solutions will be studied. (1016-306 and 1016-331) **Class 4, Credit 4 (F)**

1016-707 **Dynamical Systems**
This course is a study of dynamical systems theory motivated by nonlinear differential equations. Basic definitions of dynamical systems are followed by fundamental theorems about local behavior close to fixed points and stability theory of solutions of differential equations. Simplification methods such as center manifold theory and normal forms are introduced. Asymptotic behavior of solutions is investigated through limit sets, attractors, Poincare-Bendixson theory, and index theory. The notion of local bifurcation is introduced and investigated. (1016-306 and 1016-432 or permission of instructor) **Class 4, Credit 4 (W)**

1016-709 **Chaotic Dynamical Systems**
This course is a study of chaotic dynamical systems theory in discrete dynamical systems. Definitions and examples of discrete dynamical systems are followed by the study of symbolic dynamics and its connection to mappings. The notion of topological conjugacy and equivalency is introduced and different definitions of chaos are investigated. Sharkovskii Theorem about the ordering of prime periods in a discrete dynamical system is discussed. The notion of local and global bifurcation is introduced and investigated as well as the period doubling route to chaos. (Permission of instructor) **Class 4, Credit 4 (S) (offered upon sufficient enrollment)**

1016-711 **Numerical Analysis**
This course is a rigorous study of floating point arithmetic, numerical techniques for finding roots of nonlinear equations, interpolations and approximation of functions, approximations of definite integrals and numerical solutions to initial and boundary value problems for ordinary differential equations with a study of the errors produced. This course requires independent study of certain topics that are not covered in the class lectures. Software packages such as MATLAB will be utilized. (1016-306 and 1016-331) **Class 4, Credit 4 (F)**

1016-712 **Numerical Linear Algebra**
This course is a rigorous study of theoretical concepts and computational issues in linear algebra. Topics include an analysis of Gaussian elimination with pivoting, its error and its stability, iterative methods for solving linear systems, matrix factorizations, eigenvalues, singular value decomposition, Krylov subspace methods and application to least squares, systems of nonlinear equations and partial differential equations. This course requires independent study of certain topics that are not covered in the class lectures. Software packages like MATLAB will be utilized through several computing projects. (1016-331, 1016-432 recommended) **Class 4, Credit 4 (W)**

1016-713 **Mathematical Methods in Scientific Computing**
This course examines the use of discrete Fourier transforms, simulation methods, optimization techniques, and number theory algorithms that are employed in modern scientific computing. (1016-511 or 512, or 1016-711 or 712, or permission of instructor) **Class 4, Credit 4 (S)**

1016-715 **Statistical Models for Bioinformatics**
Organic evolution over thousands of years has provided us with one of the most complicated statistical models imaginable. This course will investigate some of the statistical models that have proved useful in analyzing biological information. Examples include Markov models, such as the Jukes-Cantor and Kimura evolutionary models and hidden Markov models, and multivariate models used for discrimination and classification. (Permission of instructor) **Class 4, Credit 4 (W)**

1016-719 **Biostatistics**
This course is an introduction to the probabilistic models and statistical techniques used in the analysis of biological and medical data. Topics include univariate and multivariate summary techniques, one and two way sample parametric and nonparametric inference, censoring, one and two way analysis of variance, and multiple and logistic regression analysis. (Permission of instructor) **Class 4, Credit 4 (S)**

1016-720 **Complex Variables**
This course introduces the student to the basic elements of calculus of complex valued functions of a complex variable. The major emphasis is on integration, with the goal of using these results to evaluate certain types of real integrals. The course includes the concept of analyticity, complex integration, Cauchy's integral theorem and integral formulas, Taylor and Laurent series, residues, real integrals by complex methods, and conformal mappings. (1016-305) **Class 4, Credit 4 (F)**

1016-725 **Stochastic Processes**
This course is an introduction to stochastic processes. Important random processes that appear in various applications are studied. It covers basic properties and applications of Poisson processes and Markov processes as well as applications in renewal theory, queuing models, and optimal stopping. (1016-351 and 1016-331) **Class 4, Credit 4 (W)**

1016-759 **Special Topics: Mathematics**
Topics of special interest to a sufficiently large group of students, and not covered in other courses, may be offered upon request. (Consent of instructor) **Class variable, Credit variable (Offered upon sufficient request)**

1016-764 **Topics in Logic, Set Theory and Computability**
This course surveys logic and set theory and their connections to computer science and the foundations of discrete mathematics. Starting with the abstract construction of integers and real numbers, it proceeds to axiomatic set theory and logic stressing questions of completeness, consistency, decidability and recursive enumerability. The course includes a survey of NP (non-deterministic polynomial) and NP complete problems. (1016-411 and 1016-532, or permission of instructor) **Class 4, Credit 4 (S)**

1016-766 **Optimization Theory**
This course provides a study of the theory of optimization of linear and nonlinear functions of several variables with or without constraints. Applications of this theory to solve problems in business, management, engineering, and the sciences are considered. Algorithms for practical applications will be analyzed and implemented. Students taking this course will be expected to complete applied projects and/or case studies. (1016-331, 1016-465 desirable) **Class 4, Credit 4 (S) (offered upon sufficient enrollment)**

1016-767 **Combinatorics**
This course introduces the fundamental concepts of combinatorics and graph theory. Topics to be studied include counting techniques, generating functions, recurrence relations, the inclusion-exclusion principle, and special graphs. Applications such as design of experiments, traffic routing, tournaments will be considered. (Permission of instructor) **Class 4, Credit 4 (W)**

1016-768 **Graph Theory**
This course studies advanced concepts in graph theory and their applications. After a review of basic terminology, the topics of coverings, matchings, connectivity, and coloring will be studied. Applications to areas such as optimal routing, transport networks, network design, tournaments, and scheduling will be considered. The interplay between graph theory, counting techniques, and algebra will also be studied. (Permission of instructor) **Class 4, Credit 4 (F)**

1016-785 **Number Theory**
This course is an introduction to the standard results and techniques of Number Theory. Topics include induction, divisibility, congruences, Moebius inversion, quadratic reciprocity, and primitive roots. Cryptography and other applications will be discussed. Projects may be required. (1016-265 or permission of instructor) **Class 4, Credit 4 (W)**

1016-789 **Mathematics of Cryptography**
This course is an introduction to the mathematical foundations of modern cryptographic techniques. The material covered includes: classical cryptosystems; some aspects of computational number theory; primality tests; private key encryption schemes and public key encryption schemes (like DES, AES and RSA); further applications, such as digital signatures, one way functions, and zero knowledge proofs. Optional topics such as elliptic curve cryptography may be covered. (1016-485 or 1016-785, or permission of instructor) **Class 4, Credit 4 (S) (offered upon sufficient enrollment)**

1016-802 **Methods of Applied Mathematics**
This course is an introduction to classical techniques used in applied mathematics. Models arising in physics and engineering are introduced. Topics include dimensional analysis, scaling techniques, regular and singular perturbation theory, and calculus of variations. (1016-306 or permission of instructor) **Class 4, Credit 4 (F)**

1016-807 **Boundary Value Problems**
This course is an introduction to methods of applied mathematics that are used in the solution of problems in physics and engineering. Models such as heat flow, vibrating strings and membranes will be formulated from physical principles and solution methods such as separation of variables, Fourier series, and integral transforms will be studied. (1016-306) **Class 4, Credit 4 (S)**

1016-808 **Partial Differential Equations**
This is a continuation of 1016-807 Boundary Value Problems and deals with advanced methods for solving partial differential equations arising in physics and engineering problems. Topics to be covered include first order linear and nonlinear equations, second order equations, Green's functions, integral equations, transform methods, and wave phenomena. (1016-807) **Class 4, Credit 4 (S) (offered upon sufficient enrollment)**

1016-811 **Numerical Methods for Partial Differential Equations**
This is an advanced course in numerical methods that introduces students to computational techniques for solving partial differential equations (PDEs), especially those arising in applications. Topics include: finite difference methods for hyperbolic, parabolic, and elliptic PDEs, consistency, stability and convergence of finite difference schemes. (1016-713 or permission of instructor) **Class 4, Credit 4 (S)**

1016-812 **Wavelets and Applications**
A mathematical introduction to the theory and applications of orthogonal wavelets and their use in analyzing functions and function spaces is provided. Topics include a brief survey of Fourier series representation of functions, Fourier transform and the Fast Fourier Transform (FFT) before proceeding to the Haar wavelet system, multiresolution analysis, decomposition and reconstruction of functions, Daubechies wavelet construction, and other wavelet systems. Applications such as data compression, noise reduction, and image processing will be studied. (1016-432) **Class 4, Credit 4 (S) (offered upon sufficient enrollment)**

1016-862 **Topics in Mathematical Biology**
This course introduces areas of biological sciences in which mathematics can be used to capture the essential interactions within a system. Different modeling approaches to various biological and physiological phenomena are developed (e.g., population and cell growth, spread of disease, epidemiology, biological fluid dynamics, nutrient transport, biochemical reactions, tumor growth, genetics). The emphasis is on the use of mathematics to unify related concepts. (Permission of instructor) **Class 4, Credit 4 (S)**

1016-879 **Thesis/Project Work**
This is the capstone of the program in which the student works on a problem in applied mathematics under the guidance of the advisory committee. A formal written proposal of the problem to be studied must be presented before embarking on the project. A written report and an oral defense of the project/thesis are required at the completion of the work. This course may be repeated for a maximum of 12 quarter credit hours. (Consent of the adviser)

1016-899 **Independent Study**
A topic of special interest to the student and related to the student's area of concentration may be taken for independent study with the approval of the adviser and the instructor who will offer the course. The student submits a proposal for independent study to the advisory committee for consideration and approval. (Consent of the adviser and the instructor) **Credit variable (maximum of 4 credits/quarter)**

1016-999 **Math and Stats Grad Co-Op**

Materials Science and Engineering

1028-701 **Introduction to Materials Science**
The course provides an understanding of the relationship between structure and properties for development of new materials. Topics include atomic and crystal structure, crystalline defects, diffusion theories, strengthening mechanisms, ferrous alloys, cast irons, structure of ceramic and polymeric materials, and corrosion principles. (Graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

1028-702 **Introduction to Polymer Science**
A study of the chemical nature of plastics detailing the relationships between polymerization conditions, structure and properties in both the solid and fluid states. **Class 4, Credit 4 (W)**

1028-703 **Solid State Science**
Survey of topics in the physics of solids. Included are crystal symmetry, structure and binding; mechanical, thermal, and electrical properties of insulators, semiconductors and conductors, including band theory. **Class 4, Credit 4 (W)**

1028-704 **Introduction to Theoretical Methods**
Treatment of waves and fields; selected topics of interest in electrodynamics and fluid mechanics; statistical mechanics; Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac distributions, and their applications. (Graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

1028-705 **Introduction to Experimental Techniques**
Introduction to laboratory equipment for hardness testing, impact testing, tensile testing, x-ray diffraction, and thermal treatment of metallic materials. Experiments illustrating the characterization of high molecular weight organic polymers are conducted. **Class variable, Lab variable, Credit 4 (S)**

1028-706 **Experimental Techniques: Thin Films**
Production of thin films of metals and dielectrics by physical vapor deposition. Lectures cover vacuum systems, evaporation, sputtering, nucleation and growth of thin films, analysis and characterization of thin films, and application of thin films. Laboratories cover use of vacuum systems in evaporation and sputtering and some methods of characterizing the thin films thus produced. (Permission of instructor) **Class variable, Lab variable, Credit 4**

1028-707 **Experimental Techniques: Microscopy and Spectroscopy**
An in-depth look at various techniques used to characterize thin film materials. Lectures will cover resistivity measurements, ellipsometry, reflectance techniques, optical microscopy, electron microscopy, and scanning probe microscopy. The lab provides hands-on training in these techniques and is conducted in the cleanroom housed in the Center for Microelectronic Engineering. Students will be required to perform an in-depth study on a material of their choice using these techniques or to research an associated technique not covered in lecture. (Permission of instructor) **Class variable, Lab variable, Credit 4**

1028-708 **Experimental Techniques**
Provides an in-depth integrated approach to the analysis, investigation and development of materials, concentrating on specific types or classes. (1028-701 or equivalent) **Class variable, Lab variable, Credit 4**

1028-710 **Material Properties and Selections**
Study of the principles of material behavior as applied to design. Application of materials according to these principles is stressed. Ferrous, nonferrous, and nonmetallic materials are considered. (1028 701 or equivalent) **Class 4, Credit 4**

1028-714 **Glass Science**
Topics include the structure and properties of glass, applied areas such as glass melting and processing, and various technological applications of glass. (1028-701 or equivalent; 1028-704) **Class 4, Credit 4**

1028-717 **Material Degradation: Corrosion**
This course introduces the basic electrochemical nature of corrosion and considers the various factors that influence the rate of corrosion in a variety of environments. Various means of controlling corrosion are considered. (1028-701 or equivalent) **Class 4, Credit 4**

1028-720 **Organic Polymers**
Meets the needs of students in the area of organic chemistry related to synthesis, polymerization mechanism, structures, stereochemistry of reactions of organic polymers and their industrial usage. (1028 702 or equivalent) **Class 4, Credit 4**

1028-721 **Physical Chemistry of Polymers**
A study of the theoretical and experimental methods available for designing plastics products and selecting appropriate materials, with special emphasis on the interrelationships between materials, product design, tooling construction, and manufacturing producibility. (1028 702 or equivalent) **Class 4, Credit 4**

1028-722 **Polymer Processing**
A study of the basic principles and methods involved in the technology of processing polymeric materials, including treatments of heat transfer, mass transfer, and mixing and shaping or molding of these materials. (1028-702 or equivalent) **Class 4, Credit 4**

1028-730 **Optical Properties of Materials**
Fundamentals of geometrical and physical optics, interaction of radiation with matter, dielectrics and thin films, introduction to electro-optic and acousto-optic effects. (1028-704 or equivalent) **Class 4, Credit 4**

1028-733 **Magnetic Properties of Materials**
Magnetostatics, creation and measurement of magnetic fields, galvano- magnetic and magneto-optic effects, magnetic materials, applications. (1028-701 and 704 or equivalent) **Class 4, Credit 4**

1028-734 **Advanced Optics**
Lasers: theory, types and construction; optics of metals; multilayer dielectrics; electro- and acousto-optic modulators and deflectors; optical detectors. (1028-730 or equivalent) **Class 4, Credit 4**

1028-736 **Amorphous and Semicrystalline Materials**
Electrical, thermal, and optical properties of amorphous materials; model of conduction. (1028-701, 703, 704 or equivalents) **Class 4, Credit 4**

1028-740 **Nuclear Science and Engineering**
Systemics of the atomic nuclei, radioactivity, nuclear reactions, fission, nuclear reactor principles, designs, materials, and safety. (1028-701 and 704 or permission of instructor) **Class 4, Credit 4**

1028-760 **Plasma Science**
An introduction to plasma science; a study of the basic phenomena and application of plasma to etching, deposition, polymerization, plasma production of materials, analytical emission spectroscopy, and atmospheric science. (1028-701 or equivalent) **Class 4, Credit 4**

1028-770 **Physics and Chemistry of IC Processes**
Study of the various processing steps used in integrated circuit fabrication technology with special emphasis on diffusion, thermal oxidation, ion implantation and plasma-assisted deposition, and etching processes. Process modeling using SUPREM. (1028-703 or permission of instructor) **Class 4, Credit 4**

1028-780 **Theory of Microsensors and Actuators**
This course gives a broad background to the theory and development of sensors at the molecular and ionic levels. The mechanistic details of operation of the sensors and actuators limited to selected examples will be considered. Fundamental aspects related to chemical, biochemical, piezo resistive, magnetic, thermal and luminescent sensors will be discussed with an orientation towards development of innovative products. Control systems based on ion selectivity for biomedical applications will be dealt with rigorously. Special topics to be covered will be neuro transmitters, neural network and directional selectivity using conducting polymers. (Permission of instructor) **Class 4, Credit 4 (F, W)**

1028-800 Special Topics
In addition to in-depth study of any of the courses listed under Elective Courses, special topics may be selected from such areas as elastomers, organometallics, radiation damage, processing of materials, superconductivity, sensors, and actuators, etc. (Permission of instructor) **Class variable, Credit 4**

1028-877 External Research
Research using equipment and facilities at a site other than RIT. Prior to enrollment in the course, a proposal from the student that includes a letter of support from the host facility is evaluated for determination of credit to be awarded upon successful completion of the project. A total of 8 quarter credit hours, with a maximum of 4 quarter credit hours per quarter, can be applied toward the MS degree. For matriculated MSE students employed full time by local companies. (Permission of program director) **Credit variable**

1028-879 Research and Thesis Guidance
A project involving research on a topic in materials science and engineering. An oral examination and written thesis are required. **Credit variable**

1028-890 Seminar
Required for completion of the program and involves a one-hour presentation on some topic in materials science in engineering. **Class variable, Credit 1 (F, S)**

1028-899 Independent Study
This course number should be used by students wishing to study a topic on an independent study basis. (Permission of instructor) **Credit variable**

1028-999 Materials Science Graduate Co-Op
Optional cooperative work experience for graduate materials science students. (Permission of graduate program director) **Credit 0**

Color Science

1050-702 Applied Colorimetry
This course covers the principles of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, color order systems, color measurement including spectral sensitivity optimization, metamerism, color inconstancy, history and theory of color tolerance equations and spaces, and an overview of color management. (Graduate status in Color Science or permission of instructor) **Class 4, Credit 4 (F)**

1050-703 Color Appearance
This course is for students who have an understanding of the applications of colorimetry. It presents the transition from the measurement of color patches and differences to the description and measurement of color appearance. This seminar course is based mainly on review and discussion of primary references. Topics include appearance terminology, appearance phenomena, viewing conditions, chromatic adaptation and color appearance modeling. (1050-701, 702) **Class 3, Credit 3 (W)**

1050-704 Computing for Color Science
This course explores the computational techniques and methods needed to conduct research in color science. Lectures will introduce students to programming in MATLAB and will specifically address: manipulation of instrumental data, image processing, data analysis and optimization techniques, 2D and 3D graphics, user interface design, color management, and psychophysical experimentation. Programming assignments will reinforce lecture concepts and will provide the students with a library of color science functions to use in their course work and research. (Graduate status in Color Science or permission of instructor) **Class 4, Credit 4 (F)**

1050-721 Color Measurement Laboratory I
This course is the first part of a two-course sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing, and basic programming. Topics include the instrumentation and standardization required for high quality optical radiation measurements, analysis techniques for determining the accuracy and precision of those measurements, the optical properties of objects and radiation, optical and electronic design of spectroradiometric and spectrophotometric instrumentation, the use of standard reference materials for calibration, and evaluation of instrumentation and psychophysical experimentation. (1050-702) **Class 1, Lab 3, Credit 3 (W)**

1050-722 Color Measurement Laboratory II
This course is the second part of a two-quarter sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing, and basic programming. The focus of this course is on psychophysical methods in color science. Topics include: display characterization and control; stimulus presentation; data collection/analysis; methods for determining visual contrast sensitivity; color difference and corresponding color psychophysics; and measurement of observer metamerism. (1050-721) **Class 1, Lab 3, Credit 3 (S)**

1050-753 Special Topics
Advanced topics of current interest, varying from quarter to quarter, selected from the field of color science. Specific topics announced in advance. (Not offered every quarter. Consult the color science graduate program coordinator.) **Credit variable**

1050-799 Independent Study
An independent project in an area of color science not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. **Credit variable**

1050-801 Color Science Seminar
A seminar course in which students will study the literature in particular areas of color science and present that material to the class. Topics will be based on student interest and current issues in the field. May be taken more than once for credit with permission of coordinator. (Graduate status in Color Science or permission of instructor) **Class 1, Credit 1 (F, W, S)**

1050-813 Color Modeling
This course explores mathematical techniques for predicting the spectral and colorimetric properties of colored materials and images from user-controlled drive signals. Color systems that are modeled include paint, computer-controlled LCD and projector, continuous and halftone printing, and spectral cameras. Accompanying laboratory stresses the use of multivariate statistics, nonlinear optimization, and technical writing. Final laboratory consists of spectral-based color reproduction system including input, display, and printed output. (1050-702, 721, co-requisite 1050-722) **Class 4, Credit 4 (S)**

1050-840 Color Science MS Project
An independent project in an area of color science that serves as the major culminating experience for students in the Graduate Project Option of the color science MS program. This project can be an experiment, critical literature review, demonstration or other appropriate work. This course requires a formal proposal and faculty sponsor; a written technical report and oral presentation of the results. **Credit 4**

1050-890 Research and Thesis
Thesis based on experimental evidence obtained by the candidate in an appropriate topic as arranged between the candidate and the coordinator of the program. **Credit variable** (minimum of 9 credits for MS)

1050-999 Color Science Co-Op
Cooperative work experience for graduate color science students. **Credit 0**

Imaging Science

1051-706 Introduction to Imaging Science Research
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). The students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (F)**

1051-707 Introduction to Imaging Science Research
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. This course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (W)**

1051-708 Introduction to Imaging Science Research
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course also addresses issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (S)**

1051-713 Probability, Noise, and System Modeling
The purpose of this course is to develop an understanding and ability in modeling noise and random processes within the context of imaging systems. The focus will be on stationary random processes in both one dimension (time) and two dimensions (spatial). Power spectrum estimation will be developed and applied to signal characterization in the frequency domain. The effect of linear filtering will be modeled and applied to signal detection and maximization of SNR. The matched filter and the Wiener filter will be developed. Signal detection and amplification will be modeled, using noise figure and SNR as measures of system quality. At completion of the course, the student should have the ability to model signals and noise within imaging systems. Also offered online. (1051-716, 718, 719 or permission of instructor) **Class 4, Credit 4 (S)**

1051-716 Fourier Methods for Imaging
This course develops the mathematical methods required to describe continuous linear systems, with special emphasis on tasks required in the analysis or synthesis of imaging systems. The classification of systems as linear/nonlinear and shift variant/invariant is discussed first, followed by development and use of the convolution integral, and by a discussion of Fourier methods as applied to the analysis of linear systems, including the Fourier series and Fourier transform. Emphasis is placed on the physical meaning and interpretation of these transform methods. Within the context of image analysis, imaging systems as a linear filter, image enhancement and information extraction, and several basic image processing techniques are also introduced. Also offered online. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (F)**

1051-718 Digital Imaging Mathematics
This course provides a basic understanding of imaging systems, image transformations and associated mathematics and computational processes needed for upper-level classes in the imaging science graduate program. Topics covered include: camera models; image projections and rectification; image statistics and point processing; linear and nonlinear image filters; image transforms; image mathematics; and computer algorithms. Some laboratory experiments are included. Also offered online. (1051-716) **Class 4, Credit 4 (W)**

1051-719 Radiometry
This course is focused on the fundamentals of radiation propagation as it relates to making quantitative measurements with imaging systems. It includes an introduction to common radiometric terms and derivation of governing equations with an emphasis on radiation propagation in both non-intervening and turbid media; and an introduction to detector figures of merit and noise concepts. Includes some laboratory experiments. Also offered online.(Graduate standing in a science or engineering program, or permission of instructor) **Class 4, Credit 4 (F)**

1051-720 The Human Visual System
This course describes the underlying structure of the human visual system and the psychophysical techniques used to measure its performance. The visual system's optical and neural systems responsible for collecting and detecting spatial, temporal, and spectral signals from the environment are described. The sources and extent of limitations in the subsystems are described and discussed in terms of the "enabling limitations" that allow practical imaging systems. Some laboratory/homework projects are included. Also offered online. (Graduate standing in a science or engineering program, or permission of instructor) **Class 4, Credit 4 (F)**

1051-724 Introduction to Microscopy Using Light, Electrons, and Scanning Probes
This is the first course in a three-quarter microscopy sequence. The purpose of this course is to give the student an overview of the various modes of microscopy for the study of materials. The first part of the course will focus on various modes of light microscopy. The bulk of the course will be devoted to electron microscopy, with the final part of the course devoted to scanning tunneling and atomic force microscopy. Demonstrations will be held in the Nano Imaging Lab to reinforce the lecture material. (Graduate student standing in science or engineering, or permission of instructor) **Class 4, Credit 4 (W)**

1051-728 Design and Fabrication of Solid State Cameras
The purpose of this course is to provide the student with hands-on experience in building a CCD camera. The course provides the basics of CCD operation including an overview, CCD clocking, analog output circuitry, cooling, and evaluation criteria. **Class 1.5, Lab 7.5, Credit 4 (W)**

1051-730 Magnetic Resonance Imaging
This course is an introduction to the principles of magnetic resonance imaging (MRI). The course covers spin physics, Fourier transforms, basic imaging principles, Fourier imaging, imaging hardware, imaging techniques, image processing, image artifacts, safety and advanced imaging techniques. Also offered online. (1016-305 or equivalent and one of the following: 1008-311, or equivalent; 1014-442, or equivalent; 1017-313, or equivalent; or permission of instructor) **Class 4, Credit 4 (S-X*)**

1051-733 Optics
This course will provide the requisite introductory knowledge in optics needed by a student in the graduate program in imaging science. The course will cover geometrical optics; wave nature of light, the Fresnel equations, interference and diffraction, and resolution of imaging systems. Some laboratory experiments are included. Also offered online. (1051-716, 719) **Class 4, Credit 4 (W)**

1051-736 Geometrical Optics and Lens Design
This course leads to a thorough understanding of the geometrical properties of optical imaging systems and detailed procedures for designing any major lens system. Automatic lens design, merit functions and optimization are applied to real design problems. The course will utilize a modern optical design program to illustrate the design process for various lenses and imaging systems. Also offered online. (1051-733) **Class 4, Credit 4 (F)**

1051-737 Physical Optics
The wave properties of light and their application to imaging systems and metrology. Polarization, birefringence, interference and interferometers, spatial and temporal coherence, scalar diffraction theory are covered. (1051-716) **Class 4, Credit 4 (W)**

1051-739 Principles of Solid State Imaging
This course covers the basics of solid state physics, electrical engineering, linear systems and imaging needed to understand modern focal plane array design and use. The course emphasizes knowledge of the working of infrared arrays. (Optics, Linear Systems) **Class 4, Credit 4 (F)**

1051-742 Testing of Focal Plane Arrays
An introduction to the techniques used for the testing of solid state imaging detectors such as CCDs, CMOS and Infrared Arrays is provided. Focal plane array users in industry, government and university need to ensure that key operating parameters for such devices either fall within an operating range or that the limitation to the performance is understood. This is a hands-on course where the students will measure the performance parameters of a particular camera in detail. While this course can be taken individually, students will obtain maximum educational value by taking it as the third part of a sequence of imaging science courses preceded by 1051-739 Principles of Solid State Imaging Arrays and then 1051-728 Design and Fabrication of a Solid State Camera. (Graduate status in imaging science or permission of instructor) **Class 2, Lab 6, Credit 4 (S)**

1051-743 Fundamentals of Radiation-Matter Interactions
This is the first course in a three-quarter sequence on the interactions between radiation and matter. The purpose of this course is to present an overview of the many interaction mechanisms involving electromagnetic radiation, charged particles, and neutrons with material systems. The course introduces both classical and basic quantum treatments of these interactions. Topics include the dispersion, scattering, absorption, and emission of electromagnetic radiation by atoms and molecules, the scattering of light by small particles, the concept of a cross-section, mechanism of energy loss by charged particles, the attenuation of different types of radiation, and a brief introduction to how x-rays and neutrons can be used to probe the structure of materials. (Graduate status in science or engineering, or permission of instructor.) **Class 4, Credit 4 (S, alternate years)**

1051-753 Special Topics: Imaging Science
Advanced topics of current interest, varying from quarter to quarter, selected from the field of imaging science. Specific topics announced in advance. (Not offered every quarter. For more information see www.cis.rit.edu/node/309 or consult the imaging science graduate program coordinator.) **Credit variable**

1051-759 **Elements of Photogrammetry I**
The course will introduce the basic fundamentals essential to describing photogrammetry and its uses for deriving point positions, 3-D coordinates, digital elevation models, image maps, and topographic maps from airborne or space borne imaging systems. It will cover the geometry of film and digital cameras, calibration of cameras, image measurements and refinements such as atmospheric refraction, distortion corrections, image measurements, and transformation of coordinates. Derivation and use of collinearity equations are emphasized to demonstrate their applicability to ground surveyed coordinates, global positioning systems, and inertial management units for positioning and orientation of the camera images for aerial triangulation and least squares adjustments. (1016-273, 1016-331, and 1016-319 or equivalent or permission of instructor) **Class 4, Credit 4 (S)**

1051-762 **Remote Sensing: Sensors, Radiometric Image Analysis**
Introduction to the governing equations for radiance reaching an aerial or satellite based imaging system, covering the properties of these imaging systems with an emphasis on their use as quantitative scientific instruments. Methods for inverting the remotely sensed image data using the governing radiometric equation are assessed. Multidimensional image analysis (e.g. multispectral, polarimetric, multidate) is emphasized and includes issues such as image registration to support image analysis. Parameters and processes governing spatial, spectral and radiometric image fidelity are studied with an emphasis on how each step in the image chain impacts the final image or image product. Also offered online.(1051-719) **Class 4, Credit 4 (W)**

1051-763 **Remote Sensing: Spectral Image Analysis**
This course is focused on analysis of high dimensional remotely sensed data sets. A review of the properties of matter that control the spectral nature of reflected and emitted energy is followed by analysis of image noise characterization and mitigation, radiometric calibration, atmospheric compensation and dimensionality characterization and reduction. The remainder of the course focuses on spectral image analysis algorithms employing the three conceptual approaches to characterizing the data for image segmentation, subpixel detection and pixel unmixing, and target detection. The analysis methods include treatment of signal processing theory and application and incorporation of physics based algorithms into spectral image analysis. Also offered online.(1051-719 and 1051-762) **Class 4, Credit 4 (S)**

1051-765 **Remote Sensing Systems**
This course is designed to draw on the student's knowledge of linear system theory, digital image processing, and noise concepts and apply it to an end-to-end system in an area associated with remote sensing. Generalized concepts from these fields will be focused to show how they can be applied to solve remote sensing image analysis and systems design and evaluation problems. An overriding objective is on the application of theory to practice. (Permission of instructor) **Credit 4**

1051-769 **Spectral Methods and Instrumentation**
This course examines methods and instrumentation for spectral sensing as applied to earth observation. Spectral dispersion and selection methods, with an emphasis on gratings, will be studied. The data collection and analysis procedures for spectral and radiometric calibration of a field spectroradiometer and an airborne spectral imager will be performed by the students in a research laboratory setting. Other methods and practices in spectral instrumentation for both passive and active sensing across the electromagnetic spectrum will be described. (1051-719 or permission of instructor) **Class 4, Credit 4 (offered alternate years) (W)**

1051-775 **Applied Colorimetry**
This course covers the principles of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, color order systems, color measurement including spectral sensitivity optimization, metamerism, color inconstancy, history and theory of color tolerance equations and spaces, and an overview of color management. (Graduate status in CIS or permission of instructor) Also offered online. **Class 4, Credit 4 (F)**

1051-776 **Color Modeling**
This course explores mathematical techniques for predicting the spectral and colorimetric properties of colored materials and images from user-controlled drive signals. Color systems that are modeled include paint, computer-controlled LCD, continuous and halftone printing, and spectral cameras. Accompanying laboratory stresses the use of multivariate statistics, nonlinear optimization, and technical writing. Final laboratory consists of a spectral-based color reproduction system including input, display, and printed output. (1051-775) **Class 4, Credit 4 (S)**

1051-779 **Astronomical Instrumentation and Techniques**
This course provides an in-depth look at various pieces of instrumentation used in many low light imaging applications with emphasis on astronomical requirements. Aspects of hardware, systems analysis, and performance calculation will be covered. **Class 4, Credit 4 (offered occasionally) (S)**

1051-780 **Image Processing with Wavelet Transforms**
This course introduces the student to the theory and application of wavelet transforms. The mathematical operations of continuous and discrete wavelet transforms are defined and properties described. The attractiveness of the transform in applications requiring signal/image localization in time/space and frequency is underscored. Wavelet design methods are covered. Application of the transform to image/video compression, pattern matching, noise removal and other topics are discussed. Wavelet based standards such as FBI fingerprint compression and JPEG-2000 are covered. (1051-718 or permission of instructor) **Class 4, Credit 4 (S-online only)**

1051-782 **Digital Image Processing**
This course follows up on concepts introduced in 1051-718 Digital Imaging Mathematics. Topics covered include linear vector spaces, image mathematics, image statistics and point processing, linear and nonlinear image filters, image transforms and computer algorithms. Computational methods and techniques for essential processes for imaging systems are used as the course framework. Also offered online. (1051-718 or permission of instructor) **Class 4, Credit 4 (S)**

1051-784 **Pattern Recognition**
This course develops a fundamental understanding of adaptive pattern recognition and a basic working knowledge of techniques for use in a broad range of applications. Inherent in adaptive pattern recognition is the ability of the system to learn by supervised or unsupervised training, or by competition within a changing environment. The effectiveness of the system depends upon it structure, adaptive properties and specifics of the application. Particular structures developed and analyzed include Bayes decision theory, parametric and nonparametric techniques, multilayer perceptrons and unsupervised clustering methods. the goal is to gain both a fundamental and working knowledge of each kind of technique and the ability to select the most appropriate one when faced with a real application design. Also offered online. (1051-716, 718, 726, and 0304-834 or equivalent) **Class 4, Credit 4 (S, alternate years)**

1051-786 **Advanced Digital Image Processing**
This course investigates algorithms and techniques for a variety of imaging applications. The techniques build on the background that is established in the course 1051-782 Introduction to Digital Image Processing, which focuses on basic image processing methods. The course is taught using a lecture and group project format, in which the lectures focus on advanced techniques and provide applications of their use in selected applications. The group projects enable students to work on substantial designs that require the understanding of the task domain, exploration of solution methods by analysis and prototyping, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration. (1051-726, 1051-782 or permission of instructor) **Class 4, Credit 4 (offered alternate years, offered 2011–12) (F)**

1051-797 **Principles of Computed Tomographic Imaging**
Image reconstruction from projections is introduced as a mathematical problem. Technique for reconstruction via Fourier domain is explained using Fourier slice theorem. Simple and Filtered Backprojection and iterative methods are analyzed. Algorithms for various techniques are developed and artifacts and noise in discrete case are considered. Applications to several medical imaging modalities are outlined, with brief consideration of the physics of imaging involved in each case. **Class 4, Credit 4 (S)**

1051-799 **Independent Study**
An independent project in an area of imaging science not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. **Credit variable**

1051-812 **Medical Imaging Systems**
This is an advanced graduate level course that describes existing medical imaging systems in terms familiar to imaging scientists and electrical engineers. These include impulse response, the transfer functions, and the signal to noise ratio. The course considers in detail, four different imaging modalities: conventional projection X ray, CT, ultrasonic imaging, and magnetic resonance imaging. A complete system is examined piece by piece in terms of subsystems. **Class 4, Credit 4 (W)**

1051-840 **MS Project Paper**
The analysis and solution of Imaging Science Systems problems for students enrolled in Systems Capstone option. **Credit 1**

1051-890 **Research and Thesis**
Thesis (MS) or dissertation (Ph.D.) based on experimental data obtained by the candidate for an appropriate topic as arranged between the candidate and the research adviser. **Credit variable**

1051-999 **Imaging Science Graduate Co-Op**
Cooperative work experience for graduate imaging science students. **Credit 0**

Astrophysical Sciences and Technology

1060-701 Astrophysical Sciences Graduate Seminar
This course is focused on familiarizing students with research activities and practices in the university research environment as well as policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Astrophysical Sciences and Technology Program (usually weekly presentations). The students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. (Graduate standing in Astrophysical Sciences and Technology) **Class 1, Credit 1 (F)**

1060-702 Astrophysical Sciences Grad Seminar II
This course is focused on familiarizing students with research activities in the Astrophysical Sciences and Technology, research practices in the university research environment and policies and procedures impacting graduate students. This course is coupled with the research seminar sponsored by the Astrophysical Sciences and Technology graduate program (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. (Graduate standing in Astrophysical Sciences and Technology) **Class 1, Credit 1 (W)**

1060-703 Astrophysical Sciences Grad Seminar III
This course is focused on familiarizing students with research activities in Astrophysical Science and Technology, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Astrophysical Sciences and Technology Graduate Program (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course also addresses issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. (Graduate standing in Astrophysical Sciences and Technology) **Class 1, Credit 1 (S)**

1060-710 Mathematical and Statistical Methods for Astrophysics
This course provides an introduction to the applied mathematical and statistical tools used frequently in astrophysics ? including data reduction and analysis and computational astrophysics. Topics will include Numerical Methods, Probability and Statistics, Frequency Domain Analysis. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (F)**

1060-711 Astronomical Observational Techniques and Instrumentation
This course will survey multiwavelength astronomical observing techniques and instrumentation. Students will gain an understanding of how the telescopes, detectors, and instrumentation in the major ground based and space based observatories function and how to use them. Observatories to be studied may include the Very Large Array, GBT, ALMA, Spitzer, HST, Gemini, JWST, and Chandra. Students will plan and carry out a multiwavelength archival program on a topic of their choice. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (S)**

1060-712 Astronomical Systems
This is a practical course that will teach students the requisite knowledge needed to design and fabricate modern astronomical instrumentation systems. It would be useful for those who are interested in either fabricating or using such instruments. The course will cover aspects of optical design, electronics design, mechanical design, computer control, and project management, Knowledge of the performance of the individual components making up the system will be required as will their interplay with each other. The specific measurement challenge will vary from year to year but may include designing a fiber-fed imaging spectrometer, a sub millimeter detector system, or an infrared camera. **Class 4, Credit 4**

1060-714 Computational Methods in Astrophysics I
This course surveys the different ways that scientists use computers to address problems in astrophysics. The course will choose several common problems (time-series analysis, N-body simulations, etc.); for each one, it will provide an introduction to the problem, review the literature for recent examples, and illustrate the basic mathematical technique. In each of these segments, students will write their own code in an appropriate language. **Class 4, Credit 4**

1060-715 Computational Methods in Astrophysics II
This course is the second part of a two-quarter series. This course continues to explore the methods scientists use to study problems in astrophysics which cannot be solved analytically. The first half of the course will introduce the student to new techniques (adaptive mesh, smoothed particle hydrodynamics, etc.) which do not appear in the first course (Computational Methods in Astrophysics I). In the second half of the course, students will plan and execute a large software project, more detailed and sophisticated than those small projects done in the first course. **Class 4, Credit 4**

1060-720 Stellar Structure and Evolution I
An overview of the physical principles governing the internal structures and energy generation mechanisms of stars, as well as brief introductions to the processes of star formation and the late stages of stellar evolution. Topics covered include: static stellar structure; stellar energy generation and transport; simple stellar atmospheres; characteristic timescales for and stages of stellar formation and evolution; the transition from main-sequence star to red giant and stellar remnant. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (F)**

1060-721 Stellar Structure and Evolution II
The second of a two-course sequence concerning the internal structures and temporal evolution of stars. Topics covered include: stellar pulsation **and** mass loss; binary star systems; protostellar contraction, accretion, and outflow; planetary nebulae and supernovae; degenerate stars. (1060-720) **Class 4, Credit 4**

1060-730 Radiative Processes I
This course will survey the emission mechanisms which produce radiation in astrophysical environments, including thermal bremstrahlung, synchrotron, comptonization, and pair production. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (F)**

1060-731 Radiative Processes II
This course is the second quarter of a two quarter sequence. This course will survey the emission mechanisms which produce radiation in astrophysical environments, including atomic and molecular line emission; and the process which scatter radiation, e.g., Thompson, Raleigh, and Mie scattering. (1060-730) **Class 4, Credit 4**

1060-732 High Energy Astrophysics I
This course will survey violent astrophysical phenomena including supernovae, X-ray binaries, active galactic nuclei and gamma ray bursts. It will examine physical processes associated with the emission of high-energy radiation, with the production of high energy particles, with accretion discs around compact objects and with the production and propagation of astrophysical jets. It will review current models for the sources of high-energy phenomena. Emphasis will be placed on current models for active galactic nuclei, which produce a wide range of high-energy phenomena. **Class 4, Credit 4**

1060-733 High Energy Astrophysics II
This course is the second in a two quarter sequence. This course will survey the properties Active Galactic Nuclei (AGN) including distances, luminosities and size scales; observational classification; the central engine. Standard black-hole model; AGN accretion disks; the Eddington limit; evidence for supermassive black holes; continuum emission; radio sources; broad emission lines; unification theories; lifecycles of AGN. **Class 4, Credit 4**

1060-740 Galactic Astrophysics and Interstellar Medium I
First course in a two-course sequence on Galactic Astrophysics and the Interstellar Medium. This course will cover stellar and galactic dynamics with special application to the Milky Way galaxy. Topics will include theory of orbits; Jeans's theorem and equilibrium of stellar systems; the virial theorem; the Jeans equations; gravitational instabilities; structure and kinematics of the Milky Way. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (W)**

1060-741 Galactic Astrophysics and Interstellar Medium II
Second course in a two-course sequence on Galactic Astrophysics and the Interstellar Medium. This course will cover structure and energetics of the interstellar medium (ISM), with special application to the Milky Way galaxy. Topics will properties of the ISM; molecular clouds and cloud cores; HII regions; outflows and shock waves; dust. (1060-740) **Class 4, Credit 4**

1060-750 Extragalactic Astrophysics I
First course in a two-course sequence on extragalactic astrophysics. Topics in this first course are the properties of galaxies, the formation and evolution of galaxies, and the intergalactic medium. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (S)**

1060-751 Extragalactic Astrophysics II
Second course in a two-course sequence on extragalactic astrophysics. Topics in this course are the properties of clusters of galaxies, the formation and evolution of clusters, the intracluster medium, and activity in galaxies. (1060-751) **Class 4, Credit 4**

1060-752 Cosmology I
First course in a two-course sequence on cosmology. The course will present the foundations of cosmology, including the cosmological principle and its consequences, Newtonian cosmology, and types of universes. **Class 4, Credit 4**

1060-753 **Cosmology II**
Second course in a two-course sequence on cosmology. This will present the studies of the early universe and inflation; thermal evolution of the universe; nucleosynthesis; baryogenesis; cosmic microwave radiation; large scale structure and galaxy formation models; dark matter; current universe: dark energy and the cosmic acceleration. **Class 4, Credit 4**

1060-759 **Special Topics**
This is an advanced course on topics of current interest in astrophysics and/or related technologies that are not covered by the formal curriculum. Course offerings and topics will be announced by the program director. This course is structured as an ordinary course and has specific prerequisites, contact hours, and examination procedures. **Class variable (1-4). Credit Variable (1–4)**

1060-760 **General Relativity I**
This course is the first in a three course sequence that introduces Einstein's theory of general relativity as a tool in modern astrophysics. The course will cover various aspects of both special and general relativity, with applications to situations in which strong gravitational fields play a critical role, such as black holes and gravitational radiation. Topics include differential geometry, curved spacetime, gravitational waves, and the Schwarzschild black hole. (Graduate standing in a science, computer science, or engineering program and permission of instructor) **Class 4, Credit 4 (S)**

1060-761 **General Relativity II**
This course is the second in a three course sequence that introduces Einstein's theory of general relativity as a tool in modern astrophysics. The course will cover various aspects of general relativity, with applications to situations in which strong gravitational fields play a critical role, such as black holes and gravitational radiation. Topics include advanced differential geometry, generic black holes, energy production in black-hole physics, black-hole dynamics, introductory cosmology, and methods for solving the Einstein equations.(1060-760) **Class 4, Credit 4**

1060-762 **Advanced Topics in General Relativity**
This course is the third in a three course sequence on general relativity. The main topics include modern differential geometry applied to general relativity, including differential manifolds, geometrical descriptions of tensors, set theory, and differential forms and integration; techniques for solving the Einstein equations, such as the classic 3+1 and characteristic decompositions; and a brief survey of advanced topics, including Newman-Penrose formalism, singularity theorems, and asymptotic descriptions of spacetime. (1060 761) **Class 4, Credit 4 (F)**

1060-799 **AST: Independent Study**
An independent study in an area of astrophysical sciences and technology not covered in the available courses. This study may be reading study of an appropriate textbook, literature review, or other appropriate work. The course requires a formal proposal, faculty sponsor, and program approval. **Credit variable** (1 to 4 credits)

1060-890 **Research and Thesis**
Thesis (MS) or dissertation (Ph.D.) research by the candidate for an appropriate topic as arranged between the candidate and the research adviser. **Credit variable (0-6 credits)**

Semester Courses

Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Biological Sciences

BIOL-601 **Genetic Diseases and Disorders**
The identification of genetic causes of disease has been one of the major modern scientific breakthroughs. This course examines a range of inherited diseases, how causative genetic variations were or are being identified, and what this means for the treatment of the diseases. Scientific literature will be utilized, both current and historical. (BIOL-321 Genetics or equivalent) **Class 3, Credit 3 (S, alternate years)**

BIOL-625 **Ethics in Bioinformatics**
This course will be focused on individual and organizational responsibilities in bioinformatics research, product development, product commercialization and clinical and consumer genetic testing. (Graduate standing in Bioinformatics or permission of instructor) **Class 3, Credit 3 (F)**

BIOL-630 **Bioinformatics Resources**
Bioinformatics Resources will focus on the types of analyses, tools, and databases that are available and commonly used in Bioinformatics. The labs will apply the lecture material in the analysis of real data. (BIOL-330 Bioinformatics or Graduate standing) **Class 2, Lab 3, Credit 3 (F)**

BIOL-635 **Bioinformatics Seminar**
The course provides opportunities for students and faculty to develop and share professional interests while discussing current trends and developments in bioinformatics. Material for this course will be drawn from the current scientific literature. (Graduate standing in Bioinformatics or permission of instructor) **Class 3, Credit 3 (F)**

BIOL-655 **Biogeography**
This course is the study of the distribution of biodiversity on the earth. Patterns of past and present animal and plant distributions are used to help understand the mechanisms of basic biological processes including speciation, dispersal, divergence and extinction. This course will cover the character and history of the science of biogeography, as well as its basic principles and applications. We will also examine the assumptions, methods and conclusions of historically significant biogeographic studies. (BIOL-240 General Ecology or BIOL-265 Evolutionary Biology, or permission of instructor) **Class 3, Credit 3 (S)**

BIOL-673 **Advanced Marine Biology**
This course explores marine biology by focusing on the diversity of life and influence of oceanographic phenomena on the various ecosystems. Morphological and physiological adaptations along with environmental threats will also be investigated. The course will explore marine conservation issues, in depth. (BIOL-240 General Ecology and graduate standing or permission of instructor) **Class 4, Credit 4**, **(F, alternate years)**

BIOL-675 **Advanced Conservation Biology**
This course focuses on the application of ecological principles to conservation issues. Human impact on species diversity will be emphasized as it relates to agricultural, forest, coastal and wetland ecosystems. Case studies of management practices used to manage and restore disturbed ecosystems will be included. Students will explore a topic in depth through writing a review paper of published literature. (BIOL-240 General Ecology or equivalent) **Class 3, Credit 3 (S)**

BIOL-694 **Molecular Modeling and Proteomics**
This course will explore two facets of protein molecules: their structure and their expression. The structure component will build upon information from earlier bioinformatics courses. The course will also include the analysis of inter-molecular interactions, such as ligand/receptor pairing, by employing software that permits modeling of molecular docking experiments. Tissue-specific protein expression will be addressed in lectures with descriptions of microarray, SAGE, 2D gel electrophoresis and other contemporary technologies and in the laboratory through software commonly used to analyze and compare gene expression levels. Each student will be assigned a project designed to integrate salient principles covered in the course and provide an opportunity for each student to give an oral presentation to his or her peers. In addition, each student will write a paper describing a practical application of proteomics. (BIOL-330 Bioinformatics or Graduate standing) **Class 2, Lab 3 Credit 3 (S)**

BIOL-700 Cell and Molecular Genetics
This course will introduce cellular and molecular biology to graduate students with limited background in the biological sciences. The approach to be taken entails the use of empirical data to support the basic concepts presented. Upon completion of this course students will not only be familiar with cellular and molecular biology but will also be acquainted with the theoretical foundations of modern laboratory techniques. Topics covered in this course include cellular evolution, small molecules, energy and biosynthesis, macromolecules, protein functions, genetics mechanisms, recombinant DNA technologies, the nucleus, regulation of gene expression, membrane structure and function, intracellular protein trafficking, energy conversion in mitochondria and chloroplasts, cell signaling, the cytoskeleton, the cell cycle, cell division, intercellular interactions, germ cells and development, cellular differentiation, immunity and cancer. (BIOL-330 Bioinformatics or Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

BIOL-798 Graduate Biology Independent Study
This course is a faculty-directed, graduate level tutorial of appropriate topics that are not part of the formal curriculum. (Permission of instructor) **Class variable, Credit 1–4 (F, S, Su)**

Environmental Science

ENVS-601 Environmental Science Graduate Studies
This course helps graduate students learn how to assess journal articles, government reports, whitepapers, and essays as well as other relevant sources of information. Students will also refine their discussion and presentation skills and gain experience in clarifying their comments and responding to questions by an audience. This course will introduce students to careers in environmental science, to graduate studies in environmental science at RIT, and to the process of defining, conducting, presenting, and defending a thesis proposal. (Graduate standing in Environmental Science or permission of instructor) **Class 3, Credit 3 (F)**

ENVS-650 Advanced Applications of Geographic Information Systems
Aerial photography, satellite imagery, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) are extremely useful tools in ecological and environmental applications such as biological monitoring, environmental assessment, habitat restoration, change analysis, resource management, and risk assessment. This course will: 1) introduce students to spatial analysis theories, techniques and issues associated with ecological and environmental applications; 2) provide hands-on training in the use of these spatial tools while addressing a real problem; 3) provide experience linking GIS analyses to field assessments and monitoring activities; and 4) enable students to solve a variety of spatial and temporal ecological and environmental problems. (Graduate standing and ENVS-250 Application of Geographic Information Systems or equivalent; or permission of instructor) **Lecture/Lab 6, Credit 4 (S)**

ENVS-670 Advanced Concepts of Environmental Chemistry
This course will build on previous chemistry courses to expand knowledge of biogeochemical cycles, environmental toxicology and applied methods of environmental analysis. The course will be conducted in a workshop format at the graduate level. (CHMO-231 Organic Chemistry I, CHMO-235 Organic Chemistry I Lab(or equivalent) and graduate standing in Environmental Science, or permission of instructor) **Lecture/Lab 3, Credit 3 (S)**

ENVS-780 Environmental Science Project
This course will result in an Environmental Science project accomplished by the MS student for an appropriate topic as arranged between the candidate and the project advisor. (Permission of instructor) **Credit variable (F, S, Su)**

ENVS-790 Environmental Science Thesis
The thesis option will be available to environmental science graduate students only with prior written approval of program faculty. Students will submit a proposal to a faculty member who agrees to serve as the student's thesis committee chair. The proposal will describe the basic research question to be investigated and the experimental protocols to be employed. Proposals will be reviewed by the program faculty who will give permission to register for thesis credit. This course may be taken several times over the course of a student's graduate program, for variable credits. A written thesis and oral defense are required at the completion of the thesis research. (Permission of instructor) **Credit 1–4 (F, S, Su)**

ENVS-798 Advanced Environmental Science Independent Study
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for student in the Environmental Science graduate program. (Permission of instructor) **Credit 1–4 (F, S, Su)**

Chemistry

CHEM-670 Graduate Chemistry Writing
Chemists are required to communicate information about their research, laboratory, and themselves in writing. This course is designed to develop these skills. Students will learn how to write a curriculum vitae, resume, laboratory overview, short and long research abstracts, and scientific research articles using the various formats and styles used by chemists. An integral part of the writing of a research article is the initial formulation of the research hypothesis and design of experiments to test the hypothesis. This course will also review and stress the importance of these components. (Graduate standing in chemistry) **Class 1, Credit 1 (F)**

CHEM-771 Graduate Chemistry Seminar I
Chemists are required to communicate information about their research, their laboratory, and themselves orally. Graduate Chemistry Seminar I is the first in a series of four courses designed to develop the ability to assimilate useful information and organize a chemistry seminar while increasing a student's breadth and depth of knowledge of chemical research topics. This seminar requires the students to attend weekly chemistry seminars and write seminar summaries. Additionally, each student will present a seminar on their proposed research that also summarizes the scientific literature related to the research. (Graduate standing in chemistry) **Class 1, Credit 1 (F)**

CHEM-772 Graduate Chemistry Seminar II
Chemists are required to communicate information about their research, their laboratory, and themselves orally. Graduate Chemistry Seminar II is the second in a series of four courses designed to develop the ability to assimilate useful information and organize a chemistry seminar while increasing a student's breadth and depth of knowledge of chemical research topics. This seminar requires the students to attend weekly chemistry seminars and write seminar summaries. (CHEM-771 Graduate Chemistry Seminar I) **Class 1, Credit 1 (S)**

CHEM-773 Graduate Chemistry Seminar III
Chemists are required to communicate information about their research, their laboratory, and themselves orally. Graduate Chemistry Seminar III is the third in a series of four courses designed to develop the ability to assimilate useful information and organize a chemistry seminar while increasing a student's breadth and depth of knowledge of chemical research topics. This seminar requires students to attend weekly chemistry seminars and write seminar summaries throughout the four semesters. Additionally, each student must invite, organize, host, and introduce an external seminar speaker to participate in the Chemistry Seminar Series. (CHEM-772 Graduate Chemistry Seminar II) **Class 1, Credit 1 (F)**

CHEM-774 Graduate Chemistry Seminar IV
Professional chemists are required to communicate information about their research, their laboratory, and themselves orally. Graduate Chemistry Seminar IV is the fourth in a series of four courses designed to develop the ability to assimilate useful information and organize a chemistry seminar while increasing a student's breadth and depth of knowledge of chemical research topics. This seminar requires the students to attend weekly chemistry seminars and write seminar summaries. Additionally, each student will present a seminar summarizing their thesis research at RIT which serves as the public portion of their thesis defense. (CHEM-773 Graduate Chemistry Seminar III) **Class 1, Credit 1 (S)**

CHEM-780 Chemistry Project
Chemistry project accomplished by the MS student for an appropriate topic as arranged between the candidate and the project advisor. (Permission of instructor.) **Credit 1–3 (F, S, Su)**

CHEM-789 Graduate Special Topics
This is a master-level course on a topic that is not part of the formal curriculum. This course is structured as an ordinary course and has specific prerequisites, contact hours, and examination procedures. (Permission of instructor) **Credit 1–3**

CHEM-790 Research and Thesis
Dissertation research by the candidate for an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor.) **Credit 1–6 (F, S, Su)**

CHEM-799 Independent Study
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for a masters-level student. (Permission of instructor) **Credit 1–3**

CHMA-711 Advanced Instrumental Analysis
The theory, applications, and limitations of selected instrumental methods in qualitative, quantitative and structural analysis will be discussed. This course is also intended to give an opportunity to develop writing and revising abilities, as well as communication skills. Library, literature, and textbook research will be required. (Graduate Standing or CHMA-221 Instrumental Analysis and CHMP-441 Physical Chemistry I(or equivalent)) **Class 3, Credit 3 (F)**

CHMA-725 **The Magnetic Resonance Family**
This course presents the magnetic resonance family of techniques. General techniques include nuclear magnetic resonance (NMR), electron spin resonance (ESR), nuclear quadrupole resonance (NQR), and muon spin resonance (mSR). Each technique will be presented in enough detail to give the student an appreciation of its capabilities and an understanding the theory of the spectroscopy. (Graduate standing or permission of the instructor) **Class 3, Credit 3 (F)**

CHMA-740 **Practical NMR**
A graduate level lecture and laboratory course designed to teach a student how to use a Bruker high-resolution NMR spectrometer to perform a variety of chemical analyses. Students are presented a series of brief descriptions of how to perform various functions and experiments on a Bruker NMR. Students then receive hands-on training and perform the experiment. Specific operations taught include: file management, magnet shimming, probe tuning, parameter optimization, pulse sequence development, one-dimensional and two-dimensional acquisitions, variable temperature studies, data processing, diffusion measurements, and measuring relaxation times. This course serves as mechanism to gain different levels of access to the Chemistry Department's NMR spectrometers. (Graduate Standing, or CHMO-332 Comprehensive Organic Chemistry II or CHMA-221 Instrumental Analysis and permission of instructor) **Class 2, Lab 3, Credit 3 (S)**

CHMA-750 **NMR Spectrometer Maintenance**
This course is designed to introduce the technical aspects of keeping a magnetic resonance system operating. The theory of operation of the magnet, radio frequency, pulse programmer, computer, and supporting subsystems of a magnetic resonance instrument will be studied. Emphasis is placed on relating theory to achievable practice and the consequences of differences between the two. Techniques for troubleshooting problems will be presented and developed. (Graduate standing or CHMA-725 The Magnetic Resonance Family, CHMP-747 Principles of Magnetic Resonance, and CHMA-740 Practical NMR) **Class 3, Credit 3 (F)**

CHMB-610 **Advanced Protein Biochemistry: Structure and Function**
This course analyzes protein structure function relationships. Students will investigate how proteins function and how the structure relates to that function. The principles that explain enzyme rate enhancements and mechanistic enzymology will be examined., Additionally, protein superfamilies for phylogenetic relationships will be explored to enhance understanding of protein structure-function relationships. Students will read and discuss the current scientific literature and classic papers. (Graduate standing or CHMB-403 Biochemistry II or equivalent) **Class 3, Credit 3 (S)**

CHMB-702 **Protein Conformation and Dynamics**
An advanced study of the structure and function of proteins and enzymes. Biophysical and mechanistic aspects of enzyme function will be examined. Applications of computation to protein structure will also be discussed. (Graduate standing or CHMB-403 Biochemistry II or equivalent) **Class 3, Credit 3 (F)**

CHMB-704 **Biochemistry of Nucleic Acids**
This course will cover nucleic acid structures as determined by NMR and X-ray crystallography and nucleic acid catalysis, especially that of ribozymes. Genomics, specifically whole-genome sequencing papers, will be analyzed. Current RNA topics including the RNA world, ribozymes, RNAi, and riboswitches will be discussed. Current DNA topics including lateral/Horizontal DNA transfer, genome duplication, alternate gene expression, and synthetic life will also be discussed. (Graduate standing or CHMB-403 Biochemistry II or equivalent) **Class 3, Credit 3 (S)**

CHMI-764 **Modern Inorganic Chemistry**
Students will become acquainted with advanced instrumental methods that are of particularly great value to the inorganic chemist, and appreciate the value of symmetry in the study of spectroscopy. They will also study reactions that depict the distinctive chemical behaviors o the heavier elements and how they can be applied in current areas of inorganic chemistry research. (CHMP-442 Physical Chemistry II) **Class 3, Credit 3 (S, alternate years**)

CHMO-636 **Spectrometric Identification of Organic Compounds**
This course covers the theory and application of proton, carbon-13, and correlation nuclear magnetic resonance, infrared, mass spectrometry, and ultraviolet spectra for organic structure determination. (Graduate standing in chemistry, or CHMO-332 Comprehensive Organic Chemistry II and permission of instructor) **Class 3, Credit 3 (F)**

CHMO-637 **Advanced Organic Chemistry**
This course will revisit many of the reactions covered in the first year of organic chemistry with an emphasis on stereochemical control. Students will be introduced to the technique of retrosynthesis. The course will introduce more reactions with an emphasis on current topics from the literature. Students will hone their skills in writing electron pushing mechanisms and the use of protecting groups while practicing the art of designing synthetic strategies for making natural products. (Graduate Standing or CHMO-332 Comprehensive Organic Chemistry II (or equivalent) and permission of instructor) **Class 3, Credit 3 (F)**

CHMO-640 **Mechanisms of Drug Interactions**
Drugs are naturally occurring or synthetic substances that upon exposure to a living organism form complexes with biological targets. These complexes result in a characteristic pharmacological effect which alter physiological functions or counteract environmental insults. The goal of this course is to systematically study drug discovery, lead optimization, drug-receptor interactions, and bioavailability. Historically important drug classes and their mechanism of action will receive special consideration. (CHMO-637 Advanced Organic Chemistry or Graduate standing) **Class 3, Credit 3 (S, alternate years)**

CHMO-739 **Advanced Physical Organic Chemistry**
This course covers topics in physical organic chemistry including: techniques for elucidation of mechanism (kinetic, and linear free energy relationships); isotope effects; molecular orbital theory; and electrocyclic reactions. (Graduate standing, CHMO-332 Comprehensive Organic Chemistry II and CHMP-441 Physical Chemistry I; or equivalent) **Class 3, Credit 3 (S)**

CHMP-747 **Principles of Magnetic Resonance**
This course is designed to present the theory of magnetic resonance from a physical chemistry perspective. Students will learn about isotropic and anisotropic proton-electron hyperfine, proton-electron dipolar, and proton-proton dipolar interactions; choosing basis functions and eigenfunctions for energy states; setting up the Hamiltonian; and solving for the energies of the states in both the rigid (solid) and rapidly tumbling (liquid) states. The dynamic nature of magnetic resonance will be developed from a kinetic perspective and focus on relaxation times, observable phenomena on the magnetic resonance timescale, and line broadening. Pulsed NMR will be presented from a classical perspective emphasizing spin packets, net magnetization, and rotation matrices through the Bloch equations. (Graduate standing or CHMP-442 Physical Chemistry II and permission of instructor) **Class 3, Credit 3 (F)**

CHMP-751 **Colloid and Interface Science**
The parallel growth of nanotechnology and a molecular perspective in the medical and life sciences has focused attention on the colloidal domain structures of dimension 1 nm to 1 mm. This course will introduce colloid and interface science that will allow for an appreciation of the role of colloids in biological systems, industrial processes and commercial products. (Graduate standing or CHMP-441 Physical Chemistry I or equivalent) **Class 3, Credit 3 (F, alternate years)**

CHMP-752 **Molecular Photophysics and Photochemistry**
This course provides a comprehensive and clear description of the concepts and principles of molecular photophysical processes and photochemistry. The practical methods required for associated photophysical characterization and measurement are presented along with important applications of molecular photonics in cutting-edge research. A review of quantum mechanics is given with the photochemist in mind such that the student is encouraged to make more use of quantum mechanical terms, quantities and concepts. The course covers the interaction of light with molecular orbitals to form an excited state, and its subsequent de-activation. Applications such as lasers, spectroscopy, photoinduced charge transfer in modern organic photovoltaics and photosynthesis are described. (Graduate standing or CHMP-442 Physical Chemistry II or equivalent) **Class 3, Credit 3 (S, alternate years)**

CHMP-753 **Computational Chemistry**
This course will introduce students to an in-depth investigation into the computational theories and applications used to model complex physical and chemical phenomena. Computational methods are used to provide synergy linking experiment with theory involving such chemical processes as reaction mechanisms, docking, energy transfer and conformational conversions. Predicting spectral and thermodynamic properties of molecular systems and ensembles will also be treated. (Graduate standing or CHMP-442 Physical Chemistry II or equivalent) **Class 2, Lab 3, Credit 3 (F, alternate years)**

CHPO-706 **Polymer Chemistry I**
This course offers an in-depth survey of contemporary chemistry involved in the synthesis of high molecular weight polymers and macromolecules and the relationships between their structure, functionality, and applications. The course focuses on fundamental principles that govern chain structure and statistics, solution behavior, and characterization of polymers. Specific attention is given to recent advances and current issues in the synthesis of polymers, and to controlled architecture and self-assembly of polymers and macromolecules. (Graduate standing or CHMO-332 Comprehensive Organic Chemistry II and CHMP-441 Physical Chemistry I or equivalent) **Class 3, Credit 3 (F)**

CHPO-707 **Polymer Chemistry II**
This course further investigates the contemporary chemistry of high molecular weight polymers and macromolecules and the relationships between their structure, functionality, and utility. The course focuses on fundamental principles that govern swollen gels and soft matter. Mechanisms of the formation of polymers containing heteroatoms in their chains are examined in detail. Specific attention is given to the synthesis of polymers of controlled architecture and self-assembly, and of polymers and macromolecules. Dendrimers, hyper-branched polymers, functional polymers, polymeric reagents, polyelectrolytes, and biopolymers are also discussed. (CHPO-706 Polymer Chemistry I) **Class 3, Credit 3 (S)**

CHPO-708 **Polymer Synthesis and Characterization Lab**
Students will synthesize about eight polymers and characterize them carry by specific methods. In about half of those experiments step-growth polymerizations and in the other half chain-addition polymerizations will be performed. Among the polymers produced will be Nylon 6-10, Nylon 11, polystyrene, high-density polyethylene, linear low density polyethylene, copolymer of styrene and methyl methacrylate and polyurethane. The most specific types of polymerizations and reactions introduced will be cross-linking polymer, interfacial and bulk step-growth polymerizations, cyclopolymerization, radical, ionic and coordinative chain polymerizations. The methods of characterization which will be applied are infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy, end-group determination by titration, thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC), and viscometry. (CHMO-336 Comprehensive Organic Chemistry Lab II and permission of instructor) **Lab 8, Credit 3 (F)**

Mathematics

MATH-601 **Methods of Applied Mathematics**
This course is an introduction to classical techniques used in applied mathematics. Models arising in physics and engineering are introduced. Topics include dimensional analysis, scaling techniques, regular and singular perturbation theory, and calculus of variations. (MATH-221 Multivariable and Vector Calculus, MATH-231 Differential Equations or permission of instructor) **Class 3, Credit 3 (S)**

MATH-603 **Optimization Theory**
This course provides a study of the theory of optimization of linear and nonlinear functions of several variables with or without constraints. The theory is applied to solve problems in business, management, engineering, and the sciences. Algorithms for practical applications will be analyzed and implemented. Students taking this course will be expected to complete applied projects and/or case studies. (MATH-601 Methods of Applied Mathematics or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

MATH-605 **Stochastic Processes**
This course is an introduction to stochastic processes especially those that appear in various applications. It covers basic properties and applications of Poisson processes, and Markov chains in discrete and continuous time. (MATH-241 Linear Algebra and MATH-251 Probability and Statistics I or permission of instructor) **Class 3, Credit 3 (S)**

MATH-611 **Numerical Analysis**
This course covers numerical techniques for the solution of nonlinear equations, interpolation, differentiation, integration, and solution of initial value problems. (Permission of instructor) **Class 3, Credit 3 (F)**

MATH-612 **Numerical Linear Algebra**
This course covers numerical techniques for the solution of systems of linear equations, eigenvalue problems, singular-value and other decompositions, applications to least squares, boundary value problems, and additional topics at the discretion of the instructor. (MATH-611 Numerical Analysis or permission of instructor) **Class 3, Credit 3 (S)**

MATH-621 **Complex Analysis**
This course provides a brief discussion of preliminaries leading to the concept of analyticity. It includes complex integration, Cauchy's integral theorem, integral formulas, Taylor and Laurent series, calculus of residues and its applications, and conformal mappings and their applications. It concludes with the argument principle and Rouche's theorem. (MATH-601 Methods of Applied Mathematics or permission of instructor) **Class 3, Credit 3 (F)**

MATH-631 **Dynamical Systems**
This course is a study of dynamical systems theory. Basic definitions of dynamical systems are followed by a study of maps and time series. Stability theory of solutions of differential equations is studied. Asymptotic behavior of solutions is investigated through limit sets, attractors, Poincare-Bendixson theory, and index theory. The notion of local bifurcation is introduced and investigated. Chaotic systems are studied. (MATH-231 Differential Equations, MATH-241 Linear Algebra, or permission of instructor) **Class 3, Credit 3 (F)**

MATH-641 **Logic, Set Theory, and Computability**
This course studies Peano's axioms for the natural numbers, induction principles, and re-cursive definitions. The topics in set theory include axiomatic set theory and the Cantor-Bernstein theorem. The topics in logic are propositional logic and First-order logic. The section on computability covers formulation of the family of the computable functions and a discussion of the halting problem. (Permission of instructor) **Class 3, Credit 3 (S, alternate years)**

MATH-651 **Combinatorics and Graph Theory I**
This course introduces the fundamental concepts of combinatorics and graph theory. Topics to be studied include counting techniques, generating functions, partitions, the inclusion/exclusion principle, graph isomorphism, network flows, and connectivity in graphs. Applications such as traffic routing and tournaments will be considered. (Permission of instructor) **Class 3, Credit 3 (F)**

MATH-652 **Combinatorics and Graph Theory II**
This course introduces advanced topics in combinatorics and graph theory. Topics to be studied include generating functions, partition theory, Polya-Redfield counting, matchings, graph colorings, Hamiltonian cycles, and planar graphs. Applications such as traffic routing and scheduling problems will be considered. (MATH-651 Combinatorics and Graph Theory I or permission of instructor) **Class 3, Credit 3 (S)**

MATH-655 **Biostatistics**
This course is an introduction to the probabilistic models and statistical techniques used in the analysis of biological and medical data. Topics include univariate and multivariate summary techniques, one and two sample parametric and nonparametric inference, censoring, one and two way analysis of variance, and multiple and logistic regression analysis. (Permission of instructor) **Class 3, Credit 3 (F)**

MATH-671 **Number Theory**
This course is an introduction to the standard results and techniques of number theory. Topics include divisibility, congruences, Diophantine equations, Moebius inversion, quadratic reciprocity, and primitive roots. Cryptography and other applications will be discussed. Projects may be required. (Permission of instructor) **Class 3, Credit 3 (F)**

MATH-695 **Statistical Models for Bioinformatics**
This course will investigate some of the statistical models that have proved useful in analyzing biological information. Examples include Markov models, such as the Jukes-Cantor and Kimura evolutionary models and hidden Markov models, and multivariate models used for discrimination and classification. (Permission of instructor) **Class 3, Credit 3 (S)**

MATH-711 **Advanced Methods in Scientific Computing**
This course examines the use of discrete Fourier transforms, simulation methods, optimization techniques, and number theory algorithms that are employed in modern scientific computing. (MATH-611 Numerical Analysis or permission of instructor) **Class 3, Credit 3 (F)**

MATH-712 **Numerical Methods for Partial Differential Equations**
This is an advanced course in numerical methods that introduces students to computational techniques for solving partial differential equations, especially those arising in applications. Topics include: finite difference methods for hyperbolic, parabolic, and elliptic partial differential equations, consistency, stability and convergence of finite difference schemes. (MATH-611 Numerical Analysis or permission of instructor) **Class 3, Credit 3 (F)**

MATH-731 **Advanced Dynamical Systems**
This course covers an analysis of iterations of maps, symbolic dynamics, their uses, and fractals. It includes methods for simplifying dynamical systems (center manifolds and normal forms), Melnikov's method, and applications. (MATH-631 Dynamical Systems or permission of instructor) **Class 3, Credit 3 (S)**

MATH-741 **Partial Differential Equations I**
This course uses methods of applied mathematics in the solution of problems in physics and engineering. Models such as heat flow and vibrating strings will be formulated from physical principles. Characteristics methods, maximum principles, Green's functions, D'Alembert formulas, weak solutions and distributions will be studied. (MATH-231 Differential Equations or permission of instructor) **Class 3, Credit 3 (F)**

MATH-742 **Partial Differential Equations II**
This is a continuation of Partial Differential Equations I and deals with advanced methods for solving partial differential equations arising in physics and engineering problems. Topics to be covered include second order equations, Cauchy-Kovalevskaya theorem, the method of descent, spherical means, Duhamel's principle, and Green's function in higher dimensions. (MATH-741 Partial Differential Equations I or permission of instructor) **Class 3, Credit 3 (S)**

MATH-761 **Mathematical Biology**
This course introduces areas of biological sciences in which mathematics can be used to capture essential interactions within a system. Different modeling approaches to various biological and physiological phenomena are developed (e.g., population and cell growth, spread of disease, epidemiology, biological fluid dynamics, nutrient transport, biochemical reactions, tumor growth, genetics). The emphasis is on the use of mathematics to unify related concepts. (MATH-601 Methods of Applied Mathematics or permission of instructor) **Class 3, Credit 3 (S)**

MATH-771 **Mathematics of Cryptography**
This course is an introduction to the mathematical problems and techniques that serve as a foundation for modern cryptosystems. The topics include: classical cryptosystems computational number theory, primality tests, finite fields, private and public key encryption schemes (RSA, El-Gamal), and applications such as digital signatures, one way functions, and zero knowledge proofs. Use of elliptic curves in cryptography will also be covered. (MATH-371 Number Theory or MATH-671 Number Theory or permission of instructor) **Class 3, Credit 3 (F)**

MATH-781 **Wavelets and Applications**
A mathematical introduction to the theory and applications of orthogonal wavelets and their use in analyzing functions and function spaces is provided. Topics include a brief survey of Fourier series representation of functions, Fourier transform and the Fast Fourier Transform (FFT) before proceeding to the Haar wavelet system, multiresolution analysis, decomposition and reconstruction of functions, Daubechies wavelet construction, and other wavelet systems. Applications such as data compression, noise reduction and image processing will be studied. (MATH-611 Numerical Analysis or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

MATH-789 **Special Topics**
This is a master-level course on a topic that is not part of the formal curriculum. This course is structured as an ordinary course and has specific prerequisites, contact hours, and examination procedures. (Permission of instructor) **Class 1–6, Credit 1–6 (F, S, Su)**

MATH-790 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor.) **Credit 1–6 (F, S, Su)**

MATH-799 **Independent Study**
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for a masters-level student. (Permission of instructor) **Class 1–6, Credit 1–6 (F, S, Su)**

Materials Science & Engineering

MTSE-601 **Materials Science**
This course provides an understanding of the relationship between structure and properties necessary for the development of new materials. Topics include atomic and crystal structure, crystalline defects, diffusion, theories, strengthening mechanisms, ferrous alloys, cast irons, structure of ceramics and polymeric materials and corrosion principles. Term paper on materials topic. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

MTSE-617 **Material Degradation**
This course introduces the basic electrochemical nature of corrosion and considers the various factors that influence the rate of corrosion in a variety of environments. Various means of controlling corrosion are considered with demonstrations. (Graduate standing or Permission of Instructor) **Class 3, Credit 3 (F)**

MTSE-660 **Plasma Science**
This course is an introduction to plasma science. Phenomena and application of plasma to etching, deposition, polymerization, plasma production of materials, and atmospheric science will be discussed. Various methods for plasma surface modification of materials with relevance to adhesion and characterization will also be covered. (Graduate Standing or Permission of Instructor) **Class 3, Credit 3 (S)**

MTSE-699 **Materials Science Graduate Co-op**
This course is a cooperative education experience for materials science and engineering masters-level students. (Permission of instructor) **Credit 0 (F, S, Su)**

MTSE-702 **Polymer Science**
This course is an introduction to the chemistry and physics of synthetic polymers, which include plastics, elastomers and fibers. The synthesis of polymers, their fundamental properties, and the relations between their syntheses, structure, and properties will be studied. Among the topics discussed are the morphology, thermal behavior, solubility, viscoelasticity and characterization of polymers. Copolymerization, tacticity and sustainability of polymers will also be covered. (Graduate standing or permission of instructor) **Class 3, Credit 3 (S)**

MTSE-703 **Solid State Science**
This course provides a survey of topics in the physics of solids. It will include crystal symmetry, and structure and binding. It will also address the mechanical, thermal, and electrical properties of insulators, semiconductors, and conductors as well as band theory. (Graduate standing or permission of instructor) **Class 3, Credit 3 (S)**

MTSE-704 **Theoretical Methods in Materials Science and Engineering**
This course includes the treatment of vector analysis, special functions, waves, and fields; Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac distributions, and their applications. Selected topics of interest in electrodynamics, fluid mechanics, and statistical mechanics will also be discussed. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

MTSE-705 **Experimental Techniques**
The course will introduce the students to laboratory equipment for hardness testing, impact testing, tensile testing, X-ray diffraction, SEM, and thermal treatment of metallic materials. Experiments illustrating the characterization of high molecular weight organic polymers will be performed. (Graduate standing and permission of instructor) Lab 6, Credit 3 **(S)**

MTSE-777 **Graduate Project**
This course is a capstone project using research facilities available inside or outside of RIT. (Graduate standing and permission of instructor) **Credit 1–4, (F, S, Su)**

MTSE-780 **Theory of Microsensors and Actuators**
This course introduces the theory and development of sensors at the molecular and ionic levels. Mechanism details for operation of the sensors and actuators will be discussed. Fundamental aspects related to chemical, biochemical, piezoresistive, magnetic, thermal, and luminescent sensors will be discussed with an emphasis on the development of innovative products. Control systems based on ion selectivity for biomedical applications will be covered in detail. Neurotransmitters, neural network, and directional selectivity using conducting polymers will also be covered. (Graduate standing and permission of instructor) **Class 3, Credit 3 (S)**

MTSE-789 **Graduate Special Topics**
This is a master-level course on a topic that is not part of the formal curriculum. This course is structured as an ordinary course and has specific prerequisites, contact hours, and examination procedures. (Permission of instructor) **Credit 1–4 (F, S)**

MTSE-790 **Research and Thesis**
Dissertation research by the candidate for an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor) **Credit 1**-9 **(F, S, Su)**

MTSE-791 **Seminar**
This seminar course is designed to develop the ability to assimilate useful information while increasing a student's breadth and depth of knowledge of materials science and engineering research topics. This seminar requires the students to attend weekly seminars and present a seminar summarizing their thesis research at RIT which serves as the public portion of their thesis defense. (Graduate Standing and Permission of Instructor) **Class 1, Credit 1 (S)**

MTSE-792 **External Research**
Research conducted off-site by the candidate for an appropriate topic as arranged between the student, the RIT advisor, and the off-site research mentor. (Permission of instructor) **Credit 1–4 (F, S, Su)**

MTSE-799 **Independent Study**
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for a masters-level student. (Permission of instructor) **Credit 1–4**

Color Science

CLRS-700 **Colorimetry**
This course covers the principles of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, color order systems, color measurement including spectral and multi-channel, color rendering, metamerism, color inconstancy, history and theory of color difference formulas and spaces, and color signal processing for color management. **Class 3, Credit 3 (F)**

CLRS-710 **Colorimetry Lab**
This laboratory course accompanies Colorimetry and teaches the proper use and data interpretation of color measuring instrumentation including spectroradiometers, spectrophotometers, multi-angle spectrophotometers, and glossmeters. Also included is the use and analysis of a color managed color reproduction system. (Co-requisites: CLRS-700-Colorimetry) **Lab 3, Credit 1 (F)**

CLRS-711 **Material Appearance Lab**
This course is the second part of a two-course sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing, and advanced programming techniques. Topics include the instrumentation and standardization required for high quality optical radiation measurements, analysis techniques for determining the accuracy and precision of those measurements, the optical properties of objects and radiation, optical and electronic design of spectroradiometric and spectrophotometric instrumentation, the use of standard reference materials for calibration, and evaluation of instrumentation, all in support of the analysis of material appearance. (CLRS-700-Colorimetry, CLRS-710-Colorimetry Lab) **Class 1, Lab 3, Credit 2 (S)**

CLRS-720 **Computational Vision Science**
This course provides an introduction to modern computer-based methods for the measurement and modeling of human vision. Lectures will introduce the experimental techniques of visual psychophysics including threshold measurement, psychometric functions, signal detection theory, and indirect, direct, and multidimensional scaling. Lectures will also introduce the MATLAB technical computing environment and will teach how to use MATLAB to run computer-based psychophysical experiments and to analyze experimental data and visualize results. Laboratory exercises will provide practical experience in using computer-based tools to conduct psychophysical experiments and to develop computational models of the results. Prior experience in vision science and/or scientific computing will be helpful but is not required. (Graduate student standing in the Color Science or Imaging Science programs or permission of the instructor) **Class 3, Credit 3 (F)**

CLRS-750 **Historical Research Perspectives**
Historical Research Perspectives is a weekly forum in which students will learn about historical and classic topics in color science. The course focuses on journal club discussions of papers selected by the students and faculty. It also includes oral presentations from students, laboratory staff, and faculty as well as visiting speakers from within and external to RIT. Students will prepare their own oral presentations and written assignments based on the course readings and independent research. Students will develop professional skills required for formal scientific presentations and writing. **Class 1, Credit 1 (F)**

CLRS-751 **Research and Publication Methods**
This course is a weekly forum in which students will learn about current research topics in color science. The course focuses on journal club discussions of papers selected by the students and faculty. It also includes oral presentations from students, laboratory staff, and faculty as well as visiting speakers from within and external to RIT. Students will prepare their own oral presentations and written assignments based on the course readings and independent research. Students will further develop professional skills required for formal scientific presentations and writing. A draft thesis or dissertation proposal will also be prepared. (CLRS-750 Historical Research Perspectives) **Class 2, Credit 2 (S)**

CLRS-790 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor.) **Credit variable (F, S, Su)**

CLRS-800 **Color Systems Engineering**
This course explores mathematical techniques for predicting the spectral and colorimetric properties of colored materials and images from user-controlled drive signals. Color systems that are modeled include paint, computer-controlled LCD and projector, continuous and halftone printing, and spectral cameras. Accompanying laboratory stresses the use of multivariate statistics, nonlinear optimization, and technical writing. Final laboratory consists of spectral-based color reproduction system including input, display, and printed output. (CLRS-700-Colorimetry, CLRS-710 Colorimetry Lab, CLRS-720 Computational Vision Science) **Class 2, Lab 3, Credit 3 (S)**

CLRS-820 **Modeling Visual Perception**
This course presents the transition from the measurement of color matches and differences to the description and measurement of color appearance in complex visual stimuli. This seminar course is based mainly on review and student-led discussion of primary references. Topics include: appearance terminology, appearance phenomena, viewing conditions, chromatic adaptation, color appearance modeling, image appearance, image quality, and material appearance. (CLRS-700 Colorimetry, CLRS-710 Colorimetry Lab, CLRS-720 Computational Psychophysics, IMGS-620 Human Visual System) **Class 3, Credit 3 (S)**

CLRS-850 **Material Appearance Seminar**
This seminar course provides a forum in which students, faculty, and researchers with an interest in the interdisciplinary field of Material Appearance can interact through reading, presentation, and discussion of classic texts and contemporary research papers in the field. Subject matter will change from semester to semester but may include material appearance measurement, modeling, rendering, perception, and applications. Students will read and summarize weekly readings in writing and will periodically prepare presentations and lead discussions (Permission of instructor) **Class 1, Credit 1 (F, S)**

CLRS-890 **Research and Thesis**
PhD-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor) **Credit variable (F, S, Su)**

Imaging Science

IMGS-606 **Graduate Seminar I**
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course also addresses issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. (Graduate standing in Imaging Science) **Class 1, Credit 1 (F)**

IMGS-607 **Graduate Seminar II**
This course is a continuation of the topics addressed in the preceding course Imaging Science Graduate Seminar I. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course addresses issues and practices associated with technical presentations. Credits earned in this course apply to research requirements. (IMGS-606 Graduate Seminar II) **Class 1, Credit 1 (S)**

IMGS-609 **Graduate Laboratory I**
This laboratory course is intended to familiarize students with the concepts considered in the required Radiometry course. Students work with a variety of radiometry hardware in a laboratory to perform measurements and experiments in topics such as radiation detection and propagation, source and instrument calibration, and calibration and use of a camera as a radiometer. (Graduate standing in Imaging Science, Co-requisite: IMGS-619 Radiometry) **Lab 3, Credit 1 (F)**

IMGS-610 **Graduate Laboratory II**
This laboratory course is intended to familiarize students with the concepts considered in the required Optics and Digital Image Processing courses. Students work with a variety of optical hardware in a laboratory to perform measurements and experiments in topics such as ray tracing, diffraction, optical filtering, polarization, interferometry, and holography. (Co-requisites: IMGS-633 Optics for Imaging, IMGS-682 Digital Image Processing) **Lab 3, Credit 1 (S)**

IMGS-613 **Probability, Noise, and System Modeling**
This course develops models of noise and random processes within the context of imaging systems. The focus will be on stationary random processes in both one dimension (time) and two dimensions (spatial). Power spectrum estimation will be developed and applied to signal characterization in the frequency domain. The effect of linear filtering will be modeled and applied to signal detection and maximization of SNR. The matched filter and the Wiener filter will be developed. Signal detection and amplification will be modeled, using noise figure and SNR as measures of system quality. At completion of the course, the student should have the ability to model signals and noise within imaging systems. (IMGS-616 Fourier Methods for Imaging and IMGS-619 Radiometry; or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-616 Fourier Methods for Imaging
This course develops the mathematical methods required to describe continuous and discrete linear systems, with special emphasis on tasks required in the analysis or synthesis of imaging systems. The classification of systems as linear/nonlinear and shift variant/invariant, development and use of the convolution integral, Fourier methods as applied to the analysis of linear systems. The physical meaning and interpretation of transform methods are emphasized. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-619 Radiometry
This course is focused on the fundamentals of radiation propagation as it relates to making quantitative measurements with imaging systems. The course includes an introduction to common radiometric terms and derivation of governing equations with an emphasis on radiation propagation in both non-intervening and turbid media. The course also includes an introduction to detector figures of merit and noise concepts. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-620 The Human Visual System
This course describes the underlying structure of the human visual system, the performance of those structures and the system as a whole, and introduces psychophysical techniques used to measure them. The visual system's optical and neural systems responsible for collecting and detecting spatial, temporal, and spectral signals from the environment are described. The sources and extent of limitations in the subsystems are described and discussed in terms of the enabling limitations that allow practical imaging systems. (Graduate status in Center for Imaging Science or permission of Instructor) **Class 3, Credit 3 (F)**

IMGS-633 Optics for Imaging
This course provides the requisite knowledge in optics needed by a student in the graduate program in Imaging Science. The topics covered include the ray and wave models of light, diffraction, imaging system resolution. (IMGS-616 Fourier Methods for Imaging and IMGS-619 Radiometry) **Class 3, Credit 3 (S)**

IMGS-661 Multiwavelength Astronomical Imaging
This course is a survey of multiwavelength astronomical observing techniques and instrumentation. Students will gain an understanding of how the telescopes, detectors, and instrumentation in the major ground-based and space-based observatories function and how to use them. Observatories to be studied include the Very Large Array, GBT, ALMA, Spitzer, HST, Gemini, JWST, and Chandra. Students will plan and carry out a multiwavelength archival program on a topic of their choice. (PHYS-213 or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-682 Digital Image Processing
This course will cover a wide range of current topics in modern still digital image processing. Topics will include grey scale and color image formation, color space representation of images, image geometry, image registration and resampling, image contrast manipulations, image fusion and data combining, point spatial and neighborhood operations, image watermarking and steganography, image compression, spectral data compression, image segmentation and classification, and basic morphological operators. Projects will involve advanced computational implementations of selected topics from the current literature in a high level language such as Matlab or IDL and will be summarized by the students in written technical papers. (IMGS-616 Fourier Methods for Imaging) **Class 3, Credit 3 (S)**

IMGS-699 Imaging Science Co-op
This course is a cooperative education experience for graduate imaging science students. (Permission of instructor) **Credit 0 (F, S, Su)**

IMGS-722 Remote Sensing: Systems, Sensors, and Radiometric Image Analysis
This course introduces the governing equations for radiance reaching an aerial or satellite based imaging systems. The course also covers the properties of these imaging systems with an emphasis on their use as quantitative scientific instruments. It also includes a treatment of methods to invert the remotely sensed image data to measurements of the Earth's surface (e.g. reflectance and temperature) through various means of inverting the governing radiometric equation. The emphasis is on multidimensional image analysis (e.g., multispectral, polarimetric, and multidate) and includes issues such as image registration to support image analysis. Based on the previous treatment, the parameters and processes governing spatial, spectral, and radiometric image fidelity are studied with an emphasis on how each step in the image chain impacts the final image or image product. (IMGS-619 Radiometry or permission of instructor) **Class 3, Credit 3 (S)**

IMGS-723 Remote Sensing: Spectral Image Analysis
This course is focused on analysis of high-dimensional remotely sensed data sets. It begins with a review of the properties of matter that control the spectral nature of reflected and emitted energy. It then introduces three mathematical ways to characterize spectral data and methods to perform initial analysis of spectral data to characterize and preprocess the data. These include noise characterization and mitigation, radiometric calibration, atmospheric compensation, dimensionality characterization, and reduction. Much of the course focuses on spectral image analysis algorithms employing the three conceptual approaches to characterizing the data. These analytical tools are aimed at segmentation, subpixel or pixel unmixing approaches and target detection including treatment of signal processing theory and application. There is also a significant emphasis on incorporation of physics based algorithms into spectral image analysis. The course concludes with an end-to-end treatment of image fidelity incorporating atmospheres, sensors, and image processing effects. (IMGS-619 Radiometry and IMGS-722 RS: Systems, Sensors, and Radiometric Image Analysis, or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-724 Introduction to Electron Microscopy
The course will introduce the basic concepts and practice of electron microscopy, including transmission electron microscopy (TEM), scanning electron microscopy (SEM) and x-ray microanalysis. During the second half of the course students will do an 8-10 hour hands-on project in SEM or TEM or both, including a project paper and a poster presentation. Laboratory demonstrations will be held in the NanoImaging Lab to reinforce the lecture material. (Graduate student standing in science or engineering, or permission of instructor.) **Class 3, Credit 3 (F, alternating years)**

IMGS-728 Design and Fabrication of Solid State Camera
The purpose of this course is to provide the student with hands-on experience in building a CCD camera. The course provides the basics of CCD operation including an overview, CCD clocking, analog output circuitry, cooling, and evaluation criteria. (Graduate status in Imaging Science or by permission of instructor) **Class 1, Lab 6, Credit 3 (F)**

IMGS-729 Photogrammetry for Airborne and Space Systems
This course will introduce the fundamentals essential to describing photogrammetry and its uses for deriving point positions, 3-D coordinates, digital elevation models, image maps, and topographic maps from airborne or spaceborne imaging systems. It will cover the geometry of film and digital cameras, calibration of cameras, image measurements, and refinements such as atmospheric refraction, distortion corrections, image measurements, and transformation of coordinates. The geometry of the single photo will be utilized to develop the general solution to the problem of photogrammetry. Derivation and use of the collinearity equations will be emphasized to demonstrate their applicability to ground-surveyed coordinates, global positioning system (GPS), and inertial management units (IMUs) for positioning and orientation of the camera images for aerial triangulation and least squares adjustments. Other selected topics are light planning for mapping projects, object space coordinate systems, map accuracy standards, and estimating errors in the system outputs. (IMGS-616 Fourier Methods for Imaging) **Class 3, Credit 3 (F)**

IMGS-730 Magnetic Resonance Imaging
This course is designed to teach the principles of the imaging technique called magnetic resonance imaging (MRI). The course covers spin physics, Fourier transforms, basic imaging principles, Fourier imaging, imaging hardware, imaging techniques, image processing, image artifacts, safety, and advanced imaging techniques. (Graduate standing, or CHMA-221 Instrumental Analysis, MATH-219 Multivariable Calculus, and one year of College Physics or equivalent) **Class 3, Credit 3 (F)**

IMGS-731 Ultrasound Imaging
This course is an overview of the physics and signal processing principles of ultrasound as applied to the different medical imaging modalities such as B-mode, M-mode, Doppler, and 3D imaging. Tissue characterization methods are introduced. (IMGS-616 Fourier Methods for Imaging and IMGS-682 Digital Image Processing, or permission of instructor) **Class 3, Credit 3 (F, alternating years)**

IMGS-732 Advanced Environmental Applications of Remote Sensing
This course will focus on a broader selection of analytical techniques with an application-centric presentation. These techniques include narrow-band indices, filtering in the spatial and frequency domains, principal component analysis, textural analysis, hybrid and object-oriented classifiers, change detection methods, and structural analysis. All of these techniques are applied to assessment of natural resources. Sensing modalities include imaging spectroscopy (hyperspectral), multispectral, and light detection and ranging (lidar) sensors. Applications such as vegetation stress assessment, foliar biochemistry, advanced image classification for land use purposes, detecting change between image scenes, and assessing topography and structure in forestry and grassland ecosystems (volume, biomass, biodiversity) and built environments will be examined. Real-world remote sensing and field data from international, US, and local sources are used throughout this course. Students will be expected to perform a more comprehensive final project and homework assignments, including literature review and discussion and interpretation of results. (IMGS-431 Environmental Applications of Remote Sensing, PHYS-112 College Physics II, or permission of instructor) **Class 2, Lab 3, Credit 3 (S)**

IMGS-733 Medical Imaging Systems
This course is an introduction to the physics, instrumentation, and signal processing methods used in different imaging modalities such as X-ray CT, MRI, PET/SPECT and ultrasound. (IMGS-616 Fourier Methods for Imaging and IMGS-682 Digital Image Processing, or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

IMGS-737 **Physical Optics**
This course covers the wave properties of light, its interaction with matter, and the application of these principles to imaging systems. Topics include polarization of light, birefringence, interference and interferometers, spatial and temporal coherence, and scalar diffraction theory. (IMGS-633 Optics for Imaging or permission of instructor) **Class 2, Lab 3, Credit 3 (S)**

IMGS-739 **Principles of Solid State Imaging**
This course covers the basics of solid state physics, electrical engineering, linear systems and imaging needed to understand modern focal plane array design and use. The course emphasizes knowledge of the working of CMOS and infrared arrays. (Graduate status in Imaging Science or by permission of instructor) **Class 3, Credit 3 (F)**

IMGS-742 **Testing of Focal Plane Arrays**
This course is an introduction to the techniques used for the testing of solid state imaging detectors such as CCDs, CMOS and Infrared Arrays. Focal plane array users in industry, government and university need to ensure that key operating parameters for such devices either fall within an operating range or that the limitation to the performance is understood. This is a hands-on course where the students will measure the performance parameters of a particular camera in detail. (Graduate status in Imaging Science or by permission of instructor) **Class 1, Lab 6, Credit 3 (S)**

IMGS-754 **Pattern Recognition**
This course develops a fundamental understanding of adaptive pattern recognition and a basic working knowledge of techniques for use in a broad range of applications. Inherent in adaptive pattern recognition is the ability of the system to learn by supervised or unsupervised training, or by competition within a changing environment. The effectiveness of the system depends upon its structure, adaptive properties, and specifics of the application. Particular structures developed and analyzed include Bayes decision theory, parametric and non-parametric techniques, multilayer perceptrons, and unsupervised clustering methods. The goal is to gain both a fundamental and working knowledge of each kind of technique and the ability to select the most appropriate one when faced with a real application design. (IMGS-613 Probability, Noise, and System Modeling or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

IMGS-756 **Advanced Digital Image Processing**
This course investigates algorithms and techniques for a variety of imaging applications. The techniques build on the background from IMGS-682. The course is taught using a lecture and group project format, in which the lectures focus on advanced techniques and provide applications of their use in selected applications. The group projects enable students to work on substantial designs that require the understanding of the task domain, exploration of solution methods by analysis and prototyping, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration. (IMGS-682 Digital Image Processing or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

IMGS-766 **Geometrical Optics and Lens Design**
This course leads to a thorough understanding of the geometrical properties of optical imaging systems and detailed procedures for designing any major lens system. Automatic lens design, merit functions, and optimization are applied to real design problems. The course will utilize a modern optical design program and examples carried out on a number of types of lenses to illustrate how the process of design is carried out. (IMGS-633 Optics for Imaging or permission of instructor) **Class 2, Lab 2, Credit 3 (F)**

IMGS-790 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor) **Credit 1–6 (F, S, Su)**

IMGS-797 **Principles of Computed Tomographic Imaging**
Image construction from projections is introduced as a mathematical problem in this course. Techniques for image construction are explained using the Fourier slice theorem. Pure and filtered back-projection and iterative methods are introduced and analyzed. Algorithms for various techniques are developed. Artifacts and noise in discrete cases are considered. Applications to several medical imaging modalities (x-ray CT, PET, SPECT, MRI) are outlined with consideration of the physics involved in each case. (IMGS-616 Fourier Methods for Imaging or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

IMGS-799 **Imaging Science Independent Study**
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for student in their graduate studies. (Permission of instructor) **Class variable, Credit 1–4 (F, S, Su)**

IMGS-830 **Advanced Topics in Remote Sensing**
This course is an in-depth examination of emerging techniques and technologies in the field of remote sensing at an advanced level. Examples of topics, which will differ each semester, are typically formed around a specific remote sensing modality such as lidar, polarimetry, radar, and hyperspectral remote sensing. (IMGS-723 Remote Sensing: Spectral Image Analysis or permission of instructor) **Class 3, Credit 3 (S)**

IMGS-890 **Research and Thesis**
PhD-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor) **Credit 1–6 (F, S, Su)**

Astrophysical Sciences and Technology

ASTP-601 **Graduate Seminar I**
This course is the first in a two-semester sequence intended to familiarize students with research activities, practices, and ethics in the university research environment and to introduce students to commonly used research tools. As part of the course, students are expected to attend research seminars sponsored by the Astrophysical Sciences and Technology Program and participate in a weekly journal club. The course also provides training in scientific writing and presentation skills. Credits earned in this course apply to research requirements. (Graduate standing in the Astrophysical Sciences and Technology program.) **Class 2, Credit 1 (F)**

ASTP-602 **Graduate Seminar II**
This course is the second in a two-semester sequence intended to familiarize students with research activities, practices, and ethics in the university research environment and to introduce students to commonly used research tools. As part of the course, students are expected to attend research seminars sponsored by the Astrophysical Sciences and Technology Program and participate in a weekly journal club. The course also provides training in scientific writing and presentation skills. Credits earned in this course apply to research requirements. (Graduate standing in the Astrophysical Sciences and Technology program.) **Class 2, Credit 1 (S)**

ASTP-610 **Mathematical Methods for the Astrophysical Sciences**
This course is a stand-alone course on mathematical methods for astrophysics covering tensor algebra, group theory, complex analysis, differential equations, special functions, integral transforms, the calculus of variations, and chaos. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

ASTP-611 **Statistical Methods for Astrophysics**
This course provides an introduction to the statistical techniques used in astrophysics and other observational sciences, including parameter estimation, hypothesis testing, and statistical signal processing. An introduction is given to both Bayesian and frequentist approaches. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor.) **Class 3, Credit 3 (S, alternate years)**

ASTP-613 **Astronomical Observational Techniques and Instrumentation**
This course will survey multi-wavelength astronomical observing techniques and instrumentation. The design characteristics and function of telescopes, detectors, and instrumentation in use at the major ground based and space based observatories will be discussed as will common observing techniques such as imaging, photometry and spectroscopy. The principles of cosmic ray, neutrino, and gravitational wave astronomy will also be briefly reviewed. Students will plan and carry out a multi-wavelength archival program on a topic of their choice. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor.) **Class 3, Credit 3 (F)**

ASTP-615 **Radiative Processes for Astrophysical Sciences**
This course will cover classical continuum radiation emission mechanisms that commonly occur in astrophysical environments. Topics will include properties of astrophysical radiation, radiative transfer, blackbody radiation, radiation from moving charges, Bremstrahlung, Synchrotron, and inverse Compton radiation. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor.) **Class 3, Credit 3 (S)**

ASTP-617 **Astrophysical Dynamics**
This course provides an introduction to advanced classical dynamics starting from an action principle, and its applications to astrophysical systems. Topics include Lagrangian and Hamiltonian mechanics, the two-body system, perturbation theory applied to Keplerian orbits, motion near black holes and the many-body problem. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor.) **Class 3, Credit 3 (F)**

ASTP-720 Computational Methods for Astrophysics
This course surveys the different ways that scientists use computers to address problems in astrophysics. The course will choose several common problems in astrophysics; for each one, it will provide an introduction to the problem, review the literature for recent examples, and illustrate the basic mathematical technique. In each of these segments, students will write their own code in an appropriate language. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

ASTP-730 Stellar Structure and Atmospheres
An overview of the physical principles governing the internal structures and energy generation mechanisms of main sequence stars, with brief introductions to pre- and post-main sequence stellar evolution. Topics covered include: observational aspects of main sequence stars, giants, and white dwarfs; stellar timescales and equations of state; static stellar structure; stellar energy generation and transport; simple stellar atmospheres. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor; corequisite: ASTP-615 Radiative Processes for Astrophysical Sciences or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

ASTP-740 Galactic Astrophysics
This course will cover stellar and galactic dynamics with special application to the Milky Way galaxy. Topics will include theory of orbits; Jeans theorem and equilibrium of stellar systems; the virial theorem; the Jeans equations; gravitational instabilities; structure and kinematics of the Milky Way; properties of spiral and elliptical galaxies. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor; Co-requisite: ASTP-617 Astrophysical Dynamics or permission of instructor.) **Class 3, Credit 3 (F, alternate years)**

ASTP-750 Extragalactic Astrophysics
This course will cover objects in the universe beyond our own Milky Way galaxy, with an emphasis on the observational evidence. Topics will include properties of ordinary and active galaxies; galaxy clusters; the extragalactic distance scale; evidence for dark matter; cosmological models with and without lambda. (ASTP-740 Galactic Astrophysics or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

ASTP-760 Introduction to Relativity and Gravitation
This course is the first in a two-course sequence that introduces Einstein's theory of General Relativity as a tool in modern astrophysics. The course will cover various aspects of both Special and General Relativity, with applications to situations in which strong gravitational fields play a critical role, such as black holes and gravitational radiation. Topics include differential geometry, curved spacetime, gravitational waves, and the Schwarzschild black hole. (Prerequisite: Graduate standing in Astrophysical Sciences and Technology or permission of instructor; Co-requisite: ASTP-617 Astrophysical Dynamics or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

ASTP-789 Special Topics
This is a masters-level course on topics of current interest in astrophysics and/or related technologies that are not covered by the formal curriculum. Course offerings and topics will be announced by the Program Director. This course is structured as an ordinary course and may have specific prerequisites, contact hours, and examination procedures. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor) **Credit 1–3**

ASTP-790 Research and Thesis
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor) **Credit 1–6 (F, S, Su)**

ASTP-799 AST Independent Study
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for graduate studies leading to MS or Ph.D. (Permission of instructor) **Credit 1–3**

ASTP-831 Stellar Evolution and Environments
A survey of contemporary topics in star formation and pre- and post-main sequence stellar evolution, with emphasis on the physical processes governing stellar accretion, mass loss, and the effects of binary companions on these processes. (ASTP-730 Stellar Structure **and** Atmospheres or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

ASTP-835 High-Energy Astrophysics
This course will survey violent astrophysical phenomena including supernovae, compact stellar remnants, X-ray binaries, gamma ray bursts, and supermassive black holes in active galactic nuclei. It will examine physical processes associated with the emission of high-energy radiation, production of high-energy particles, accretion discs around compact objects, and production and propagation of astrophysical jets. It will review current models for the sources of high-energy phenomena. (ASTP-615 Radiative Processes for Astrophysical Sciences or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

ASTP-841 The Interstellar Medium
This course provides a detailed overview of the physical processes and properties of the interstellar medium in our Galaxy and other galaxies. This course explores the fundamental physical basis of the observed properties of low-density astrophysical gases observed throughout the universe. Topics may include HII regions, planetary nebulae, HI clouds, molecular clouds, photodissociation regions, supernova remnants, and multi-phase models of the interstellar medium. (ASTP-615 Radiative Processes for Astrophysical Sciences or permission of instructor) **Class 3, Credit 3 (F, alternate years)**

ASTP-851 Cosmology
This course will cover the evolution of the universe from the big bang to the present, with an emphasis on the synergy between theory and observations. Topics will fall under three general headings: classical and relativistic cosmology, the early universe, and structure formation. (ASTP-617 Astrophysical Dynamics or permission of instructor; Co-requisites: ASTP-750 Extragalactic Astrophysics or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

ASTP-861 Advanced Relativity and Gravitation
This course is the second in a two-course sequence that introduces Einstein's theory of General Relativity as a tool in modern astrophysics. The course will cover various aspects of General Relativity, with applications to situations in which strong gravitational fields play a critical role, such as black holes and gravitational radiation. Topics include advanced differential geometry, generic black holes, energy production in black-hole physics, black-hole dynamics, introductory cosmology, and methods for solving the Einstein equations. (ASTP-760 Introduction to Relativity and Gravitation; corequisites: PHYS-612 Classical Electrodynamics II, ASTP-610 Mathematical Methods for the Astrophysical Sciences) **Class 3, Credit 3 (S, alternate years)**

ASTP-889 Special Topics
This is a PhD-level course on topics of current interest in astrophysics and/or related technologies that are not covered by the formal curriculum. Course offerings and topics will be announced by the Program Director. This course is structured as an ordinary course and has specific prerequisites, contact hours, and examination procedures. (Graduate standing in Astrophysical Sciences and Technology or permission of instructor) **Credit 1–3**

ASTP-890 Research and Thesis
Dissertation research by the candidate for an appropriate topic as arranged between the candidate and the research advisor. (Permission of instructor.) **Credit 1–6 (F, S, Su)**

ASTP-899 AST Independent Study
This course is a faculty-directed tutorial of appropriate topics that are not part of the formal curriculum. The level of study is appropriate for a PhD-level student. (Permission of instructor) **Credit 1–3**

Physics

PHYS-611 Classical Electrodynamics I
This course is a systematic treatment of electro- and magneto-statics, charges, currents, fields and potentials, dielectrics and magnetic materials, Maxwell's equations and electromagnetic waves. Field theory is treated in terms of scalar and vector potentials. Wave solutions of Maxwell's equations, the behavior of electromagnetic waves at interfaces, guided electromagnetic waves, and simple radiating systems will be covered. (PHYS-412 Advance Electricity and Magnetism or equivalent) **Class 3, Credit 3 (F)**

PHYS-612 Classical Electrodynamics II
This course is an advanced treatment of electrodynamics and radiation. Classical scattering theory including Mie scattering, Rayleigh scattering, and the Born approximation will be covered. Relativistic electrodynamics will be applied to charged particles in electromagnetic fields and magnetohydrodynamics. (PHYS-611 Classical Electrodynamics I) **Class 3, Credit 3 (S)**

Golisano Institute for Sustainability

Nabil Nasr, Assistant Provost and Institute Director
www.sustainability.rit.edu/

Programs of study

This bulletin reflects curriculum for the 2012-13 academic year. Beginning in the fall of 2013, RIT will convert from three 10-week quarters to two 16-week semesters. For students enrolled in multi-year programs that will extend beyond the 2012-13 academic year, graduate program advisers will provide assistance with planning and course selection throughout the transition to semesters. Every program in this bulletin includes charts that illustrate the typical course sequence for all programs in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

The Golisano Institute for Sustainability is a comprehensive academic, training, and technology-transfer center focusing on multidisciplinary studies in sustainability and sustainable production systems.

The institute offers expertise in the areas of sustainable development and design combining real world experience with a strong academic and research programs. Focus areas of include sustainable production, sustainable mobility, alternative energy systems, and eco-IT.

Admission requirements

The college offering the program makes all decisions on graduate admission. Please refer to each individual program for information regarding specific admission criteria. For general graduate admission information, please refer to the Admission section of this bulletin.

Financial aid and scholarships

Please refer to the Financial Aid and Scholarship section of this bulletin for information regarding financial aid, scholarships, grants, loans, and graduate assistantships.

Research

The Golisano Institute for Sustainability is home to six different research centers and institutes, each with a highly specific mission in sustainability.

- National Center for Remanufacturing and Resource Recovery is internationally recognized as a leading center for applied research in remanufacturing.
- Center for Sustainable Production is dedicated to enhancing the environmental and economic performance of products and processes.
- Center for Sustainable Mobility assesses and evaluates the environmental and economic impact of different alternative fuel and propulsion technologies on the entire U.S. public transportation system.
- Systems Modernization and Sustainment Center develops technology for optimal life-cycle design, management, and modernization of large equipment systems.
- New York State Pollution Prevention Institute enhances the understanding of pollution prevention techniques while disseminating technologies to enhance these efforts.
- NanoPower Research Labs is dedicated to the creation and utilization of nano devices and materials for power generation and storage.

Facilities

The institute is housed in a 170,000-square-foot facility that provides easy access to six large manufacturing bays and 21 specialized labs featuring state-of-the-art equipment. Labs and facilities include:

- *Reliability Lab:* Focuses on testing the durability and reliability of components with the goal of enhancing the quality and performance of the entire system;
- *Materials Engineering Lab:* Provides analysis of how the physical and mechanical properties of components meet desired design characteristics;
- *Systems Performance and Reliability Lab:* Focuses on researching the life cycles of components and systems to properly understand and predict aging and wear while utilizing this data to enhance overall performance;
- *Integrated Diagnostics and Prognostics Lab:* Used to develop components, software, and integrated systems for the evaluation and implementation of diagnostics technology for in-the-field environments;
- *Imaging Products Laboratory:* Provides state-of-the-art evaluation and research to enhance the sustainability of imaging products and systems through improved testing procedures and the utilization of sustainable design capabilities;
- *Rapid Reverse Engineering Lab:* Equipped with instruments to accurately reconstruct missing product information to enable new production, improve design, and enhance opportunities for remanufacturing and reuse;
- *Clean Technologies Demonstration Facility:* Features a wide variety of cleaning machines utilized for alternative cleaning testing and demonstration. Engineers utilize the equipment to develop and implement technologies that will prevent pollution and reduce costs to companies; and

- *Vehicle Integration Facility:* Features equipment related to the integration of sustainable design technologies into vehicle systems and includes equipment related to life cycle engineering, material restoration, and accelerated aging.

Sustainability, Ph.D.

http://www.rit.edu/gis/academics/ph.d-sustainability/

Program overview

The doctorate program in sustainability is the first program in the world to focus on sustainable production systems. The program seeks to advance research and education in alternative-energy development, sustainable production, sustainable mobility, and eco-IT.

The program's curriculum emphasizes sustainable production systems, which create goods and services using processes that are non-polluting; conserving of energy and natural resources; economically viable; and safe for workers, communities, and consumers. Course work and research take a systems level and interdisciplinary approach to solving seemingly intractable sustainability problems.

Students in the program have the opportunity to work with multidisciplinary faculty and researchers in numerous research centers, including the institute's National Center for Remanufacturing and Resource Recovery, the Center for Sustainable Production, the Center for Sustainable Mobility, the Systems Modernization and Sustainment Center, the New York State Pollution Prevention Institute, and the NanoPower Research Labs.

Curriculum

Students must complete a minimum of 60 quarter credit hours of course work and a minimum of 27 quarter credit hours of research to total 99 quarter credit hours.

Semester conversion

Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Sustainability, Ph.D. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
5001-802	Fundamentals of Sustainability Science	4
5001-810	Economics of Sustainability	4
5001-804	Industrial Ecology	4
5001-805	Technology, Policy, and Sustainability (or approved substitute)	4
5001-806	Risk Analysis	4
5001-808	Multi-criteria Sustainable Systems Analysis	4
5001-800	Graduate Seminar	3
	Elective	4
Second Year		
5001-805	Technology, Policy and Sustainability	4
5001-800	Graduate Seminar	3
5001-820	Dissertation Research	8
	Electives	12
Third Year and Beyond		
5001-820	Dissertation Research	20
5001-800	Graduate Seminar	6
	Electives	20
Total Quarter Credit Hours		**99**

Sustainability, Ph.D. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ISUS-802	Fundamentals of Sustainability Science	3
ISUS-804	Industrial Ecology	3
	Elective	3
ISUS-800	Graduate Seminar	2
ECON-810	Economics of Sustainability	3
ISUS-806	Risk Analysis	3
ISUS-808	Multi-criteria Sustainable Systems Analysis	3
Second Year		
ISUS-805	Technology Policy and Sustainability (or approved substitute)	3
	Elective	3
ISUS-899	Dissertation Research	7
ISUS-800	Graduate Seminar	2
Third Year and Beyond		
ISUS-899	Dissertation Research	21
ISUS-800	Graduate Seminar	4
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the Ph.D. program in sustainability, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution (course work must include at least one year of college science and one year of college mathematics including calculus and statistics),
- Submit scores from the Graduate Record Examination (GRE),
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Submit at least two letters of academic and/or professional recommendation,
- Participate in a personal interview with the faculty committee (by teleconference when necessary), and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language. Minimum scores of 600 (paper-based) or 100 (Internet-based) are required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL. Minimum scores will vary, however, the absolute minimum score required for unconditional acceptance is 6.5. For additional information about the IELTS, please visit www.ielts.org.

Sustainable Systems, MS

http://www.sustainability.rit.edu/ms_degree.html
Paul Stiebitz, Associate Academic Director
(585) 475-2602, Paul.Stiebitz@rit.edu

Program overview

The MS degree in sustainable systems focuses on sustainable production systems, which create goods and services using processes that are non-polluting; conserving of energy and natural resources; economically viable; and safe and healthful for workers, communities, and consumers. Course work and research takes a systems level and interdisciplinary approach to solving sustainability problems, as opposed to single disciplinary and locally optimized approaches destined to yield marginally positive impacts.

Graduates of this program are prepared to pursue careers in their chosen fields with an understanding of basic sustainability principles and the expertise to analyze and solve complex sustainability issues. For example, students entering the program with a degree in information systems may go on to work in the eco-IT field while students with an economics background may work in the area of life-cycle economic analysis of alternative energy systems.

Curriculum

Students must complete a minimum of 48 quarter credit hours of combined course work and research. This includes a minimum of 40 quarter credit hours of course work and 8 quarter credit hours of thesis or research. Full-time students may complete the degree in 6 to 8 quarters.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Sustainable systems, MS degree, typical course sequence (quarters)

COURSE	QUARTER CREDIT HOURS	
First Year		
5001-802	Fundamentals of Sustainability Science	4
	Elective	4
5001-804	Industrial Ecology	4
5001-810	Economics of Sustainability	4
5001-806	Risk Analysis	4
5001-808	Multi-criteria Sustainable Systems Analysis	4
Second Year		
5001-805	Technology, Policy, and Sustainability (or approved substitute)	4
	Electives	12
	Thesis or Capstone	8
Total Quarter Credit Hours		**48**

Sustainable systems, MS degree, typical course sequence (semesters), effective fall 2013

COURSE	SEMESTER CREDIT HOURS	
First Year		
ISUS-802	Fundamentals of Sustainability Science	3
ISUS-804	Industrial Ecology	3
ECON-810	Economics of Sustainability	3
ISUS-806	Risk Analysis	3
ISUS-808	Multicriteria Sustainable Systems Analysis	3
	Elective	3
Second Year		
ISUS-705	Technology, Policy and Sustainability (or approved elective)	3
	Elective	3
ISUS-807	Thesis or Capstone	6
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in sustainable systems, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited college or university,
- Have fulfilled the following curriculum requirements: one year of college science and one year of college mathematics (including calculus and statistics),
- Have a minimum grade point average of 3.0,
- Participate in an interview with the academic department,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit scores from the Graduate Record Exam (GRE),
- Submit two letters of reference,
- Submit a personal statement of educational objectives,
- Submit a current resume, and
- Complete a graduate application.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 600 (paper-based) or 100 (Internet-based) are required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL exam. The minimum acceptable score is 6.5.

Additional information

Non-matriculated students

An applicant with a bachelor's degree from an approved undergraduate institution and the background necessary for specific courses is permitted to take graduate coursesin the institute as a non-matriculated student. If the student is subsequently admitted to the graduate program, courses taken for credit may be able to be applied toward the degree. A maximum number of 9 quarter credit hours (from courses taken at RIT as a non-matriculated student) can be transferred to the degree program. Any applicant who wishes to register for a graduate course as a non-matriculated student must obtain permission from the chair of the graduate program and the course instructor.

Architecture, M. Arch.

Dennis A. Andrejko, Program Chair
(585) 475-4990, info@sustainability.rit.edu

Program overview

At a time of significant transition for the architectural profession, the architecture program allows for full incorporation of the skills and knowledge critical to the 21st century architect. The program's purpose is to produce broad-thinking architects well grounded in the principles and practices of sustainability who can apply their knowledge and talents to the architectural problems posed by the modern city.

The program is designed for students with a broad range of interests and backgrounds who are interested in studying architecture at the graduate level, but whose undergraduate degrees were obtained in fields outside of architecture.

The program's curriculum has been shaped by the global emphasis of sustainability, factors that impact urbanism, and the hands-on application of the principles of design and technology on materials and construction.

Sustainability

With a global push for a more sustainable world, including buildings that use energy and environmental factors more efficiently to lessen an overall carbon footprint, the focus of many courses reflect the conditions of sustainable design and practice.

Technology

Design exploration is enhanced through the understanding the implication of technology on both design process and product. The program enables students to focus and collaborate in many specialized areas of technology, including engineering, computer science, imaging science, materials and construction, and products and remanufacturing.

Urbanism

Because a degraded urban environment has grave implications for social, economic, cultural, and environmental health, the program pays particular attention to urban settings and urban principles. The complexity of the urban environment requires an interdisciplinary approach to architecture education – one that references economics, public policy, sociology, and regional culture. The program will focus on the practices and principles of preservation and adaptive reuse. The city of Rochester, New York, will serve as an active learning environment for students.

Integrated learning/Integrated practice

Like all strong design programs, the program's core education will take place in the studio. However, our studio curriculum integrates construction technologies, material science, and mechanics into design. From the outset, students will approach design problems within teams, learning to value and leverage collective intelligence. The integrated learning model prepares students for the increasingly integrated practice of architecture, where integrated project delivery is fast becoming the dominant model, and architects are orchestrating teams of professionals from a variety of fields, including engineering, management, science, and computer science.

Curriculum

Students are required to complete 148 quarter credit hours to successfully complete the program. Designed as a full-time program, courses will be offered on campus, primarily during the day.

The majority of the coursework is studio-based, with the exception of some elective and sustainability courses. In addition to three required sustainability courses, students will take one sustainability elective. All students will prepare a thesis in their last year. Students will take three graduate electives, drawn from courses offered by the colleges of Liberal Arts, Engineering, Applied Science and Technology, Imaging Arts and Sciences, and Business.

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. For reference, the following charts illustrate the typical course sequence for this program in both quarters and semesters. Students should consult their graduate program adviser with questions regarding planning and course selection.

Architecture, M. Arch. degree, typical course sequence (quarters)

COURSE		QUARTER CREDIT HOURS
First Year		
5010-611, 612, 613	Architectural Graphics I, II, III	12
5010-621, 622, 623	Architectural Design I, II, III	12
5010-631, 632	Integrated Building Systems I, II	8
5010-651, 652	Architectural History I, II	8
5001-703	Fundamentals of Sustainable Science	4
Second Year		
5010-721, 722, 723	Design Studio: Site, Tectonic and Adaptive	12
5010-733, 734, 735	Integrated Building Systems III, IV, IV	12
5010-741	Urban and Regional Planning	4
5010-751, 752	Architectural Theory I, II	8
5001-704	Industrial Ecology	4
5001-711	Performance Metrics and Certification of Sustainable Buildings	4
Third Year		
5010-724	Design Studio: Urban	4
5010-726, 727	Thesis Studio I, II	8
5010-736	Integrated Building Systems VI	4
5010-743	Research Seminar: Social	4
5010-737	Innovative Building Systems	4
5010-725	Thesis Preparation	4
5010-742	Research Seminar: Urban	4
5010-761	Professional Practice	4
Total Quarter Credit Hours		**148**

Architecture, M. Arch. degree, typical course sequence (semesters), effective fall 2013

COURSE		SEMESTER CREDIT HOURS
First Year		
ARCH-611	Architectural Representation I	3
ARCH-621	Architectural History I	3
ARCH-631	Architectural Design I	6
ARCH-761	Understanding Sustainability	3
ARCH-612	Architectural Representation II	3
ARCH-622	Architectural History II	3
ARCH-632	Architectural Design II	6
ARCH-741	Integrated Building Systems I	3
Second Year		
ARCH-731	Architectural Studio I: Site	6
ARCH-742	Integrated Building Systems II	3
ARCH-751	Architectural Theory	3
ARCH-732	Architectural Studio II: Tectonic	6
ARCH-743	Integrated Building Systems III	3
ARCH-752	Urban and Regional Planning	3
ARCH-762	Industrial Ecology Fundamentals	3
	Graduate Elective	3
Third Year		
ARCH-733	Architectural Studio III: Adaptive	6
ARCH-744	Integrated Building Systems IV	3
ARCH-753	Research Seminar	3
ARCH-763	Sustainable Building Metrics	3
ARCH-734	Architectural Studio IV: Urban	6
ARCH-745	Integrated Building Systems V	3
ARCH-771	Professional Practice and Thesis Preparation	3
	Graduate Elective	3
Fourth Year		
ARCH-790	Thesis Studio	6
ARCH-772	Innovative Architecture	3
	Sustainability Elective	3
	Graduate Elective	3
ARCH-699	Cooperative Education	Co-op
	Global Experience	0
Total Semester Credit Hours		**105**

Admission requirements

To be considered for admission to the M.Arch. program, candidates must fulfill the following requirements:

- Hold a baccalaureate degree (other than a B.Arch.) from an accredited institution,
- Have an undergraduate cumulative GPA of B (3.0) or higher,
- Successful completion of at least one semester each of previous college-level course work in calculus (not pre-cal) and physics,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a one page personal statement explaining why you are interested in studying architecture at the graduate level.
- Submit the results of the Graduate Record Examination (GRE).
- Submit three letters of recommendation submitted directly to RIT via e-mail (from references directly) or in a sealed envelope, signed by the letter writer across the seal. (One from a current or former teacher or academic adviser; one from a current or former supervisor; and one from someone familiar with your creative abilities),
- Submit a portfolio of your best creative work, which may include sketches, constructions, graphics, and/or photographs (While student portfolios will likely not include examples of architectural drawing/design, evidence of creative talent will be important in determining admission).
- Applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 250 (computer-based), and 100 (Internet-based) are required.

Applicants who exceed the general admission requirements may be considered for conditional acceptance before GRE scores are available.

Portfolio requirements

All applications must be accompanied by a PDF digital portfolio. Print or bound portfolios or digital portfolios in formats other than PDF will not be accepted or reviewed. Please note, all PDF portfolios should be less than 6.0mb. Files larger than this will not be accepted or reviewed. In the event the review committee requires additional information or higher resolution images, the applicant will be notified. Guidelines for portfolio preparation:

Image quality: A medium quality image setting on a digital camera is sufficient. No images should be pixelated.

File size: The total size must be 8.5x11" and cannot exceed 6.0mb. Alternatively you may use the PDF portfolio feature (found under FILE, in more recent versions of Acrobat) to create your portfolio. Again, total file size may not exceed 6.0mb.

Orientation: Landscape orientation is preferred.

Cropping: Crop out unnecessary objects from the images so that there are no distractions from work presented..

Image enhancement: If the image files of your work are not accurate after photographing, image-editing software is allowed to correct the appearance of the files you are submitting. Please use caution. It is important to maintain the integrity of the original artwork. Images should be clear and free of reflections or "hot spots."

File name: You may submit only one PDF file as your portfolio. It should follow this format: UARC_XX_LASTNAME.PDF, where XX is equal to the two year code for the academic year to which you are applying, 2011, for example would be 11, 2012 would be 12, etc. Enter your last name in all capital letters in place of LASTNAME. Do not enter given names or middle names in this field. Submission. All PDF portfolio files must be submitted via email to gradapp@rit.edu. Include your name in the subject line of the email. Files delivered on CD/ROM or USB drives will not be reviewed or accepted.

Graduate Faculty

Nabil Nasr, BS, Helwan University; M.Eng., Pennsylvania State University; MS, Ph.D., Rutgers University—Assistant Provost and Director, Golisano Institute for Sustainability

Dennis A. Andrejko, B. Arch, Arizona State University; M. Arch, Massachusetts Institute of Technology—Program Chair, Architecture; Associate Professor

Alex Bitterman, BS, M.Arch., State University of New York at Buffalo; Ph.D., University of New York at Buffalo—Associate Professor

Callie W. Babbitt, BS, Georgia Institute of Technology; ME, Ph.D., University of Florida—Assistant Professor

Jules Chiavaroli, B.Arch., University of Notre Dame; MBA, Rochester Institute of Technology—Professor

Gabrielle Gaustad, BS, Alfred University; MS, Ph.D., Massachusetts Institute of Technology—Assistant Professor

Michael Haselkorn, BS, Alfred University; MS, Ph.D., University of Illinois at Urbana—Research Associate Professor

Nenad Nenadic, BA, University of Novi Sad (Yugoslavia); MS, Ph.D., University of Rochester—Research Associate Professor

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan—Professor; Interim Academic Director

Paul H. Stiebitz, BS, ME, Rochester Institute of Technology; MS, State University of New York at Buffalo—Associate Professor; Associate Academic Director

Michael Thurston, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Research Associate Professor and Technical Director, Systems Modernization and Sustainment Center

Thomas A. Trabold, BS, Ph.D., Clarkson University—Research Associate Professor

Anahita Williamson, BS, MS, Ph.D., Clarkson University—Research Assistant Professor

Quarter Courses

2012–2013 Academic Year

Sustainability

5001-700 Special Topics

A critical examination of issues in some area of sustainability not covered in other Golisano Institute for Sustainability courses. (Enrollment in Sustainability Ph.D. or Sustainable Systems MS program, or permission of instructor) **Class 4, Credit 4 (offered occasionally)**

5001-710 Tools for Graduate Research

This class will introduce graduate students to tools and software that will be of use in conducting, analyzing, and presenting their research. An introduction, highlights of key features, and the basics of operation will be taught for software aimed at: bibliographic referencing (e.g. Endnote, Latex), statistical analysis (e.g. Excel, SPSS, SAS), analytical work (e.g. Matlab, Mathematic, Maple), advanced plotting (e.g. Deltagraph, Illustrator, Origin), equation editing (e.g. Mathtype) and search engines (e.g. setting up RSS feeds, material property databases). Assignments will be direct applications to thesis / dissertation research. (Enrollment in the sustainability Ph.D. or MS program or the permission of the instructor) **Class 4, Credit 4 (W)**

5001-711 Design For Sustainability

This transdisciplinary, problem-based studio course is a joint offering between GIS and Industrial Design, focused on the topic of integrating sustainability objectives at the conceptual product design stage. The goals of this course are to provide industrial design and sustainability students with an appreciation of cross disciplinary perspectives and to test design for sustainability principles through student-led course projects that investigate the design feasibility and the environmental impact of proposed product alternatives. Topics covered will include product design process, sustainability priorities, environmental attributes of a product life cycle, and environmentally preferable design alternatives. (Graduate standing required) **Class 4, Credit 4 (F)**

5001-712 Applied Programming

This class will explore intermediate programming for applied dissertation research. Optimization and numerical simulation case studies will be explored using Microsoft Excel, Matlab, and Lingo software. Students will formulate and code programs to explore multi-criteria sustainability problems related to their research projects. Special topics include advanced uncertainty analysis (including beginner stochastic programing) and algorithm improvement for faster processing. The final project deliverable will be a journal-quality paper including proper mathematical formulation of the program and algorithm, optimal solutions, and sensitivity analysis of both dynamic parameters and implicit uncertainty. (5001-808 Multi-Criteria Sustainable Systems Analysis or the permission of the instructor). **Class 4, Lab 0, Credit 4 (F)**

5001-800 Graduate Seminar

This is a required course for students admitted to the Sustainability Ph.D. program. Students will learn about current research in sustainable production systems from faculty and guest speakers. Topics pertaining to the development of plans of study and research proposals, and as well as teaching skills, will also be covered. (Enrollment in the sustainability Ph.D. program or sustainable systems MS program, or permission of instructor) **Class 1, Credit 1 (F, W, S)**

5001-801 Independent Study

An independent project in sustainability not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. (Enrollment in sustainability Ph.D. or sustainable systems MS program or permission of instructor) **Credit variable (F, W, S)**

5001-802 Fundamentals of Sustainability Science

This course prepares students to conduct original research related to sustainable production and consumption systems. Fundamental concepts of industrial ecology, ecological economics, ecosystem health, and social ecology essential to understanding the interaction of industrial and ecological systems are introduced. Students will learn multiple perspectives of sustainability such as strong and weak formulations, the importance of sustainability as an ethical concept, and a life-cycle approach to organizing research related to sustainability. (Enrollment in Sustainability Ph.D. or Sustainable Systems MS program or permission of instructor.) **Class 4, Credit 4 (F)**

5001-804 Industrial Ecology

Industrial ecology is the study of the interaction between industrial and ecological systems. Students in this course learn to assess the impact and dependency of production systems on the natural environment by mastering life-cycle assessment tools, concepts in biomimicry and principles of sustainability. (Enrollment in Sustainability Ph.D. or Sustainable Systems MS program or permission of instructor) **Class 4, Credit 4 (S)**

5001-806 Risk Analysis

This course examines the three pillars of sustainability (economics, environment, and society from a risk analytic perspective and presents an introduction to financial, toxicological and socio-political risk assessment, management and communication. Topics include utility theory, net present value analysis, benefit-cost analysis, ecotoxicology, environmental impact statements, environmental justice, risk management and risk communication. The course prepares students for further study in sustainable design, decision making and policy. (Enrollment in the Sustainability Ph.D. or Sustainable Systems MS program or the permission of the instructor) **Class 4, Credit 4 (W)**

5001-807 Research

Sustainability Ph.D. research conducted prior to passing the qualifying exam. (Enrollment restricted to students in the Sustainability Ph.D. program who have not yet passed the qualifying exam and Sustainable Systems MS) **Credit variable (F, W, S)**

5001-808 Multi-Criteria Sustainable Systems Analysis

This class will explore how decisions are made when confronted with multiple, often conficting, criteria or constraints. The focus will be on the following analytical methods; linear and stochastic programming, optimization, and Monte Carlo simulation. Case studies will focus on sustainability multi-criteria problems such as energy planning, sustainable development, resource management, and recycling. Students will apply methods learned to a project involving their dissertation research. This is a core course within the Sustainability Ph.D. and MS programs. (5001-806 Risk Analysis or the permission of the insturctor). (**Class 4, Credit 4 (S)**

5001-820 Dissertation Research

Research fulfillment of Sustainability Ph.D. dissertation requirements. (Enrollment restsricted to students in the Sustainability Ph.D. program who have successfully completed the qualifying exam). **Credit variable (F, W, S)**

5001-899 Continuation of Thesis

Continuation of Thesis is a required one credit course for students who have started their thesis or dissertation research but are not otherwise registered for research credits. **Credit 1 (F, W, S, Su)**

Architecture

5010-611 Architectural Graphics I

This course introduces the range of graphic communication skills necessary to effectively document geometric forms. Skill development will be both manual and computer based and range from spontaneous free-hand sketching to formal 3-D computer modeling. Principles of orthographic projection, paraline drawings, and perspective will be covered. (Students enrolled in the M.Arch program) **Class 2, Studio 4, Credit 3 (F)**

5010-612 Architectural Graphics II

This course extends basic graphic communication skills into the realm of architectural graphics including floor plans, sections, and elevations. Both paraline and perspective views will also be used in order to effectively communicate design ideas and construction documentation. Skill development will be both manual and computer based. (Architectural Graphics I) **Class 2, Studio 4, Credit 3 (W)**

5010-613 Architectural Graphics III

This course will elevate architectural graphic communication to the building information modeling (BIM) level. Virtual models of moderate sized building projects will be created using advanced 3-D computer modeling software. Renderings and elemental working drawings will be generated from these models. (Architectural Graphics II) **Class 2, Studio 4, Credit 3 (S)**

5010-621 Architectural History I

Students will study historical architecture dating from the beginning of human shelter and the patterns of early communities through the end of the Romanesque period in Europe. The sub-theme of sustainability will be highlighted with appropriate examples. Western and non-western regions will be explored with similarities and differences highlighted. (Acceptance into the M.Arch program or permission of the instructor) **Class 3, Credit 3, (F)**

5010-622 **Architectural History II**
Students will study historical architecture dating from the beginning of the Gothic period in the West through the French Revolution in the late 18th century. Western examples and Non-Western cultures will be studied in light of their earlier traditions and parallel, and contrasting, developments. The European Renaissance and its formal differences from classical prototypes will be contrasted. Sustainability will be examined via developments in building technology and adaptations to climate portrayed by building form. North and South American cultures will be contrasted with the Western traditions brought into collision by European colonialism. (Architectural History I) **Class 3, Credit 3, (W)**

5010-623 **Architectural History III**
Starting with the late-18th century, students will examine Classic Revivals and their distinctiveness from historical/archeological precedents. Similarly, the Romantic and eclectic revivals will be reviewed and contrasted with advances in building technology and the introduction of new building materials and systems. The international scope of these trends will be explored with particular emphasis on the rapidly-developing United States. Modernism will be contrasted with parallel and competing design directions. The continuing and dramatic impact of new material technologies, transportation, building systems developments, explosive urbanization, and the 20th century trend away from sustainable design principals will be explored. (Architectural History II) **Class 3, Credit 3 (S)**

5010-631 **Architectural Design I**
This course is the first of the three course introductory sequence to architectural design. It includes a basic synthesis and application of visual and tectonic communication skills necessary to convey architectural design concepts. Analysis develops acuity of the students' awareness of formal/spatial principles. Projects articulate coherent sets of architectural intentions and aim to develop the spatial, structural, and organizational tools of the beginning designer. (Corequisite: Architectural Graphics I) **Credit 6 (F)**

5010-632 **Architectural Design II**
This course is the second of the three course introductory sequence to architectural design. It covers a basic application of visual and tectonic architectonic skills necessary to convey and analyze architectural design concepts. Students will continue to develop acuity of formal/spatial principles, and will further develop presentation and self-critique skills. Projects articulate coherent sets of architectural intentions and aim to further develop the spatial, structural, and organizational tools of the beginning designer. (Architectural Design I, Corequisite Architectural Graphics II). **Credit 6 (W)**

5010-633 **Architectural Design III**
This course is the third of the three course introductory sequence to architectural design. With a focus on residential design, students will communicate and analyze building based architectural design concepts. Students will continue to develop acuity of formal/spatial principles, and will further develop presentation and self-critique skills. Projects articulate coherent sets of architectural intentions and aim to further develop the spatial, structural, and organizational tools of the beginning designer. (Architectural Design II, corequisites: Architectural Graphics III, Integrated Building Systems II) **Credit 6 (S)**

5010-731 **Architectural Studio I: Site**
Building on the 1st year studios that explored basic communications between form and space this introduction to the 2nd year will investigate in greater depth the complexity and integrated nature of the architectural object and design process. Students will explore the artistic, conceptual, creative, and experiential side of architecture as a way of developing a rigorous process of architectural form-making. By developing methods, parameters, and alternatives of form-making, issues such as expression, perception, and representation will be explored. Although site design will be the focus of the course, full building designs will be examined in response to site parameters. Students will be expected to work in teams to explore communally a broad spectrum of design strategies at every opportunity. (Architectural Design III, corequisite Integrated Building Systems III) **Class 3, Studio 9, Credit 6 (F)**

5010-732 **Architectural Studio II: Tectonic**
This foundation studio considers architecture both as a representation and as a built form. It will expand student horizons beyond the confines of the studio by bridging the gap between theory (representation) and practice (action). Architects are responsible for shaping the built environment and this studio will provide students with a first-hand experience of the professional responsibility to the public. Through the process of design students will be making strong connections between drawing/representation and the finished building produced. (Architectural Studio I: Site, Corequisite ST: Integrated Building Systems IIIb) **Class 3, Studio 9, Credit 6 (W)**

5010-741 **Integrated Building Systems I**
In this overview course, students will study the various systems that comprise a building project; architectural material and method systems, land use, and structural, mechanical, and electrical systems. The constraints that control these systems will also be studied such as building and zoning codes, construction costs, and sustainability demands. **Class 4, Credit 4 (W)**

5010-743 **Integrated Building Systems III**
In this course, students will study the various systems that comprise a building project's site work; civil engineering and landscaping materials and methods, storm water control systems, soil analysis, material solar reflectance, and exterior lighting. Applicable zoning codes, surveying and mapping methods, construction costs, and sustainability demands will also be studied. (Integrated Building Systems II, corequisite Architectural Studio I: Site) **Class 4, Credit 4 (F)**

5010-751 **Architectural Theory**
A survey of architectural theory and criticism with emphasis on the period from the mid-twentieth century to the present. This course offers students the opportunity to investigate, learn, and apply critical thinking in the context of architecture and communicating these findings to others. **Class 3, Credit 3 (F)**

5010-761 **Understanding Sustainability**
This course will develop students' understanding of the interaction between industrial, environmental/ecological and social systems in the built environment by introducing them to systems thinking and the multiple disciplines comprising sustainability. Topics include definitions of sustainability and sustainable development, concepts in sustainable production and consumption, sustainability as an ethical concept, the evolution of environmental thinking, systems thinking: industrial ecology, ecological economics, ecosystem health, human, social and political ecology, design for the environment, ecologically sustainable design, and assessing sustainability—metrics and indicators (acceptance into M. Arch. program or permission of instructor) **Class 4, Credit 4. (F)**

5010-789 **ST: Residential Building Systems**
In this course, students will study the various systems that comprise a residential building project; residential architectural materials and methods, site considerations, and structural, mechanical, and electrical systems. Applicable building and zoning codes, construction costs, and sustainability demands will also be studied. (Integrated Building Systems I, corequisite Architectural Design III) **Class 4, Credit 4 (S)**

5010-789 **ST: Architectural Studio IIb: Tectonic**
This studio course extends study of Architectural Studio II: Tectonic. (Architectural Studio II: Tectonic, corequisite Integrated Building Systems IIIc) **Class 3, Studio 9, Credit 6 (S)**

5010-789 **ST: Integrated Building Systems IIIb**
In this course, students will study the various systems that comprise non-residential building projects be they low, moderate, or high-rise. More complex building materials and methods of construction and engineering systems will be studied, as well as applicable zoning codes, construction costs, and sustainability demands. (Integrated Building Systems III, corequisite Architectural Studio II: Tectonic) **Class 3, Credit 3 (W)**

5010-789 **ST: Integrated Building Systems IIIc**
In this course, students will further study the various systems covered in ST: Integrated Building Systems IIIb. (Integrated Building Systems I, Corequisite Architectural Design III) **Class 4, Credit 4 (S)**

5010-789 **ST: Architectural Theory II**
In this course, students will further study architectural theory. (Architectural Theory) **Class 3, Credit 3 (W)**

5010-999 **ST: Coop Architecture**
This course provides a ten-week (350-400 hours) work experience in the field. (Second-year program status) **Credit 0 (Su)**

Semester Courses
Effective fall 2013

Semester conversion
Effective fall 2013, RIT will convert its academic calendar from quarters to semesters. Each program and its associated courses have been sent to the New York State Department of Education for approval of the semester plan. This is a preliminary list of courses. Students should consult their graduate program adviser with questions regarding planning and course selection.

Sustainability

ISUS-600 **Graduate Seminar**
This is a required course for students admitted to the Sustainability Ph.D. program. Students will learn about current research in sustainable production systems from faculty and guest speakers. Topics pertaining to the development of plans of study and research proposals, and as well as teaching skills, will also be covered. (Enrollment in the Sustainability Ph.D. or Sustainable Systems MS program) **Class 1, Credit 1 (F, S)**

ISUS-700 **Special Topics**
A critical examination of issues in some area of sustainability not covered in other Golisano Institute for Sustainability courses. Topic depends on specific offering. (Enrollment in Sustainability Ph.D. or MS in Sustainable Systems program or permission of instructor) **Class 3, Credit 3 (offered occasionally)**

ISUS-701 **Independent Study**
An independent project in sustainability not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. (Enrollment restricted to students in the Sustainability Ph.D. or Sustainable Systems program) **Class 1, Credit 1 (F, S, Su)**

ISUS-702 **Fundamentals of Sustainability Science**
This course prepares students to conduct original research related to sustainable production and consumption systems and apply the scientific method in an integrative, team-based approach to graduate research. This course introduces the fundamental concepts of industrial ecology, ecological economics, ecosystem health and social ecology that are essential to understanding the interaction of industrial and ecological systems. Successful students will understand multiple perspectives on sustainability such as strong and weak formulations, the importance of sustainability as an ethical concept and a life-cycle approach to organizing research related to sustainability. It is a core course within the Sustainability Ph.D. program. (Research experience and graduate standing recommended; enrollment in Sustainability Ph.D. program or MS in Sustainable Systems program or permission of instructor) **Class 3, Credit 3 (F)**

ISUS-704 **Industrial Ecology**
Industrial ecology is the study of the interaction between industrial and ecological systems. Students in this course learn to assess the impact and interrelations of production systems on the natural environment by mastering fundamental concepts of ecology as a metaphor for industrial systems and the resultant tools from industrial ecology, including life cycle assessment, material flow analysis, and energy and greenhouse gas accounting. This is a core course within the Sustainability Ph.D. program. (Research experience and graduate standing recommended; enrollment in Sustainability Ph.D. or MS in Sustainable Systems program or permission of instructor) **Class 3, Credit 3 (S)**

ISUS-710 **Sustainable Product Design**
The application of sustainability and product design methods. Lectures and projects will incorporate strategies such as effective sustainability methods and life-cycle assessment; enhancement of product value and prolonged use; and balance between recycling, reusing and repurposing. Sustainable Product Design enables an interdisciplinary collaboration between Sustainability and Industrial Design. Both areas will offer their unique approach while learning and integrating knowledge from each other. (Enrollement in Sustainability Ph.D. or MS in Sustainable Systems program or permission of instructor) **Class 3, Credit 3 (F)**

ISUS-780 **Capstone**
An independent project in sustainability serving as a capstone experience for students completing the non-thesis option. This course requires a formal proposal and a faculty sponsor. (Enrollment restricted to students enrolled in the Sustainable Systems MS program with approval of the academic director) **Class 1, Credit 1 (F, S, Su)**

ISUS-790 **Thesis**
Independent research in sustainability leading to the completion of the MS thesis. This course requires a formal proposal and a faculty sponsor. (Enrollment restricted to students enrolled in the Sustainable Systems MS program) **Class 3, Credit 1 (F, S, Su)**

ISUS-806 **Risk Analysis**
This course examines risk identification, quantification, and management from the standpoint of the three key components of sustainability science (economics, environment, and society). Economic subjects include cost-benefit analysis, value of information, time value of money, basic decision analysis, value functions, monetizing challenges for ecosystem services, and sustainability risk management. Environmental subjects include toxicological perspectives such as fate and transport and dose-response relationships including an overview of EPA's current practice. Policy and societal subjects include utility theory and lotteries, risk perception, ethical issues in risk quantification, and impact statements. It is a core course within the Sustainability Ph.D. and MS programs. (Enrollment in the Sustainability Ph.D. or MS program or the permission of the instructor) **Class 3, Credit 3 (F)**

ISUS-807 **Research**
Research in fulfillment of Sustainability Ph.D. dissertation or MS capstone requirements. (Enrollment restricted to students in the Sustainability Ph.D. or Sustainable Systems MS program) **Credit variable (F, S, Su)**

ISUS-808 **Multicriteria Sustainable Systems Analysis**
This class will explore how decisions are made when confronted with multiple, often conflicting, criteria or constraints. The focus will be on the following analytical methods: linear and stochastic programming, optimization, and Monte Carlo simulation. Case studies will focus on sustainability multi-criteria problems such as energy planning, sustainable development, resource management, and recycling. Students will apply methods learned to a project involving their dissertation research. It is a core course within the Sustainability Ph.D. and MS programs. (ISUS-806 Risk Analysis or the permission of the instructor) **Class 3, Credit 3 (S)**

ISUS-821 **Applied Life Cycle Assessment**
Life cycle assessment (LCA) is a tool used in the field of industrial ecology to evaluate the environmental impacts of products or processes over their entire life cycle – from raw material extraction, manufacturing, use, and end-of-life management. This course will build on fundamental principles of LCA by allowing students to conduct project-based studies on the application of LCA to real-world sustainability issues. Students will apply process, economic input-output, and hybrid methodologies to evaluate technological systems for opportunities of environmental improvement. (Permission of the instructor) **Class 3, Credit 3 (S)**

ISUS-890 **Dissertation Research**
Research fulfillment of Sustainability Ph.D. dissertation requirements. (Enrollment restricted to students in the Sustainability Ph.D. program who have successfully completed qualifying exam.) **Credit Variable (F, S, Su)**

Architecture Program

ARCH-611 **Architectural Representation I**
This course introduces the range of architectural representation skills necessary to effectively document geometric forms and simple architectural form and space. Skill development will be both manual and digital and include free-hand sketching, 3-D modeling, 2-D drafting, paraline drawings, perspectives, and presentation techniques. **Class 2, Studio 4, Credit 6 (F)**

ARCH-612 **Architectural Representation II**
This course deepens the study of architectural representation skills necessary to effectively document more complex architectural form and space. Skill development will be both manual and digital and include free-hand sketching, 3-D modeling, 2-D drafting, paraline drawings, perspectives, and presentation techniques. (ARCH-611 Architectural Representation I) **Class 2, Studio 4, Credit 6 (S)**

ARCH-621 **Architectural History I**
Students will study the history of architecture for both western and non-western traditions from the beginning of human shelter and the patterns of early communities through the end of the Medieval period in Europe. The sub-theme of sustainability will be explored by illustrating how ancient building designs modified the effects of climate without the use of large amounts of wealth or energy. **Class 3, Credit 3 (F)**

ARCH-622 **Architectural History II**
Students will study the history of architecture for both western and non-western traditions from the Renaissance to the present day. The sub-theme of sustainability will be explored by illustrating how ancient building designs modified the effects of climate without the use of large amounts of wealth and energy. **Class 3, Credit 3 (S)**

RCH-631 Architectural Design I
Students will develop acuity of formal/spatial principles, and will develop presentation and self-critique skills. Projects articulate coherent sets of architectural intentions and aim to develop the spatial, structural, and organizational tools of the beginning designer. Students will also have the opportunity for basic synthesis and application of visual and tectonic communication skills necessary to convey architectural design concepts. (Co-requisite, ARCH-611 Architectural Representation I) **Classroom 3, Studio 9, Credit 6 (F)**

ARCH-632 Architectural Design II
With a focus on residential design, students will communicate and analyze building based architectural design concepts. Students will continue to develop acuity of formal/spatial principles, and will further develop presentation and self-critique skills. Projects articulate coherent sets of architectural intentions and aim to further develop the spatial, structural, and organizational tools of the beginning designer. (Co-requisite, ARCH-612 Architectural Representation II) **Classroom 3, Studio 9, Credit 6 (S)**

ARCH-699 Coop Architecture
This course provides a fifteen-week (500 hours) work experience in the field. (Second year program status) **Credit 0 (Su)**

ARCH-731 Architectural Studio I: Site
Building on the 1st year studios that explored basic communications between form and space this introduction to the 2nd year will investigate in greater depth the complexity and integrated nature of the architectural object and design process. Students will explore the artistic, conceptual, creative, and experiential side of architecture as a way of developing a rigorous process of architectural form-making. By developing methods, parameters, and alternatives of form-making, issues such as expression, perception, and representation will be explored. Although site design will be the focus of the course, full building designs will be examined in response to site parameters. Students will be expected to work in teams to explore communally a broad spectrum of design strategies at every opportunity. (ARCH-632 Architectural Design II, corequisite ARCH-742 Integrated Building Systems II) **Class 3, Studio 9, Credit 6 (F)**

ARCH-732 Architectural Studio II: Tectonic
This foundation studio considers architecture both as a representation and as a built form. It will expand student horizons beyond the confines of the studio by bridging the gap between theory (representation) and practice (action). Architects are responsible for shaping the built environment and this studio will provide students with a first-hand experience of the professional responsibility to the public. Through the process of design students will be making strong connections between drawing/representation and the finished building produced. (ARCH-731 Architectural Studio I: Site, Corequisite ARCH-743 Integrated Building Systems III) **Class 3, Studio 9, Credit 6 (S)**

ARCH-733 Architectural Studio III: Adaptive
This course examines the adaptive reuse of existing spaces, with implicit exposure to the basics of historic preservation. Students will examine and document an existing "real" space within the region, and propose coherent and rational architectural interventions for that space. (ARCH-732 Architectural Studio II: Tectonic, corequisite ARCH-744 Integrated Building Systems IV) **Classroom 3, Studio 9, Credit 6 (F)**

ARCH-734 Architectural Studio IV: Urban
This studio builds upon and expands the students design skills in architecture through the lens of urban design and landscape architecture, and introduces the new dynamic of community leadership and urban planning. The approach to urban design engages the city as an integrated design problem that is best solved through a participatory and engaged design process. Drawing on expertise from a variety of disciplines and skill sets, students will study the process of working directly in the community to create visions for future change. The studio is intended to inform an understanding of building design in relation to the urban context. The course is devoted to expanding and developing design skills at the block and neighborhood scale. (ARCH-733 Architectural Studio III: Adaptive, corequisite ARCH-745 Integrated Building Systems V) **Class 3, Studio 9, Credit 6 (S)**

ARCH-742 Integrated Building Systems II
In this course, students will study the various systems that comprise a building project's site work; civil engineering and landscaping materials and methods, storm water control systems, soil analysis, material solar reflectance, and exterior lighting. Applicable zoning codes, surveying and mapping methods, construction costs, and sustainability demands will also be studied. (ARCH-741 Integrated Building Systems I, corequisite ARCH-731 Architectural Studio I: Site) **Class 3, Credit 3 (F)**

ARCH-743 Integrated Building Systems III
In this course, students will study the various systems that comprise non-residential building projects be they low, moderate, or high-rise. More complex building materials and methods of construction and engineering systems will be studied, as well as applicable zoning codes, construction costs, and sustainability demands. (ARCH-742 Integrated Building Systems II, corequisite ARCH-732 Architectural Studio II: Tectonic) **Class 3, Credit 3 (S)**

ARCH-744 Integrated Building Systems IV
In this course, students will study how the various systems that comprise building projects may be reconfigured, renovated, or adapted to meet changing needs. Applicable zoning and building codes, construction costs, and sustainability demands will also be studied. (ARCH-743 Integrated Building Systems III, corequisite ARCH-733 Architectural Studio III: Adaptive) **Class 3, Credit 3 (F)**

ARCH-745 Integrated Building Systems V
In this course, students will study how the various systems that comprise building projects within an urban context are integrated. Applicable zoning and building codes, construction costs, and sustainability demands will also be studied. (ARCH-744 Integrated Building Systems IV, corequisite ARCH-734 Architectural Studio IV: Urban) **Class 3, Credit 3 (S)**

ARCH-751 Architectural Theory
A survey of architectural theory and criticism with emphasis on the period from the mid-twentieth century to the present. This course offers students the opportunity to investigate, learn, and apply critical thinking in the context of architecture and communicating these findings to others. **Class 3, Credit 3 (F)**

ARCH-752 Urban and Regional Planning
This course immerses students in the field of urban and regional planning as individuals as well as part of a team. By working with area planning organizations/and or agencies, teams of students will provide community service in the design process for neighborhoods, small towns/villages, or regions. (ARCH-632 Architectural Design II) **Class 3, Credit 3 (S)**

ARCH-753 Research Seminar
This seminar experience exposes architecture graduate students to a range of contemporary social and urban issues along with the historical content that underlies the development of these issues. Selected readings from current periodicals, critical writing, group dialogue, presentations, and guest lectures will be integrated into the course as appropriate. (Prerequisite, 60 credit hours in the program) **Class 3, Credit 3 (F)**

ARCH-762 Industrial Ecology Fundamentals
Industrial ecology is the study of the interaction between industrial and ecological systems. Students in this course will learn how to assess the impact and interrelations of built environments on the natural environment by utilizing life cycle assessment tools and principles of sustainability. (ARCH-761 Understanding Sustainability) **Class 3, Credit 3 (S)**

ARCH-763 Sustainable Building Metrics
This course addresses the measurement science, performance metrics, assessment tools, and fundamental data critical for the development and implementation of building systems associated with the life-cycle operation of buildings while simultaneously maintaining a healthy and productive indoor environment. Certification processes and design guides, such as LEED, Labs21©, Whole Building Design Guide, will be reviewed. **Class 3, Credit 3 (F)**

ARCH-771 Professional Practice and Thesis Preparation
Students will study the role and responsibilities of architects engaged in professional practice. One focus will be on the various players and the process of project delivery and management. Affiliated issues of ethics, professional development, and legal responsibilities will also be covered. In preparation for the culminating studio experience, students will also engage in a seminar format research, through analysis of precedent, site investigation, critical readings and exploration of technique. Through this, each student will be driven to develop a hypothesis as the basis for their thesis proposal. (Second-year courses) **Class 3, Credit 3 (S)**

ARCH-772 Innovative Architecture
Using case study methodology, students will research and report on innovative architectural solutions that have recently been completed or are in the planning stages. Focus will be on projects that successfully satisfy all the technical demands placed on architecture today and the team (architect, client, builder) that created the project. (Third-year courses or permission of instructor) **Class 3, Credit 3 (F)**

ARCH-790 Thesis Studio
This course is the culminating studio experience for the M.Arch. program. Students will propose, design, and defend an architectural design or research problem, while working closely with a selected faculty committee. (ARCH-745 Professional Practice and Thesis Preparation) **Class 3, Studio 9, Credit 6 (F)**

Online Learning

www.rit.edu/online

RIT is a recognized leader in the delivery of online asynchronous education. Since 1980, the university has offered distance learning courses and was among the first universities nationwide to utilize the Internet as a mode of delivery. In 1991, the university began offering full degrees through online learning.

The Wallace Center supports the RIT online course management system (myCourses), provides training for faculty, and assists in registering students and answering questions about myCourses. The center also reviews emerging technologies that support the critical mission of constantly improving teaching and learning.

RIT offers numerous degree and certificate programs in an online format—most of which may be earned without ever coming to campus. The university offers hundreds of graduate and undergraduate courses online annually. Each year nearly 5,000 students enroll in an online learning course. Students are encouraged to select and apply to their chosen academic program, but in some cases may enroll in courses prior to matriculation into a program.

Online learning offers students the flexibility to learn on their own time, when and where it best meets their needs. All online courses are taught using Internet and Web-based technologies. Students must have Internet access, a computer, DVD player and monitor, and a telephone to participate in courses. Not all courses use the same technologies. Some take advantage of toll-free phone or Web conferences, while others use text-based chat or CD-ROMs. Some have Web-based simulations and some require additional software to complete course requirements. All courses use asynchronous Internet/Web-based tools for the fundamental class structure.

Online students have full access to customer and technical support through phone and e-mail. Online learners also have full access to the library and its services. Other online services include registration, orientation, access to student records, and course material ordering. Officially registered students receive an e-mail about three weeks before the quarter begins welcoming them to online learning and directing them to MyCourses. Here, students can visit the Online Student Community to access information on courses, order course materials, and review any proctored exam requirements.

All courses offered online meet the same rigorous objectives set for traditional classroom experiences. Faculty members who teach online courses often teach the same class in a traditional format.

However, just as each professor establishes the learning outcomes for a traditional course, their individual choices are also reflected in the online classroom. Most classes establish either a weekly schedule for learning activities or a project-based learning approach, in which deliverables (assignments, projects, discussion participation, etc.) are due after certain learning outcomes are accomplished. Most classes also include various readings either from textbooks or electronic reserves. Students interact online with other students to exchange ideas and collaborate much as they would face-to-face.

Online learning serves students throughout the United States and in nearly 40 countries. Students living near Rochester may choose to take both online and traditional courses as a way of increasing flexibility and remaining on target to complete a degree.

Online graduate programs

Doctorate degree:

- Imaging Science

Master's degrees:

- Applied Statistics
- Environmental, Health and Safety Management
- Facility Management
- Health Systems Administration
- Human Resource Development
- Imaging Science
- Manufacturing Leadership
- Microelectronics Manufacturing Engineering
- Networking and Systems Administration
- Online Executive MBA
- Product Development
- Professional Studies
- Service Leadership and Innovation
- Telecommunications Engineering Technology

Advanced certificates:

- Elements of Healthcare Leadership
- Health Systems Finance
- Network Planning and Design
- Project Management
- Senior Living Management
- Service Leadership and Innovation
- Statistical Methods for Product and Process Improvement
- Statistical Quality
- Strategic Training
- Technical Information Design

Graduate Admission

The academic department offering the program makes all decisions regarding graduate admission. Correspondence between the student and the university is conducted through the Office of Graduate Enrollment Services, according to the following policies and procedures:

1. Inquiries regarding academic programs, as well as all applications for graduate study, are directed to the Office of Graduate Enrollment Services, Rochester Institute of Technology, Bausch & Lomb Center, Building 77, Room A130, 58 Lomb Memorial Drive, Rochester, NY 14623-5604.
2. The Office of Graduate Enrollment Services will acknowledge the inquiry or application, instructing the student as to the information required for admission by the school or department to which he or she is applying.
3. Once a student has submitted a formal application, the Office of Graduate Enrollment Services will prepare an applicant file. All correspondence and admission information is collected by the Office of Graduate Enrollment Services and placed in the applicant's file. The file will include an RIT application, previous college records (transcripts), applicable test scores, letters of recommendation, and other documents that may support admission of the candidate.
4. When all relevant admission data has been received, the applicant's file is sent to the appropriate school or department for review and an admission decision.
5. When the school or department has made a decision on the application, the decision and the applicant's file is returned to the Office of Graduate Enrollment Services.
6. The Office of Graduate Enrollment Services notifies candidates of admission decisions.
7. Academic departments may informally advise nonmatriculated students, but no formal program of study can be approved prior to matriculation.
8. The formal program of study will be approved by the dean's designee (department head, coordinator, program director) or other appointed person. The program must be followed by all students applying for admission or readmission.
9. The basic entry requirements for master's or doctoral degree candidates include the completion of a baccalaureate degree, the submission of support materials required by the college or department offering the program, and any other evidence that supports the applicant's potential for success. Rare exceptions to the baccalaureate requirement may be made in the case of candidates who have demonstrated unusual competence in their field of specialization. For these exceptions, the recommendation of the department chairperson/director is required in addition to the approval of the college dean and the Graduate Council.

International applicants must demonstrate English language proficiency as part of the admission process. This is normally accomplished through submission of scores from the Test of English as a Foreign Language (TOEFL). Minimum TOEFL scores vary by program, however, most programs require a minimum TOEFL score of 213 (computer-based), 550 (paper-based), or 79-80 (Internet-based). Test scores from the International English Language Testing System (IELTS) are accepted in place of the TOEFL exam. Minimum acceptable scores will vary by program, however, the absolute minimum for an unconditional acceptance is 6.5. Upon arrival at RIT, students for whom English is a second language may be required to take a number of English language exams. Upon the results, a student may be required to enroll in English instruction, which will result in additional study time and tuition cost.

In certain cases graduate students may be admitted prior to, but conditional upon, completion of the baccalaureate degree. Applicants will not be considered for admission prior to the start of the final year of undergraduate study. The student must present a final transcript covering all undergraduate study within one quarter after first registering for a graduate program.

Graduate applicants who do not fully satisfy all admission criteria (i.e.: grades, test scores, credentials), but show sufficient promise to qualify for a trial period of graduate study may be admitted to the university on probation. Such students must achieve a 3.0 (B) program cumulative grade point average by the end of their first 12 quarter credit hours of graduate study. Those students who do not meet this criterion will be suspended. Responsibility for specific requirements and maintenance of the student's appropriate status rests with the student's academic department in consultation with the Office of Graduate Enrollment Services and the Registrar. Evaluation of transfer credit is made by the academic school or department in question.

New York State immunization requirement

All students registered for four or more credits and born after January 1, 1957, must comply with New York state and RIT immunization requirements. New York State Law requires proof of immunity to measles, mumps, and rubella through either two MMR immunizations or positive blood titers for each disease. New York state also requires all students, regardless of age, to sign a meningococcal awareness form. RIT requires students age 26 and under to have the meningitis shot. Required immunizations should be obtained before arrival to avoid delay in registration or interruption of classes for which students have enrolled. Contact the Student Health Center (www.rit.edu/studentaffairs/studenthealth) with questions. Additional information and forms are available online.

Readmission

If a student has become inactive (has not completed a course in four quarters) or has withdrawn from RIT, university policy requires that he or she reapply for admission as follows:

1. Students who left a graduate program with a GPA of 3.0 or better (in good standing) and will return to the program within two years of the time their last course was completed will be readmitted to the program upon reapplication.

2. Students who left the program with a GPA of 3.0 or higher and return to the program more than two years after the last course was completed must meet current admission standards upon reapplication. The program of study is subject to review and may be rewritten. Previous waiver/transfer credit may be lost, and the student may need to make up program deficiencies.

3. Students who leave a program with a GPA below 3.0 must meet current admission standards upon reapplication. Readmission is based on all information, including previous graduate-level work. Program requirements in effect at the time of reapplication will apply. Previous waiver/transfer credit may be lost, and the student may need to make up program deficiencies.

Costs and Payment Procedures

Costs and Payment Procedures

The university reserves the right to change its tuition and fees without prior notice. Nonmatriculated students are charged graduate rates for graduate courses.

Graduate costs are listed in the table on this page. In addition, any graduate student carrying more than 18 credit hours of study will be charged the full-time tuition rate plus $999/credit hour for each hour of study exceeding 18.

Room and board for full-time students for 2012-13 will be $1,497 per quarter for a standard meal plan and $2,103 for a double occupancy room. A variety of housing options and meal plans are available, and costs may vary according to options selected.

The cost of books and supplies varies depending on the area of study and the number of courses taken by a student. The estimated cost for books and supplies ranges from $500 to $2,500 a year for full-time students and $300 to $700 a year for part-time students.

Charges for tuition, fees, and room and board are computed on a quarterly basis. University billing statements may be paid by cash, check, or electronic check (e-check). The university does not accept credit card payments for tuition, fees, and room and board that appear on the student billing statement. However, we have an arrangement for a third-party vendor to accept MasterCard and Discover Card when payment is made online. The vendor does charge a percentage fee for each credit card transaction. Billing-related payments (check) may be mailed to: Rochester Institute of Technology, Student Financial Services, P. O. Box 92878-200, Rochester, NY 14692-8978. Payment also may be made in person at the Office of Student Financial Services on the first floor of the University Services Center. Credit card and e-check payment information can be found at http://finweb.rit.edu/sfs.

Due dates are clearly designated on the billing statement and our website. Failure to pay the amount due or arrange an optional payment by the due date will result in a late payment fee.

Fall Quarter—August 15, 2012
Winter Quarter—November 15, 2012
Spring Quarter—March 15, 2013
Summer Quarter—June 15, 2013

Payment plan option information can be found at http://finweb.rit.edu/sfs/billing/billingdates.html.

Graduate Costs

TUITION	PER QUARTER	3 QUARTERS
Full-time (12–18 credit hours)	$11,992	$35,976
Part-time (11 credit hours or less)	$999/credit hour	$999/credit hour
Student activities fee	$80	$240

If you have questions concerning payment options, please contact the Student Financial Services Office, (585) 475-6186 or asksfs@rit.edu.

Electronic Billing

The university has an electronic billing (E-Bill) program for students. Each quarter, all students receive an e-mail notification to their official university e-mail account stating that their E-Bill is available. Students have the option of granting additional access to allow for a parent, guardian, sponsor, or other authorized user to receive E-Bill notifications (https://ipay.rit.edu/eServices/).

Student Accident and Sickness Insurance

All registered students are required to maintain medical insurance while attending RIT. Insurance coverage can be through RIT, a family member's policy, or a personal policy.

A student accident and sickness insurance plan is available through RIT. There is a separate charge for this insurance. The plan provides coverage, within limits specified in the policy, for sickness and injury, outpatient services, emergency care, and prescriptions.

Enrollment in this plan is voluntary for all students except registered international undergraduate students (full- and part-time) on A, B, E, F, G, I, J, K, O, Q, R, and V visas. These students will be enrolled automatically in the basic accident and sickness policy on a semiannual basis.

There is no need to waive coverage if it is not desired. Students who want to enroll in this plan may enroll online or by mail. An open enrollment period is available at the beginning of each academic quarter. Payment can be made by check, money order, or credit card, or the premium can be added to the student's account.

The open enrollment period ends 30 days after the start of the academic quarter in which the student first registers.

For plan and enrollment information, visit the Web at www.universityhealthplans.com or call (800) 437-6448. Students are not required to obtain the student accident and sickness insurance plan to receive services at the Student Health Center.

Refund Policies

The acceptable reasons for withdrawal with full refund during the quarter are:

1. Active military service: A student called to active military service during the first eight weeks of the term may receive a full tuition refund. If called after the eighth week, he or she may elect to complete the course by making special arrangements with both the instructor and department, or may withdraw and receive a full tuition refund. If he or she withdraws, the course must be repeated at a later date.
2. Academic reasons: Students sometimes register before grades for the previous quarter are available. If such a student later finds that they are subject to academic suspension or have failed to meet prerequisites, the student will be given a full refund upon withdrawal.
3. Part-time students: If a part-time student drops a course during the official drop/add period (first six days of classes in any quarter), they may contact the Student Financial Services Office for a full refund for the course dropped.

Full-time students must officially withdraw from all courses or take a leave of absence in order to be eligible for a partial tuition refund. Students must complete a leave of absence or withdrawal form, which can be initiated with their academic department. A partial refund will be made during a quarter if withdrawal/leave of absence is necessitated for one of the following reasons:

1. Illness, certified by the attending physician, causing excessive absence from classes,
2. Withdrawal for academic or disciplinary reasons at the request of RIT during a quarter,
3. Transfer by employer, making class attendance impossible, or
4. Withdrawal for academic, disciplinary, or personal reasons at the request of the student, approved by the student's adviser or department representative, and the Student Financial Services Office.

Partial refund schedule for tuition

Partial refunds will be made according to the following withdrawal schedule and percentage of tuition reduction:

1. During official drop/add period—100 percent tuition reduction
2. From the end of the official drop/add period through the end of the second week of classes—70 percent tuition reduction
3. During the third week of classes—60 percent tuition reduction
4. During the fourth week of classes—50 percent tuition reduction
5. During the fifth week of classes—25 percent tuition reduction
6. Sixth and subsequent weeks—no tuition reduction

Note: *Nonattendance does not constitute an official withdrawal.*

A student is not officially withdrawn until he or she receives a copy of the withdrawal form. The date on which a withdrawal form is properly completed will be the date of official withdrawal, used to determine the refundable amount.

If the student drops their course load from full-time (12 or more credits) to part-time (less than 12 credits) status during the official drop/add period, they may contact the Student Financial Services Office for a refund based on the difference between the full-time tuition charge and the total per-credit charge for the part-time course load.

No refund will be made for classes dropped after the official drop/add period unless the student is officially withdrawing from the university. Advance deposits are not refundable.

If institutional charges are reduced due to withdrawals, financial aid programs are reimbursed before a cash refund is issued to the student. The student also is responsible for any unpaid balance at the time of withdrawal. Aid programs are reimbursed in the following sequence: Federal Direct Unsubsidized Loan, Federal Direct Subsidized Loan, Graduate PLUS Loan, Parent PLUS Loan, Federal Pell Grants, Federal SEOG, other federal grants, state aid, institutional aid. If a credit balance still remains, the student is then issued a refund.

For further information or comments regarding refund policies and specific withdrawal dates, contact the Student Financial Services Office.

Appeals process

An official appeals process exists for those who feel that individual circumstances warrant exceptions from published policy. The inquiry in this process should be made to Mary Beth Nally, director of Student Financial Services.

Partial refund schedule for room and board

To complete a withdrawal from RIT, a resident student must check out with Housing Operations. All students on a meal plan should check out with the Food Service administrative office, located in the Student Alumni Union, room A520 (lower level). Refunds, when granted, are from the date of official check out. Room and board refund policies are established by the Center for Residential Life and RIT Food Service.

Room

1. During the first week of classes—90 percent of unused room charge
2. During the second week of classes—75 percent of unused room charge
3. During the third week of classes—60 percent of unused room charge
4. During the fourth week of classes—50 percent of unused room charge
5. Fifth and subsequent weeks—no refund

Board

1. Within the first four weeks—75 percent of the unused meal/debit charges
2. After the fourth week (during week five through the end of week eight)—50 percent of the unused meal/debit charges
3. During the last two weeks of classes—no refund

Any student who intentionally defrauds or attempts to defraud the university of tuition, fees, or other charges, or who gives false information in order to obtain financial aid, is subject to legal liability, prosecution, and university disciplinary action.

Financial Aid

www.rit.edu/financialaid

General Information

RIT offers a full range of financial aid programs to assist graduate students with their educational expenses. The information provided in this section is an overview of the sources of assistance available. Please consult the Office of Financial Aid and Scholarships' website for more detailed information.

Scholarships and assistantships are available in most graduate departments. In addition, some departments offer externally funded tuition remission and stipends from corporate or government sponsors. Please contact the appropriate graduate program director or the Office of Graduate Enrollment Services for additional information.

Financial aid awards are offered only once a student is accepted. Awards are generally given to full-time students, but exceptions are made for qualified part-time students.

International students (F-1 or J-1 visa holders) may generally work on campus for up to 20 hours per week. Special authorization from International Student Services and/or the INS is needed for all other employment, including co-ops and internships. Please consult International Student Services at (585) 475-6943 or www.rit.edu/studentaffairs/iss/ for employment or visa questions.

All federal student aid programs require submission of the Free Application for Federal Student Aid (FAFSA). The FAFSA may be completed online at www.fafsa.gov.

Federal regulations require financial aid recipients to maintain minimum standards of satisfactory academic progress (SAP) for continued receipt of federally sponsored aid. All students receiving federal assistance must remain admitted in a degree program. Regulations require a maximum time frame for degree completion, a quantitative measurement (complete two thirds or 66.6% of credit hours attempted) and a qualitative measurement (2.0 minimum cumulative grade point average). Credit hours attempted include withdrawals, repeated courses, incompletes, grade exclusions, nonmatriculated courses, and credit by exam. The annual review of academic progress at the end of spring term each year considers all terms of enrollment, including terms in which no federal aid was received. Students whose academic progress is not in compliance with federal regulations will be notified of the deficiency. Students who do not meet minimum SAP standards may continue to receive federal aid during a probationary period, not to exceed one academic year, as the result of an academic appeal initiated with the Office of Financial Aid and Scholarships, and in coordination with the academic department. Please refer to the Graduate Bulletin section titled Registration and Degree Requirements for additional information about making satisfactory academic progress.

In addition, loan eligibility for students with full-time-equivalent status is limited to a maximum of four quarters.

Financial Aid Refund Policy

Return of federal funds

In accordance with federal regulations, the Office of Financial Aid and Scholarships recalculates quarterly federal aid eligibility for students who withdraw, drop out, are suspended, or take a leave of absence prior to completing 60 percent of a quarter. "Withdrawal date" is defined as the actual date the student initiated the withdrawal process, the student's last date of recorded attendance or the midpoint of the quarter for a student who leaves without notifying the university. Recalculation is based on the percent of earned aid using the following formula: number of days completed up to the withdrawal date/total days in the quarter. Aid returned to federal programs is then equal to 100 percent minus the percentage earned multiplied by the amount of federal aid disbursed.

Funds are returned to the federal government in the following sequence: Federal Direct Unsubsidized Loans, Federal PLUS Loans, Federal Perkins Loans, other federal aid.

Late disbursement

If the student is otherwise eligible, the first disbursement of Federal Direct Unsubsidized Loan proceeds is allowed up to 180 days after the student has ceased to be enrolled. Subsequent disbursements are not allowed.

State scholarships

Regulations vary. Any adjustments are done in accordance with the specific requirements of the sponsoring state.

Privately funded grants and scholarships

In the absence of specific instructions from the sponsor, 100 percent of the quarterly award will be credited to the student's account.

RIT grants and scholarships

If a credit balance remains after all federal, state, and private adjustments, a percentage of the remaining credit balance is returned to the RIT scholarship account according to the following formula, where A=scholarship amount; B=scholarship plus student payments; c=percent returned to scholarship program; and d=remaining credit balance:

$$\frac{A}{B} = \mathrm{CxD}$$

Financial Aid Programs

GRANTS/SCHOLARSHIPS	ELIGIBILITY	AMOUNT	HOW TO APPLY
Graduate Assistantships	Graduate student matriculated into an RIT graduate degree program.	Amounts vary	Complete Graduate Admissions Application and check appropriate box to be considered for graduate assistantships.
Graduate Merit Scholarships	Graduate student matriculated into an RIT graduate degree program.	Amounts vary	Complete Graduate Admissions Application and check appropriate box to be considered for graduate scholarship.
Vietnam Veterans Tuition Award Program	Eligible Veterans who are New York state residents.	$5,295 per year for full-time study; available for undergraduate or graduate study.	File the Free Application for Federal Student Aid (FAFSA) and TAP Application. Also file the Vietnam Veterans Tuition Award Supplement at www.hesc.com.
Veterans Benefits	Eligible veterans and children of deceased veterans, or service-connected disabled veterans.	Amounts vary.	Contact: Office of Veterans Affairs at (888) 442-4551, or visit their website at www.va.gov.
Bureau of Indian Affairs Graduate Fellowship Grants	Enrolled full-time and recognized by Secretary of the Interior as a member of an Indian tribe and demonstrating financial need and academic achievement.	Amounts vary	Contact American Indian Graduate Center (AIGC) at (800) 628-1920, or on the Web at www.aigc.com.

LOANS	ELIGIBILITY	AMOUNT	HOW TO APPLY
Federal Direct Loans	Matriculated students who are enrolled at least half-time and who are U.S. citizens or permanent residents.	Maximum amount: $20,500. The maximum amount cannot exceed the cost of education minus all other financial aid awarded.	File the Free Application for Federal Student Aid (FAFSA). (must be a U.S. citizen or Permanent Resident)
Federal Perkins Loan	Students who meet requirements established by federal government.	Up to $8,000 per year; $40,000 limit for undergraduate and graduate study.	File the Free Application for Federal Student Aid (FAFSA). (must be a U.S. citizen or Permanent Resident)
Private Alternative Loans	Enrolled student who is credit-approved by lender.	Up to the cost of education minus all other financial aid awarded.	Consult the Office of Financial Aid and Scholarships website www. rit.edu/financialaid or contact the private lender directly.

EMPLOYMENT	ELIGIBILITY	AMOUNT	HOW TO APPLY
Federal Work Study Program	Students who are U.S. citizens or permanent residents with financial need: most jobs provided are on campus, and some community service positions are available.	Varies, depending on hours and wage rate (RIT wage rates start at $7.40 per hour).	File the Free Application for Federal Student Aid (FAFSA). Contact the RIT Student Employment Office at www.rit.edu/emcs/seo.
RIT Employment Program	No financial need requirement; may be on campus or off campus.	Varies, depending on hours and wage rate (RIT wage rates start at $7.40 per hour).	Contact the RIT Student Employment Office at www.rit.edu/emcs/seo.

This chart covers the most commonly awarded financial aid programs available to full-time graduate students at RIT. Information is correct as of May 2012. Most graduate programs require satisfactory progress toward degree completion to maintain eligibility. Filing the FAFSA by April 1 will ensure priority consideration for all programs. Applications filed after this date will receive consideration as long as funds remain available. Scholarships provided by RIT will be prorated for NTID-sponsored students to reflect lower NTID tuition rates.

Registration and Degree Requirements

A graduate degree at RIT may be obtained in more than 70 programs ranging from business administration to imaging science. (Please refer to page 4 for a complete listing of graduate programs of study.)

Upon completion of the stipulated requirements, students are certified by their academic departments for their degree. After commencement, a statement verifying that a degree has been awarded will be posted to the transcript. Diplomas for fall graduates are mailed in winter quarter; for winter graduates, in spring; for spring graduates, in the summer; and for summer graduates, in the fall.

Registration

1. Student should complete the registration and payment process in accordance with university registration/billing procedures, as indicated in the current registration guide.
2. It is the responsibility of the student to update their address online through the Student Information System (SIS), or to advise the registrar of any change of address.
3. University ID cards are required for students to use many campus facilities and services (e.g., the library, Student Life Center, meal plans, check cashing). Identification cards are available at the Registrar's Office.
4. Students are expected to pursue their degree without a substantial break. Failure to enroll (register) for four successive academic terms can result in the loss of matriculated status.
5. RIT considers graduate-level students to be "full time" in every academic quarter in which they are enrolled for at least 12 credit hours. With approval of the department chair and associate provost for academic programs, additional equivalent credit can be granted for such activities as thesis work, teaching assistantships, and internships.

Matriculation

Matriculated graduate students are those who have applied to and been formally accepted into a graduate program through the Office of Graduate Enrollment Services. Such students may register for graduate-level courses (700 and above) that fit their home department-approved programs. When registering for graduate courses outside the home department, students may need to secure the approval of the department offering the course.

Nonmatriculated students will be allowed to take graduate courses on a space-available basis with the department's approval, and with the knowledge that course work completed while a nonmatriculated student will not necessarily apply to any given academic program.

Matriculated and nonmatriculated graduate students may register for undergraduate-level courses with the understanding that these courses may not apply to any RIT graduate program. In certain cases, where educationally sound programs will result, appropriate undergraduate courses, as approved by the faculty adviser and the department, may be included in a master's program. However, not more than nine undergraduate quarter credit hours (600-level or below) may be applied toward the 45-quarter-credit minimum (12 undergraduate hours for those programs requiring 48 or more quarter credit hours). Where undergraduate work is allowed, it must be well-planned and closely controlled. In the vast majority of cases, most, if not all, course work will be at the graduate level.

Degree Requirements

Credit requirements

The minimum credit requirement for a master's degree is 45 quarter credit hours. At least 36 of these quarter credit hours must be earned at the graduate level and in residence at the university.

Transfer credit

A maximum of nine quarter credit hours in a 45-credit-hour program or 12 quarter credit hours in a 48 or more credit-hour program may be awarded as transfer credit from other institutions. A request for transfer credit must be made at the time of application for graduate student status. Only a course with a grade of B (3.0) or better may be transferred.

Transfer credits are not calculated in the student's grade point average but will count toward overall credit requirements for the degree. Transfer credits do not count toward the satisfaction of residency requirements.

A graduate student who wishes to take courses at another institution and transfer them toward degree work at RIT must obtain prior permission from the appropriate departmental officer or dean.

Candidacy for an advanced degree

A graduate student must be a candidate for an advanced degree for at least one quarter prior to receipt of the degree. The position of the Graduate Council is that a student is a candidate for the master's degree when they are formally admitted to RIT as a graduate student.

Thesis requirements

Included as part of the total credit-hour requirement may be a research, dissertation, thesis, or project requirement, as specified by each department. The amount of credit the student is to receive must be determined by the time of registration for that quarter. For the purpose of verifying credit, an end-of-quarter grade of R should be submitted for each registration of research and thesis/dissertation guidance by the student's faculty adviser. Before the degree can be awarded, the acceptance of the thesis/dissertation must be recorded on the student's permanent record. Students also should note the following continuation of thesis/dissertation policy.

Students who complete a thesis or dissertation as a requirement for their master's or doctoral degree are required to submit a hard copy of the document to the Wallace Library to be placed in the Archives. Students also are required to submit an electronic copy of the thesis or dissertation to ProQuest/UMI for publication.

Continuation of thesis/project/dissertation

Once work has begun on a thesis, project or dissertation, it is seen as a continuous process until all requirements are completed. If a thesis, project, or dissertation is required, or such an option is elected, and if the student has completed all other requirements for the degree, the student must register for the Continuation of Thesis/Project/Dissertation course each quarter (including summer quarter). This course costs the equivalent of one-quarter credit hour, although it earns no credit.

1. Registration for the Continuation of Thesis/Project/Dissertation course preserves student access to RIT services; e.g., Wallace Library, academic computing, and faculty and administrative support. With payment of appropriate user fees, access to the Student Life Center and Student Health Center also is preserved.
2. If circumstances beyond students' control preclude them from making satisfactory progress on their thesis/project/dissertation, they should consider taking a leave of absence and discuss such a leave in advance with their adviser/department head. The dean's signature of approval is required on the Leave of Absence or Institute Withdrawal form, a copy of which also must be sent to the associate provost for academic programs. If students do not register for the Continuation of Thesis/Project/Dissertation course, or take an approved leave of absence, their departments may elect to remove them from the program.
3. The length of time to complete a thesis/project/dissertation is at the discretion of the department. Be sure to read, however, the first point under "Summary of requirements for master's degree" on this page.

Note: The dissertation is required only of Ph.D. students.

Summary experience

The Graduate Council regards some form of integrative experience as necessary for graduate students. Such requirements as the comprehensive examination, a project, the oral examination of the thesis, and a summary conference are appropriate examples, provided they are designed to help the student integrate the separate parts of their total educational experience. The nature of the experience will be determined by the individual college or department.

Overlapping credit for second degree

At the discretion of the Graduate Committee in the specific degree area, nine to 12 previous master's quarter credit hours normally can be applied toward satisfying requirements for a second master's degree. The use of a given course in two different programs can be allowed only if the course that was used for credit toward the first degree is a required course for the second degree. The course must be used in both programs within five years; i.e., no more than five years between the time used for the first degree and when applied again toward the second degree.

In no case shall fewer than the minimum 36 quarter credit hours of residency be accepted for the second degree. If duplication of courses causes a student to go below the 36-hour limit in the second degree program, he or she would be exempted from these courses but required to replace the credit hours with departmentally approved courses. An RIT student will not be admitted through the Graduate Enrollment Services Office to the second degree program until the first program has been completed.

Financial standing

Tuition and fees paid to the university cover approximately 60 to 70 percent of the actual expense of a student's education. The rest of the cost is borne by the university through income on its endowment, gifts from alumni and friends, and grants from business and industry. Students, former students, and graduates are in good financial standing when their account is paid in full in the Student Financial Services Office. Any student whose account is not paid in full will not receive transcripts, degrees, or recommendations from RIT.

The university reserves the right to change its tuition and fees without prior notice.

Summary of requirements for master's degree

1. Successfully complete all required courses of the university and the college. These requirements should be met within seven years of the date of the oldest course counted toward the student's program. Extension of this rule may be granted through petition to the Graduate Council.
2. Complete a minimum of 45 quarter credit hours for the master's degree. At least 36 quarter credit hours of graduate-level course work and research (courses numbered 700 and above) must be earned in residence at RIT.
3. Achieve a program cumulative grade point average of 3.0 (B) or better.
4. Complete a thesis/project/dissertation or other appropriate research or comparable professional achievement, at the discretion of the degree-granting program.
5. Pay in full, or satisfactorily adjust, all financial obligations to the university.

Note: The dean and departmental faculty can be petitioned, in extraordinary circumstances, to review and judge the cases of individual students who believe the spirit of the above requirements have been met yet fall short of the particular requirement. If the petition is accepted and approved by the faculty, dean, and provost and vice president for academic affairs, a signed copy will be sent to the registrar for inclusion in the student's permanent record.

Definition of grades

Grades representing the students' progress in each of the courses for which they are registered are given on a grade report form at the end of each quarter of attendance. The letter grades are as follows:

- A Excellent
- B Good
- C Satisfactory
- D and F grades do not count toward the fulfillment of program requirements for a master's degree.

The grades of all courses attempted by graduate students will count in the calculation of the cumulative grade point average. This program cumulative grade point average shall average 3.0 (B) as a graduation requirement. The dean of the college or their designee must approve all applications for graduate courses a student wishes to repeat.

Quality points

Each course has a credit-hour value based on the number of hours per week in class, laboratory, or studio and the amount of outside work expected of each student. Each letter grade yields quality points per credit hour as follows:

- A Four quality points
- B Three quality points
- C Two quality points

- D One quality point
- F does not count in computing the grade point average (GPA)

The GPA is computed by the following formula: GPA = total quality points earned divided by total credit hours attempted. There are other evaluations of course work that do not affect GPA calculations. Only I and R (as described below) can be assigned by individual faculty members at the end of a quarter.

Registered (R)—This permanent grade indicates that a student has registered for a given course but has yet to meet the total requirements of the course or has continuing requirements to be met. The grade is given in graduate thesis/dissertation work. Completion of this work will be noted by having the approved/accepted thesis/dissertation title, as received by the registrar from the department, posted to the student's academic record. Full tuition is charged for these courses. Courses graded R are allowed in the calculation of the residency requirement for graduate programs.

Incomplete (I)—This notation is given when the professor observes conditions beyond the control of the student such that the student is not able to complete course requirements in the given quarter. This is a temporary grade that reverts to an F if the registrar has not received a change of grade directive from the professor by the end of the second succeeding quarter (including summer terms). Full tuition is charged.

Withdrawn (W)—This notation will be assigned in courses from which a student withdraws through the end of the eighth week of classes, or if a student withdraws from all courses in a given quarter.

Audit (Z)—This notation indicates a student has audited the course. An audit request form must be completed and approved by the department offering the course. The student need not take exams, and half tuition will be charged. A student can change from credit to audit or from audit to credit status for a course only during the first six days of classes. Audited courses do not count toward the residency requirement, do not get included in GPA calculations, and do not count toward degree requirements.

Credit by examination (X)—This notation is assigned for the successful completion of various external or university examinations, provided such examinations cover or parallel the objectives and content of the indicated course. Credit must be assigned in advance for any credit received through registration for the indicated courses. Courses graded X do not count toward the residency requirement. A maximum of 12 quarter credit hours is allowed for graduate courses. Exceptions to the maximum transfer credit or credit-by-exam for graduate programs can be granted by the associate provost for academic programs in unusual circumstances, upon appeal from the dean of the college involved.

Waived—Waived courses are those courses eliminated from the list of requirements that a student must take to graduate. For graduate students, required courses may be waived because of previously completed academic work, but in no case shall the resulting graduate program requirements be reduced below 45 quarter credit hours.

In addition, waiver credit for graduate courses can be applied only toward required, not elective, courses. The process of waiving courses and thereby reducing graduate program requirements is not to be confused with the process of exempting certain requirements that are then replaced by an equal number of credit hours in the specified program.

Changing grades

Once a grade has been reported by a faculty member, it is not within the right of any person to change this unless an actual error has been made in computing or recording it. If an error has been made, the faculty member must complete the appropriate form. The completed form must be approved by the head of the department in which the faculty member teaches. When approved, the form is then sent to the registrar. There is, however, an appeal procedure for disputed grades through the Academic Conduct Committee of the college in which the course is offered. A final appeal can be sent to the university's Hearing and Appeals Board.

Academic probation and suspension

Any matriculated graduate student whose program cumulative GPA falls below a 3.0 after 12 quarter credit hours will be placed on probation and counseled by the departmental adviser concerning continuation in the graduate program.

Those students placed on probation must raise their program cumulative GPA to the 3.0 level within 12 quarter credit hours or be suspended from the graduate program.

Should it be necessary to suspend a graduate student for academic reasons, the student may apply for readmission to the dean of the college or his designee upon demonstration of adequate reason for readmission.

Standards for student conduct

The RIT community intends that campus life will provide opportunities for students to exercise individual responsibility and places high priority on self-regulation by its members. All members of the community are responsible for encouraging positive behavior by others, as well as preventing or correcting conduct by others that is detrimental to RIT's educational mission and values.

As an educational community, RIT strives for a campus environment that is free from coercive or exploitative behavior by its members. Moreover, it sets high standards that challenge students to develop values that enhance their lives professionally and will enable them to contribute constructively to society.

RIT enjoys a diversity of backgrounds, lifestyles, and personal value systems among those who compose the academic community. Students, however, are expected to observe and respect the policies and standards of the university and the right of individuals to hold values that differ from their own and those expressed by RIT. Students are encouraged to review the *Student Rights and Responsibilities Handbook* for information regarding campus policies and expectations of student conduct.

Students must recognize that they are members of the local, state, and federal communities, and that they are obliged to live in accord with the law without special privilege because of their status as students or temporary residents.

RIT offers a number of services for graduate students. Those described in the following pages are among the most frequently used.

Student Services

Academic Support Center

www.rit.edu/asc
(585) 475-6682

The Academic Support Center provides academic assistance to students, faculty, and staff. The center offers drop-in services for mathematics/physics and writing support for all levels of students, from freshmen to graduates. In addition to skill development, the center offers workshops that teach students how to improve their study techniques and make the most of their individual learning abilities. Individualized appointments are available as well as assessment of learning challenges. Academic Support Center services are free to RIT students (structured monitoring services are fee-based).

Academic Assessment Program: The goal of the Academic Assessment Program is to help students determine why their academic performance is not what they, or others, would like it to be. The variety of factors that may interfere with academic performance includes learning style, content background, study habits and approaches, unclear choice of major, and/or disabilities. The AAP uses interviews, surveys, screening instruments, and diagnostic testing to explore potential sources of difficulty; helps students identify the source of academic problems; and assists them in overcoming these obstacles by referring them to resources both on and off campus.

Institute Testing Services: Institute Testing Services is dedicated to providing design, implementation, and administration of group testing programs for students and community groups. The department is responsible for RIT's role as a National Testing Center and supervises the administration of the Graduate Record Examination (GRE) subject exams, Scholastic Achievement Test (SAT), Law School Admission Test (LSAT), National Certified Counselors (NCC) certification examination, and DANTES examination. Institute Testing Services also serves as a paper and pencil proctoring site for distance learners.

Structured Monitoring Program: This program is committed to helping individuals recognize and access their natural learning abilities and offers academic coaching designed for students who anticipate difficulties navigating the complexities of the academic environment. Structured Monitoring recognizes that each student is unique and responds by offering three levels of check-ins: biweekly, weekly, or daily. Students may select their level of participation on a quarterly basis. This is a fee-based service.

Mathematics services: The center's math program supports students' progress in learning mathematics. Tutors are located in the Bates Study Center in the Gosnell Building. This is a drop-in tutoring center staffed with peer tutors and ASC faculty. Tutors can help students with math and physics homework, lecture notes, textbook reading, practice quizzes, and practice tests. Math review packets cover topics in algebra, trigonometry, and calculus. Students encountering difficulties in their math courses may schedule an appointment with an ASC math instructor for a math assessment. Individualized math is a non-credit, self-paced math review course offered to students who have completed a math assessment. Students follow a unique program of study based on their math background and future math needs.

Reading services: ASC provides reading strategies for students who are having difficulty deciphering their textbooks. Services provided include standardized reading testing and evaluation, informal reading assessment, textbook strategies, ways to improve vocabulary, and information about speedreading.

Supplemental instruction: Supplemental Instruction offers a series of weekly study Sessons open to all students enrolled in supported sections of historically difficult courses. During SI, students meet to compare notes, discuss important concepts and develop study strategies. These voluntary study sessions are planned and facilitated by an undergraduate student leader, who has recently completed the course. To view a list of SI supported course sections or to learn more about how to become an SI Leader, please visit si.rit.edu.

Study skills: Students have the opportunity to meet with faculty who will assist in the development of study strategies to promote academic success. Individual instruction, coaching, and evaluation are available. Students will find a series of one-hour workshops offered each quarter that includes topics such as time management, listening and notetaking, text reading and marking, test taking, and test preparation. Student groups may request workshops and presentations from study skills faculty. Additionally, students will find materials on the ASC website.

Tutor training: A comprehensive and up-to-date website lists all available tutorial services on campus. In addition, tutor training workshops are offered for peer tutors who have been hired in any of the learning centers or academic departments. The tutor training program does not offer content training. For more information visit www.rit.edu/tutoring.

Writing Center: The Writing Center provides individualized instruction designed to improve students' ability to complete college writing assignments. Writing instructors work with students at every stage of the writing process. Instruction can be provided to develop students' editing and proofreading skills. This is a drop-in center with no appointments necessary.

Study centers:

- Bates Study Center (1200 Gosnell) provides support in mathematics and physics.
- ASC Writing Center (1180 SAU) provides instruction on becoming a more effective writer.
- Sol Study Center (1016 Sol Heumann Residence Hall) provides support in mathematics/physics and writing during weekday evening hours.
- Global Village Study Center (Study Abroad Conference room) provides support in mathematics and physics during weekday evening hours.

Campus Stores

rit.bncollege.com
Barnes & Noble@RIT—The official college bookstore is located at Park Point. The 40,000-square-foot store features educational textbooks for all courses, 60,000 titles, and RIT-related merchandise. The store offers wireless access, a Starbucks Café, and regular shuttle service to and from campus.

Digital Den—Located in the Student Alumni Union, the Digital Den offers a wide array of merchandise including computer equipment, hardware and software, iPods, and photography equipment and accessories. The store is staffed with knowledgeable personnel who can offer guidance on equipment and purchases.

Cooperative Education and Career Services

www.rit.edu/emcs/oce/
(585) 475-2301
The Office of Cooperative Education and Career Services offers a wide range of programs and services to support the career development and employment needs of all RIT students. The office offers one-on-one advising as well as job search seminars and presentations. It also provides online access to employment opportunities. Working relationships with thousands of employing organizations can help graduate students develop their individual job search plans. Graduate students are encouraged to meet with their assigned program coordinator in the Office of Cooperative Education and Career Services early to begin their career planning. Information is available through the website, by visiting the office on the first floor of the Bausch and Lomb Building, or by making an appointment.

Counseling Center

www.rit.edu/counseling
(585) 475-2261
University life can be one of excitement and self-discovery. At the same time, it can generate academic, emotional, personal, social, and even financial concerns. At times these concerns can make it difficult to succeed or function while at school. Counseling is an excellent way to address such issues, to learn more about yourself and others, and to develop new life skills.

The center's staff of professional counselors and psychologists is committed to supporting your academic and personal success. Counselors work with students whose concerns range from the everyday challenges of university life to more disruptive psychological issues. All services provided by the center are free to eligible students. Counselors fluent in American Sign Language are available for deaf and hard-of-hearing students.

Common concerns shared by students include:

- Academic performance
- Choice of major or careers
- Anxiety or stress
- Depression
- Feeling overwhelmed
- Self-esteem
- Family, friend, and partner relationships
- Eating and body image concerns
- Loss of an important relationship
- Illness or death of a loved one
- Out-of-control feelings
- Sexual orientation
- Sexual assault and violence
- Race, ethnicity, nationality, or other cultural identity
- Gender identity
- Suicidal feelings

Location: The Counseling Center is located in the August Center, immediately above the Student Health Service.

Hours:
Monday – Friday: 8:30 a.m. - 4:30 p.m.
Wednesday evenings – by appointment only

Mental health emergencies: If the emergency is life threatening, call 911 or go to the nearest emergency room. For emergencies during business hours (8:30 a.m. – 4:30 p.m.), call (585) 475-2261 or come to the center and identify the situation as an emergency. If you or someone else is in physical danger, call Public Safety at (585) 475-3333. Do not use e-mail in an emergency situation. For after-hours emergencies, contact Public Safety or Life Line (585) 275-5151, a confidential Rochester hotline.

Career exploration counseling: Counselors can assist students in making thorough appraisals of their interests, abilities, and personality traits so they can use this information in developing educational and vocational plans. Aptitude, interest, and personality tests may be used in this assessment process.

Career exploration resources: Located in the reception area of the center, career exploration resources include occupational information on a variety of careers, as well as vocational and educational reference books. The center and its resources are available on a walk-in basis.

Confidentiality: All counseling services are confidential. The center will not release information about students without a student's written permission except where required by law, as required to protect the student or others from physical danger, or upon court order (an extremely rare occurrence).

Making an initial appointment: Schedule an intake appointment by calling (585) 475-2261 or by visiting the center. During the initial visit, which lasts approximately 90 minutes, students will be asked to complete a confidential questionnaire and to briefly speak with an intake counselor about their immediate concerns.

Upon reviewing the student's intake information, a counselor will briefly explain options that may be appropriate. These might include: scheduling a follow-up appointment with a counselor, getting the student into a support or therapy group, or referring the student to another RIT office for services.

If the intake counselor recommends counseling at the center, students will be assigned a counselor and scheduled for a subsequent appointment. On occasion, students are referred to community resources for specialized or continued counseling. In such instances, the center will assist them in locating a suitable resource.

Disability Services

www.rit.edu/dso
(585) 475-2023
RIT is committed to providing students with disabilities equal access to programs, services and physical facilities, and to fostering an environment where all community members are welcomed, valued, and respected.

Students who would like to request accommodation due to a disability should submit a "Request for Accommodations" form and appropriate documentation of the disability to the Disability Services Office. The request form can be found online or requested from Disability Services.

The director will review a student's request for accommodation and supporting documentation and recommend appropriate and reasonable accommodations as needed.

Diversity at RIT

Office for Diversity and Inclusion
www.diversity.rit.edu
(585) 475-6546
The Office for Diversity and Inclusion serves as a vital resource to develop and implement campus-wide initiatives and programs to promote diversity and inclusive excellence to students, faculty, and staff. Through various programs and special projects, the office fosters relationships between RIT and the greater Rochester community. The office is committed to the development of diversity education and monitors areas that target diverse populations across the university.

Multicultural Center for Academic Success
www.rit.edu/mcas
(585) 475-4704
The Multicultural Center for Academic Success serves all students regardless of their ethnic background. Our mission is to aid in the retention and graduation of African American, Latin American, and Native American students. MCAS offers programs that focus on academic excellence, mentoring, community development, leadership, and professional success. MCAS also offers a variety of professional development events, cultural heritage months, celebrations of diversity, and partnerships with student clubs and organizations to help students connect with the RIT community and establish a positive sense of campus life that celebrates RIT's cultural diversity.

McNair Scholars Program
www.rit.edu/mcnair
(585) 475-7611
The Ronald E. McNair Post-baccalaureate Achievement Program serves a diverse group of talented second- and third-year students who are interested in pursuing post-baccalaureate education. The program provides enriching scholastic experience that prepares eligible scholars for graduate education, with an emphasis on doctoral studies. This preparation includes research experience, the presentation of research at local and regional symposiums, and graduate school seminars and workshops.

Future Stewards Program
www.rit.edu/futurestewards
(585) 475-4982
The Future Stewards Program was established to increase the success rate and number of Native scholars (Native American, Alaska Native, and First Nations) in science, technology, engineering, and math disciplines, along with other areas of need in Indian society. The program partners with students and Tribal nations, organizations, and corporations to create opportunities for Native scholars to develop professionally, personally, and culturally. The program is dedicated to helping Native scholars succeed by recruiting, retaining, and returning scholars to the Tribal community upon graduation.

English Language Center

www.rit.edu/studentaffairs/elc/
(585) 475-6684 (voice/TTY)
The English Language Center offers both full- and part-time study of English to non-native speakers. Class offerings include conversation, grammar, writing, vocabulary, reading, pronunciation, presentation skills, business communication, and TOEFL preparation.

Full-time program: The intensive English language program consists of 20 hours of class instruction each week at beginning, intermediate, and advanced levels. There is also a learning lab where students may work on specific language skills and obtain extra assistance with their writing. There is a fee for English language services. This intensive study program meets the immigration requirements for the Certificate of Eligibility I-20 for F-1 student status.

Before a course of study can be selected, students are tested to determine their levels of English proficiency and diagnose their specific language needs.

Part-time program and individualized instruction: In addition to the full-time program, students may register for one or more English language courses. The center also offers private English classes tailored to individual needs. Pronunciation and conversation, as well as grammar, writing, reading, and vocabulary, may be studied in this manner. There is a fee for instruction.

Foreign language instruction: The center offers a fee-based program in which international students give lessons in their native languages. A trained language instructor supervises all student instructors. In addition to language, the international student can give lessons on the culture and customs of his or her country. Some of the languages offered have included Chinese, Japanese, Spanish, Portuguese, Hindi, Tagalog, Korean, French, and German.

ETC Production Services

http://www.rit.edu/academicaffairs/etc/
(585) 475-7703
ETC Production Services provides non-classroom production and event support. Individual services include:

Video production services: A full range of digital standard or high definition video services, including recording guest speakers in auditoriums, creating public relations marketing videos, producing RIT's SportsZone and SportsZone Live shows, videotaping in television studios, and editing in state-of-the-art digital post-production facilities as well as 2D and 3D animation. Finished projects can be captioned and delivered a variety of formats, including DVD, CD, Blu-ray, podcast, web or videotape.

Web/IT services: Multimedia and Web production services include website design and development, website updates, online registration systems, multimedia presentations, database development, and video streaming.

Event support services: Production and management of large and small venue video and multimedia productions, media projection, location shooting, multi-camera support, live video streaming, and real-time captioning.

Photography services: A range of digital photographic services in studio or on location, creating visual resources for slide presentations, class documentation, portfolios, websites and, publications.

Housing Operations

housing.rit.edu
(585) 475-2572
Serving nearly 7,000 students, campus housing offers many living options to meet the diverse needs, interests, and backgrounds of RIT students.

RIT Inn and Conference Center

The RIT Inn and Conference Center, located near campus, offers a student living environment combined with the perks of a first-rate hotel including fully furnished double rooms with private baths, TV with free cable service, phone with free local service, free high-speed Ethernet, free housekeeping, free reserved parking pass, and air conditioning. Students also have access to a heated indoor/outdoor pool, sauna whirlpool, fitness center, three on-site dining facilities, free laundry service, and free express shuttle service.

Apartments, University Commons Suites, Global Village

Five apartment and suite complexes with 950 apartment, suite, and townhouse units, ranging from one to four bedrooms, make up RIT's apartment and suite offerings. Additionally, Global Village offers 70 furnished suites with single and double bedroom options, as well as suites with and without kitchens. Although the majority of apartment, suite, and Global Village residents are undergraduates, each complex features a mixture of graduate and undergraduate, single and married students. Each complex offers the privacy of a small community and numerous amenities including free standard cable, free laundry service, utilities included, and much more.

The Housing Connection

Housing Connection is an online roommate and apartment referral service that provides an opportunity for upperclass students to post openings within the on-campus apartment complexes. Students use this site to look for housing within the apartments (roommate available), or to fill a vacancy in an apartment (roommate wanted).

Information and Technology Services

www.rit.edu/its/
(585) 475-4357
Campus computing and network services are provided by Information and Technology Services (ITS).

Wireless, Google Apps at RIT, and more

The campus-wide network includes high-speed wireless capabilities in all buildings on campus (except for the Riverknoll apartments and the RIT Inn & Conference Center). All RIT students are provided access to Google Apps at RIT, which includes RIT Gmail, the home for student e-mail accounts.

A campus-wide online portal is available at http://my.rit.edu. Users can customize their own site on the portal with personal Web links in addition to standard features as access to student government and RIT sporting events, University News, and the Student Information System, where individual student course information and grades are posted.

ITS, in conjunction with the Educational Technology Center, manages numerous computer labs and smart classrooms containing Windows and Macintosh workstations and printers. Most of these facilities are available to students for general computing use and to faculty for reserved class work. Lab assistants help people use the hardware and software available in the labs.

RIT computer accounts

Computer accounts are issued to students, faculty, and staff so that they can perform activities supporting educational goals and internal RIT functions. Incoming students will receive instructions for setting up their computer account upon payment of their tuition deposit. This allows students to use their accounts, get familiar with campus online systems, and feel more a part of the RIT community before they arrive.

Computer security and safeguards

RIT's Code of Conduct for Computer and Network Use guides campus-wide use of all computers and networks. This document, found online at www.rit.edu/computerconduct, outlines RIT's official policy related to ethical use of computing and network resources. ITS put into place multiple safeguards to protect RIT's network environment and the integrity of individual user accounts. Additionally, ITS provides all students, faculty, and staff with anti-virus software free of charge.

Computer-based training

ITS, along with the Center for Professional Development, provides computer-based training modules that cover a wide variety of topics. Students, faculty, and staff can access numerous online courses in the areas of technology, e-business, and business/interpersonal skills. For more information on computer-based training, visit www.rit.edu/eLearningZone.

Student employment information

ITS employs more than 250 students and is one of the largest student employers at RIT. Student employment opportunities are available at the ITS HelpDesk, in Desktop Support, at colleges through Distributed Support Services, and within Technical Support and Administrative Support services. More specific information about job opportunities within ITS is available at www.rit.edu/its/about/student_employment. Additional information about student employment opportunities can be found at the Student Employment Office site at www.rit.edu/seo.

Residential Networking (Resnet)

Residential Networking provides computer support to students living in residential housing at RIT. The Resnet team can assist students with connecting their computers to the RIT network, accessing campus computing resources, and troubleshooting computer software and hardware. Contact Resnet at (585) 475-2600 (voice), (585) 475-4927 (TTY), or resnet@rit.edu, or visit http://resnet.rit.edu.

Contacting the HelpDesk

The ITS HelpDesk is located in room 1113 of the Gannett Building. Contact HelpDesk staff via telephone/TTY, e-mail, or the Internet:

(585) 475-HELP (4357)
(585) 475-2810 (TTY)
E-mail: helpdesk@rit.edu
Online: www.rit.edu/its/help

Service hours

Fall, winter, and spring quarter hours:
Monday-Thursday: 7:30 a.m. to 9 p.m.
Friday: 7:30 a.m. to 5 p.m.
Saturday-Sunday: Noon to 5 p.m.
Summer quarter, holidays, and quarter breaks:
Monday-Friday: 7:30 a.m. to 5 p.m.
Saturday-Sunday: Closed

International Student Services

http://www.rit.edu/studentaffairs/iss/
(585) 475-6943 (voice/TTY)

International Student Services is the primary resource for more than 1,600 hearing and deaf international students from 100 countries, as well as for members of the campus community seeking cross-cultural information. The office provides assistance with immigration regulations and travel documents, helps international students adjust to academic and cultural expectations in the United States, and provides cross-cultural programming for international students and the campus at large. The staff works closely with Global Union, international student clubs, and International House (the special-interest house in the residence halls for both international and American students). Off-campus programs are regularly coordinated with the Rochester International Council.

Libraries

library.rit.edu

The RIT Libraries includes the Wallace Library, the Cary Collection, the RIT Archive Collections, and the RIT Museum. The Lawson Center, home to the RIT Cary Graphic Arts Press and the RIT Press, can also be found within the Wallace Library.

Wallace Library is a high technology, multimedia resource center. It offers hundreds of databases and thousands of electronic books and journals, as well as traditional printed resources. Online resources can be accessed onsite, or around the clock from any location. Online course reading assignments and laptops are among the many other resources available.

If the library does not have what you need, it can be ordered through Information Delivery Services (IDS). Millions of additional books are available via ConnectNY, a service that provides access to the collections of 14 academic libraries in New York state. The Rochester Regional Library Council's Access program allows patrons to obtain a library card that offers access to other area libraries, including the University of Rochester and the state university colleges at Geneseo and Brockport.

Each college has a subject expert in the library to help with research. These subject experts are available seven days a week for individual assistance, while in-depth assistance is also available by appointment. You can connect with the subject experts by phone, email, or instant messaging. The Scholarly Publishing Studio provides one-stop service for advice and assistance in preparing research, articles, books, and other documents for publication.

Quiet study spaces for individuals and groups are available throughout the library. Students can reserve group study rooms online. Java Wally's café is also a favorite spot for relaxing, studying, or meeting in an informal setting.

The Cary Library is a unique collection of more than 14,000 volumes of rare books illustrating fine printing and other materials detailing the history of printing, book design and illustration, papermaking, and other aspects of the graphic arts. The RIT Archive Collections acquires, organizes, preserves, and displays materials from the university's past. The archives are the primary resource for studying the history of the university.

Wallace Library is open more than 100 hours a week, with extended hours before and during finals.

Leadership Institute and Community Service Center

www.rit.edu/lead
(585) 475-6974

The Leadership Institute and Community Service Center provides a variety of experiences for students to engage in and learn about leadership and community service. Some examples of our opportunities include: a weekend leadership adventure with ropes course, a leadership certificate program, four different leadership courses, a corporate and an RIT leadership conference, a public speaking series, an alternative spring-break program, participation in the American Heart Walk and Hillside's Special Santa drive, and volunteer connections with more than 260 agencies in the Rochester area.

Margaret's House

www.rit.edu/studentaffairs/margaretshouse
(585) 475-5176 (voice/TTY)

Childcare Programs

Margaret's House is a state-licensed childcare center offering full-day quality care and education for children 8 weeks to 8 years of age. It includes a full-day kindergarten as well as after-school and summer programs. The center is open to children of RIT students, faculty, and staff and to members of the greater Rochester community. Margaret's House is located on campus and is open year-round. Call for information and registration material.

- Infant and toddler programs: 8 weeks to 36 months
- Preschool programs: 3- and 4-year-olds
- Full-day kindergarten/after-school programs: 5- to 8-year-olds
- Lil' Kids on Campus summer program for children entering grades 1 through 4

Parking and Transportation Services

http://facilities.rit.edu/pats
(585) 475-2074

To maintain order and safety, the Parking and Transportation Services department maintains parking policies that require all vehicles operated on campus by students, faculty, and staff to be registered within 10 days of arrival on campus. Students are not required to own the vehicle to register it, however, the address used to register the vehicle must be the same address where students reside while attending classes or working at RIT.

Transportation services are provided free of charge for all RIT housing residents, Park Point residents, and The Province residents via a shuttle service, which makes regularly scheduled stops to and from the academic areas on campus, housing areas, and other pertinent campus locations.

The Parking and Transportation Services office is located in Grace Watson Hall and is open Monday through Friday from 8 a.m. until 5 p.m. during the academic year. Summer hours may vary.

Bus and shuttle services: Transportation Services operates a van service for those with impaired mobility. The service runs Monday through Friday, 7 a.m. to 6 p.m., during fall, winter, and spring quarters. The transportation division also provides vans for use by student groups, clubs, and organizations.

Parking permits and vehicle registration: All vehicles operated on campus must be registered with the parking office annually. Vehicle registration decals must be properly displayed on each vehicle. Fines are imposed for those in violation of RIT parking and traffic regulations. We encourage everyone to become fully familiar with RIT parking policies and procedures, including online registration.

Handicap parking permits: RIT honors ADA-approved handicap parking permits from every state. Handicap parking permits can be obtained at local municipalities. Resident students can apply for a New York state permit at the Town of Henrietta. The RIT parking office does issue a one-week temporary handicap permit.

Part-time Enrollment Services

www.rit.edu/parttime
(585) 475-2229

The Office of Part-time Enrollment Services provides central information and counseling services for students interested in enrolling in part-time and online studies offered through RIT's various schools and colleges. Contact the office if you need assistance with selecting an academic program, exploring financial aid opportunities, registering for classes, or receiving information about any aspect of part-time study.

Staff members are available from 8:30 a.m. to 5 p.m., Monday through Thursday, and from 8:30 a.m. to 4:30 p.m. on Friday.

Public Safety

http://finweb.rit.edu/publicsafety/
(585) 475-2853
(585) 475-3333(Emergency Line)/(585) 205-8333(Emergency Text)

The Public Safety Department is open 24-hours-a-day and is located in Grace Watson Hall. To report an emergency call (585) 475-3333, text (585) 205-8333, or instant message staff at IM:ritpublicsafety. The department encourages the RIT community to take responsibility for their safety by staying informed of these services and reporting suspicious activity. Although each individual is ultimately responsible for their own personal safety, learning and practicing basic safety precautions can enhance one's well being.

Emergency prepardness: RIT's emergency responses are based on a national model that is flexible and can be applied to any scenario. RIT regularly communicates, prepares, and practices emergency management with public safety personnel and campus managers from various departments. If necessary, we will provide updated information through broadcast email, mass notification system (RIT ALERT), voicemail, ALERTUS beacons, and the university's website at http://www.rit.edu/.

The department provides the following services:

Blue light call boxes: Campus courtesy call boxes, identified by a blue light, are located across campus. These call boxes provide a direct line to Public Safety 24-hours-a-day. The location of the call is automatically recorded at the Public Safety Communications Center, making it possible for hard-of-hearing individuals to also use the call boxes. The call boxes may be used to request an escort, assist a motorist, report suspicious individuals or activity, or request access to a locked building or room.

Mobile escort service: Public Safety strongly encourages students to use the mobile escort service. The service is available to anyone, seven-days-a-week, on a timed schedule between 11 p.m. and 3 a.m. Call the Public Safety Department at (585) 475-2853, text to (585) 205-8333, IM: ritpublicsafety, or use one of the blue light courtesy call boxes located across campus.

Lost and found: All items lost and found on campus are stored by the Public Safety Department. To report an item lost, please visit https://finweb.rit.edu/publicsafety/safety/lostitems.html to submit information related to lost property. Public Safety will contact you if the item is found on campus.

Emergency notification: If a family member needs to make an emergency notification to a student, he or she should contact Public Safety by calling (585) 475-2853 or texting (585) 205-8333 . Public safety will locate the student and relay the message.

Awareness programs: Throughout the year, public safety hosts a variety of prevention awareness programs and services on various topics including crime prevention, personal safety, and alcohol awareness. A monthly newsletter (*RIT Ready*) is distributed via e-mail to all students, faculty, and staff to bolster emergency prepardness and safety awareness on campus.

Annual Safety and Security Report: Public safety's security report is available online and offers a description of security practices and information on reported occurrences of crime. Access the report at http://finweb.rit.edu/publicsafety/ritsaftey2011.pdf

Confidential tip line: The goal in providing this service is to obtain information that is unattainable through conventional methods and to alert public safety to endangering behavior that might go otherwise unreported. Individuals who utilize the tip line are encouraged to leave their names and contact information; however, they will not be contacted. http://finweb.rit.edu/publicsafety/forms/tipline/

The Advisory Committee on Public Safety will provide, upon request, all campus crime statistics as reported to the Department of Education. RIT crime statistics can be found at the Department of Education website (http://ope.ed.gov/security/) or by contacting the Public Safety Department. A hard copy of reported crime statistics required to be ascertained under Title 20 of the U. S. Code Section 1092(f) will be mailed to you within 10 days of the request.

Sexual assault information hotline/CARES: Confidential counseling services are available to anyone in need by calling (585) 546-2777 (voice/TTY). RIT's Campus Advocacy Response & Support (CARES) is located on campus and provides confidential and crisis intervention and support services for relationship concerns. Contact (585) 295-3533 at any time for assistance.

Emergency Preparedness: RIT's emergency responses are based on a national model that is very flexible and can be applied to any scenario. RIT regularly communicates, prepares, and practices emergency management with public safety personnel and campus managers from various departments. If necessary, we will provide updated information through broadcast email, mass notification system (RIT ALERT), voicemail, and the university's website at http://www.rit.edu/.

Religious Life

www.rit.edu/religion/
(585) 475-2135
The Center for Religious Life affirms RIT's commitment to holistic education and the exploration of mind and spirit in the college experience. A student-oriented resource, the center provides opportunities for students to interact and discuss the beliefs and practices of their religious communities. Among those traditions are the American Baptists, the Black Church Traditions, Buddhist, Jewish, Lutheran, Muslim, Orthodox Christian, and Roman Catholic. Two non-denominational and interdenominational Christian clubs, CRU and InterVarsity Christian Fellowship, are active within the center. All students are invited and encouraged to enjoy the many social and educational experiences offered by the center's communities and clubs.

The Kilian J. and Caroline F. Schmitt Interfaith Center

The Interfaith Center, a gift of Kilian and Caroline Schmitt and other generous donors, is located on the east side of the Student Alumni Union. It is a focal point for the diverse religious traditions within the university, housing two chapels, meeting rooms, and offices for the center's professional staff.

Student Financial Services

http://finweb.rit.edu/sfs/
(585)475-6186
Student Financial Services offers a variety of financial services for students, including billing, payment options, and loan repayment. The university has electronic billing for all students. Each quarter, all students are sent an e-mail notification to their university e-mail account stating that their eBill is available. Students have the option of granting three additional access to allow for a parent, guardian, sponsor, or other authorized user to receive eBill notifications. This facilitates online, real-time account inquiry and electronic payment.

Student Health Center

www.rit.edu/studenthealth/
(585) 475-2255
The Student Health Center provides primary medical care on an outpatient basis. The staff includes physicians, a psychiatrist, nurse practitioners, a physician assistant, registered nurses, and an interpreter for the deaf and support staff. Services are available by appointment. Health education programs also are provided.

The Student Health Center is located on the Quarter Mile, across from the Student Life Center. Students are seen Monday through Thursday, 8:30 a.m. to 6:30 p.m., and Friday, 8:30 a.m. to 4:30 p.m., by appointment. Emergencies are seen as need requires. Hours are subject to change and are posted.

The university requires students to maintain health insurance coverage—which they may purchase either on their own or through RIT—as long as they are enrolled at the university.

The quarterly student health fee is mandatory for all full-time undergraduate students. All other students may pay either the quarterly fee or a fee for service. Some laboratory work ordered through the Student Health Center is not covered by this fee; there is an additional charge for this service. Prescription medicines may be purchased from local pharmacies or, for some specific prescriptions, from the Student Health Center. The health fee does not include prescription medications.

Questions about the Student Health Center should be directed to the office. Questions regarding health insurance available through RIT should be directed to University Health Plans at (800) 437-6448.

RIT ambulance

(585) 475-3333

RIT ambulance is a New York state certified volunteer ambulance service that serves the campus community, including its adjoining apartment complexes. The organization, an auxiliary of the Student Health Center, is governed by RIT students and staff and is staffed by emergency medical technicians. Ambulance service is available 24-hours-a-day, seven-days-a-week. If, for some reason, RIT ambulance is not available, there may be a charge for services provided by another corps.

Health records

Medical records are confidential. Information will not be released without the written consent of the student. Exceptions to this rule are made only when required by the public health laws of New York state or a court-ordered subpoena or in a life-threatening situation.

New York state and RIT immunization requirements

New York state public law requires that all students enrolled for more than four quarter credit hours in a quarter and born after January 1, 1957, must provide proof of having received the appropriate immunizations against measles, rubella, and mumps or of having immunity to each disease validated by laboratory results from blood titers. Immunization requirements include two measles vaccinations, at least one month apart, after the first birthday; and one vaccination each against mumps and rubella and after the first birthday. RIT requires that these immunizations be given in two doses of combined MMR vaccine at least 30 days apart. New York State requires students to sign the meningitis awareness form. RIT requires all students age 21 and under to be immunized against meningitis. Failure to comply with the NY State immunization law may lead to exclusion from classes and the RIT community, and a $200 fine until compliance is obtained.

Other immunization recommendations include Hepatitis B, TD booster, and PPD (for students from high-risk areas). Additional information concerning these requirements, the necessary documentation, and where documentation must be sent is included with the Admissions Office acceptance packet and also available on the center's website.

Veteran Enrollment Services

www.rit.edu/emcs/ptgrad/veterans.php3

(585) 475-6641

If you have questions regarding VA Benefits, NYS War Veteran Scholarships, TA, or the RIT Active Duty Service Member Scholarship, contact Veteran Enrollment Services.

All RIT courses and programs are approved for the education of members of the U.S. Armed Forces, veterans, and eligible dependents under the Veterans Readjustment Benefits Act, the Rehabilitation Act, and the War Orphans Act.

To receive information or apply for benefits, contact the office. Eligible students must submit an application for the VA Certificate of Eligibility. This application can be submitted online through the VA's website. All VA educational benefits paid to RIT students are the responsibility of the VA Regional Office in Buffalo, N.Y. We can send most enrollment information well in advance of the beginning of the starting quarter, thus eliminating long delays in payments. Applications for all benefits are available online, at local VA offices, or on campus in the Office of Veteran Enrollment Services. To ensure a smooth transition and successful academic program completion, start benefits paperwork early.

The Center For Women and Gender

www.rit.edu/studentaffairs/womenscenter/

(585) 475-7464

The Center for Women and Gender promotes a campus community that is safe, equitable, and respectful of all members by fostering an educational environment in which the entire RIT community can be personally, academically, and professionally successful without regard to gender, racial/ethnic origins, sexual orientation, gender identity, socio-economic status, or spiritual beliefs.

The center provides programs and services that serve women, men, deaf, hearing, and the LGBT communities, and that address relationship and sexuality issues, pregnancy, body image issues, harassment and discrimination, assertiveness, and sexual assault.

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Weston Kemp, Professor, College of Imaging Arts and Sciences

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Robert Keogh, Professor, College of Imaging Arts and Sciences

Robert Kerr, Professor, College of Imaging Arts and Sciences

William Keyser, Professor, College of Imaging Arts and Sciences

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Michael Kleper, Professor, College of Imaging Arts and Sciences

M. Joseph Klingensmith, Professor, College of Science

Art Kovacs, Professor, College of Science

Russell Kraus, Professor, College of Imaging Arts and Sciences

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Terence Morrill, Professor, College of Science

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John Neeman, Professor, College of Science

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Robert Panara, Professor, National Technical Institute for the Deaf

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David Perlman, Professor, Kate Gleason College of Engineering

Paul Petersen, Dean, Kate Gleason College of Engineering

Daniel Petrizzi, Professor, Eisenhower College

Mark Piterman, Professor, College of Applied Science and Technology

Thomas Pray, Professor, E. Philip Saunders College of Business

Mark Price, Professor, College of Liberal Arts

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Thomas Upson, Professor, College of Science

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Vladimir Vukanovic, Distinguished Professor, College of Science

Helen Wadsworth, Assistant Professor, College of Liberal Arts

Jerome Wagner, Professor, College of Science

Andrea Walters, Professor, College of Liberal Arts

Nancy Wanek, Professor, College of Science

Charles Warren, Professor, College of Liberal Arts

Joseph Watson, Professor, College of Imaging Arts and Sciences

Charles J. Weigand, Associate Professor, College of Imaging Arts and Sciences

Houghton Wetherald, Professor, College of Liberal Arts

Dorothy Widmer, Professor, Student Affairs

Theodore Wilcox, Professor, College of Science

Norman Williams, Professor, College of Imaging Arts and Sciences

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Eugene O. Wilson, Professor, E. Philip Saunders College of Business

Fred Wilson, Professor, College of Liberal Arts

Tom Wilson

Stanley H. Witmeyer, Professor, College of Imaging Arts and Sciences

James J. Worman, Professor, College of Science

Richard Zakia, Professor, College of Imaging Arts and Sciences

Hans Zandvoort, Professor, College of Liberal Arts

Course Number Index

College of Applied Science and Technology

0618 Computer Engineering Technology
0633 Environmental Health and Safety Management
0630 Environmental, Health and Safety Management
0632 Facility Management
0624 Hospitality-Tourism Management
0626 Human Resource Development
0607 Packaging Science
0617 Manufacturing and Mechanical Systems Integration
0610 Manufacturing and Mechanical Engineering Technology
0625 Service Leadership and Innovation
0614 Telecommunications Engineering Technology

ESHS Environmental, Health and Safety Management
FCMG Facility Management
HSPT Hospitality-Tourism Management
HRDE Human Resource Development
MCET Manufacturing and Mechanical Engineering Technology
PACK Packaging Science
SERQ Service Leadership and Innovation
TCET Telecommunications Engineering Technology

E. Philip Saunders College of Business

0101 Accounting
0110 Business Legal Studies
0106 Decision Science
0103 Economics
0104 Finance
0113 International Business
0102 Management
0112 Management Information Systems
0105 Marketing

ACCT Accounting
BLEG Business Legal Studies
DECS Decision Science
ESCB Economics
FINC Finance
INTB International Business
MGMT Management
MGIS Management Information Systems
MKTG Marketing

Golisano Institute of Sustainability

5010 Architecture
5001 Sustainability

ARCH Architecture Program
ISUS Sustainability

B. Thomas Golisano College of Computing and Information Sciences

4003, 4005 Computer Science
4040 Computing and Information Sciences
4002, 4004, 4006 Information Sciences and Technologies
4085 Interactive Games and Media
4055 Networking, Security, and Systems Administration
4010, 4011 Software Engineering

CSCI Computer Science
CISC Computing and Information Sciences
ISTE, HCIN, MEDI Information Sciences and Technologies
IGME Interactive Games and Media
NSSA Networking, Security and Systems Administration
SWEN Software Engineering

Kate Gleason College of Engineering

0306 Computer Engineering
0301 Electrical Engineering
0303 Industrial and Systems Engineering
0304 Mechanical Engineering
0305 Microelectronic Engineering
0308 Microsystems
0307 Quality and Applied Statistics

CQAS Center for Quality and Applied Statistics
CMPE Computer Engineering
EEEE Electrical Engineering
ISEE Industrial and Systems Engineering
MECE Mechanical Engineering
MCEE Microelectronic Engineering
MCSE Microsystems

College of Health Sciences and Technology

1023 Clinical Chemistry
0635 Health Systems Administration
2020 Medical Illustration

HLTH, SERQ Health Systems Administration
HMIL Medical Illustration
PHYA Physician Assistant

College of Imaging Arts and Sciences

2001, 2011 Art Education
2039 Art History
2040 Ceramics
2014 Computer Graphics Design
2065 Film and Animation
2021 Fine Arts Studio
2045 General Crafts Studies
2041 Glass
2066 Graduate Photography
2037 Graduate Study
2010 Graphic Design
2019 Illustration
2035 Industrial Design
2020 Medical Illustration
2042 Metals
2080 Printing Management
2081 Printing Technology
2043 Textiles
2044 Wood

ARED Art Education
CCER Ceramics
SOFA Film and Animation
FNAS Fine Arts Studio
CGEN General Crafts Studies
CGLS Glass
PHGR Graduate Photography
ARTH Graduate Study
IDDE Industrial Design
ILLM Medical Illustration
CMTJ Metals and Jewelry Design
PPRT Print Media
VCDE Visual Communication Design
CWFD Woodworking and Furniture Design

College of Liberal Arts

0514 Applied Experimental and Engineering Psychology
0535 Communication and Media Technology
0501 Criminal Justice
0511 Economics
0507 History
0509 Philosophy
0521 Public Policy
0508 Science, Technology and Society
0527 School Psychology
0508 Science, Technology and Society

COMM Communication and Media Technology
CRIM Criminal Justice
PSYC Experimental Psychology
PUBL Public Polity
SPSY School Psychology
STSO Science, Technology and Society

National Technical Institute for the Deaf

0835, 0886 Secondary Education of Students Who Are Deaf or Hard of Hearing

MSSE Secondary Education of Students Who Are Deaf or Hard of Hearing

College of Science

1060 Astrophysical Sciences and Technology
1001 Biological Sciences
1008, 1009, 1010, 1012, 1013, 1014, 1029 Chemistry
1050 Color Science
1006 Environmental Science
1051 Imaging Science
1016 Mathematics
1028 Materials Science and Engineering

ASTP Astrophysical Sciences and Technology
BIOL Biological Sciences
CHEM, CHMA, CHMB, CHMI, CHMO, CBMP, CHPO Chemistry
CLRS Color Science
ENVS Environmental Science
IMGS Imaging Science
MATH Mathematics
MTSE Materials Science and Engineering
PHYS Physics

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Notes

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Notes

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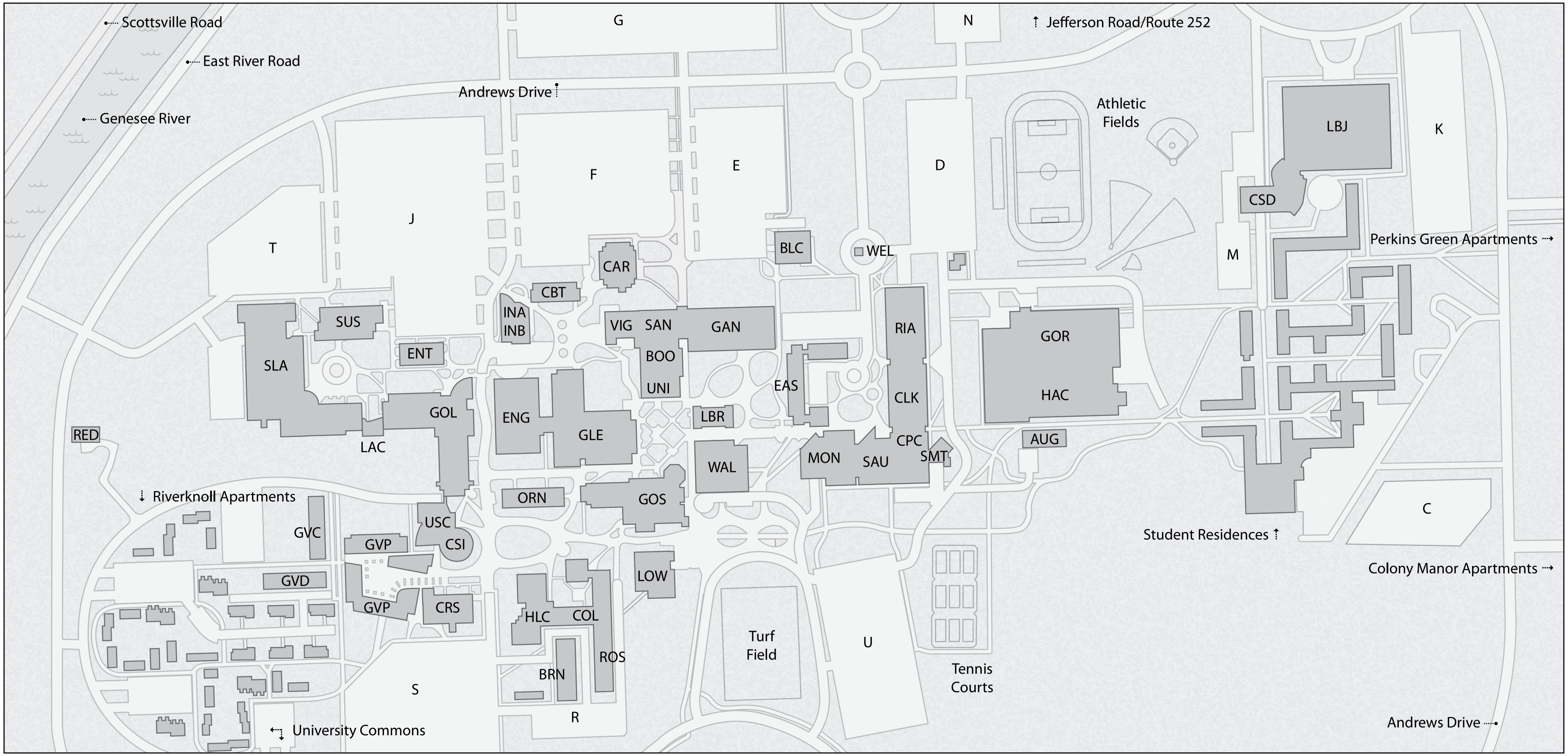

RIT CAMPUS MAP

AUG	August Center
BLC	Bausch & Lomb Center
BOO	James E. Booth Hall
BRN	Brown Hall
CAR	Chester F. Carlson Center for Imaging Science
CBT	Center for Bioscience Education & Technology
CLK	George H. Clark Gymnasium
COL	Color Science Hall
CPC	Campus Center
CRS	Crossroads
CSD	CSD Student Development Center
CSI	Center for Student Innovation
EAS	George Eastman Hall
ENG	Engineering Hall
ENT	Engineering Technology Hall
GAN	Frank E. Gannett Hall
GLE	James E. Gleason Hall
GOL	Golisano Hall
GOR	Gordon Field House and Activities Center
GOS	Thomas Gosnell Hall
GVC	Global Village Way C
GVD	Global Village Way D
GVP	Global Village Plaza
HAC	Hale-Andrews Student Life Center
HLC	Hugh L. Carey Hall
INA	Institute Hall A
INB	Institute Hall B
LAC	Laboratory for Applied Computing
LBJ	Lyndon Baines Johnson Hall
LBR	Liberal Arts Hall
LOW	Max Lowenthal Hall
MON	Monroe Hall
ORN	Orange Hall
RED	Red Barn
RIA	Frank Ritter Ice Arena
ROS	Lewis P. Ross Hall
SAN	Sands Family Studios
SAU	Student Alumni Union
SLA	Louise Slaughter Hall
SMT	Schmitt Interfaith Center
SUS	Golisano Institute for Sustainability
UNI	University Gallery
USC	University Services Center
VIG	Vignelli Center for Design Studies
WAL	Wallace Library
WEL	Welcome Center

R·I·T
Rochester Institute of Technology

Periodicals