2014

2014-2015 Graduate Bulletin

Rochester Institute of Technology

R·I·T

GRADUATE BULLETIN

2014-2015

Rochester Institute of Technology
2014–15 Academic Calendar

† *The Add/Drop period is the first six class days, excluding Saturdays, Sundays, and holidays of the fall and spring semesters.*

* *Friday of the 12th week of classes*

** *Friday of the 8th week of classes*

No. 4 June, 2014
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Fall Semester (2141)

August 19 - 24
New Student Orientation (tentative)

August 25
Day, evening, and online classes begin
First day of 6-day Add/Drop period†

August 30
Saturday classes begin

September 1
Labor Day (no classes);
University offices closed

September 2
Last day of 6-day Add/Drop period†

September 3
First day to drop from classes with a grade of W

October 13
Columbus Day (no classes);
University offices open

November 14
Last day to drop from classes with a grade of W*

November 26
No classes;
University offices open

November 27 - 28
Thanksgiving Holiday (no classes);
University offices closed

November 29
No Saturday classes

December 1
Day, evening, and online classes resume

December 6
Saturday classes resume

December 10
Last day, evening, and online classes

December 11
Reading Day (prepare for exams)

December 13
Last Saturday classes

Dec. 12, 15, 16, 17, 18
Final exams

December 19
Residence halls close

Dec. 19 - Jan. 2
Holiday break;
University closed

Intersession (2143)

January 5
Day, evening, and online classes begin
First day of 3-day Add/Drop period†

January 7
Last day of 3-day Add/Drop†

January 8
First day to drop from classes with a grade of W

January 12
Last day to drop from classes with a grade of W

January 22
Last day of classes

January 23
Final exams

January 24 - 25
Break between Intersession and spring semester

Spring Semester (2145)

January 19
Residence halls open

January 26
Day, evening, and online classes begin
First day of 6-day Add/Drop period†

January 31
Saturday classes begin

February 2
Last day of 6-day Add/Drop period†

February 3
First day to drop from classes with a grade of W

March 23 - 27
No classes (spring break);
University offices open

March 28
No Saturday classes

March 30
Day, evening, and online classes resume

April 24
Last day to drop from classes with a grade of W*

May 13
Last day, evening, and online classes

May 14
Reading Day (prepare for exams)

May 16
Last Saturday classes

May 15, 18, 19, 20, 21
Final exams

May 22
Convocation and
Commencement ceremonies

May 23
Commencement ceremonies

May 25
Memorial Day; University closed

May 26
Final grades due

May 26 - 29
Break between spring semester and summer terms

Summer Sessions

10-week Summer Session (2148)

June 1
Day, evening, and online classes begin
First day of 6-day Add/Drop period†

June 6
Saturday classes begin

June 8
Last day to Add/Drop classes†

June 9
First day to drop from classes with a grade of W

July 3
Independence Day celebrated (no classes);
University closed

July 24
Last day to drop from classes with a grade of W**

August 7
Last day, evening, and online classes

August 8
Last Saturday classes

August 12
Reading Day (prepare for exams)

August 10, 11, 13, 14
Final exams

August 17
Final grades due

August 17 - 21
Summer/Fall break

5-week Summer Session I (2148)

June 1
Day, evening, and online classes begin
First day of 6-day Add/Drop period†

June 6
Saturday classes begin

June 8
Last day to Add/Drop classes†

June 9
First day to drop from classes with a grade of W

June 19
Last day to drop from classes with a grade of W (4 weeks)

July 2
Last day of classes (final exams held)

July 6
Final grades due

5-week Summer Session II (2148)

July 6
Day, evening, and online classes begin
First day of 6-day Add/Drop period†

July 11
Saturday classes begin

July 13
Last day to Add/Drop classes†

July 14
First day to drop from classes with a grade of W

July 31
Last day to drop from classes with a grade of W (4 weeks)

August 7
Last day of classes (final exams)

August 10
Final grades due

Rochester Institute of Technology

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, fees, 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 does not discriminate. RIT promotes and values diversity within its workforce and provides equal opportunity to all qualified individuals regardless of race, color, creed, age, marital status, sex, gender, religion, sexual orientation, gender identity, gender expression, national origin, veteran status, or disability.

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Rochester Institute of Technology
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Graduate Bulletin 2014–15
Produced by the Office of University Publications

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 90 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 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 18,000 students from across the United States and 100 foreign countries.

Selected faculty and student awards, honors, and partnerships

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

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 among the 15 largest private universities 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 110,000 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 Amazon, Boeing, Fisher Price, 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

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:
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gradinfo@rit.edu | 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. 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 seven doctoral programs in the fields of astrophysical sciences and technology, color science, computing and information sciences, engineering, imaging science, microsystems engineering, and sustainability. These degrees are seven of more than 90 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 #
Art, Crafts, Design, and Graphic Communications										
Architecture	Institute for Sustainability								0202	220
Art Education (Visual Art–All Grades)	Imaging Arts and Sciences							0831		134
Ceramics	Imaging Arts and Sciences					1009				130
Film and Animation	Imaging Arts and Sciences					1010				138
Fine Arts Studio	Imaging Arts and Sciences					1002				134
Furniture Design	Imaging Arts and Sciences					1009				131
Glass	Imaging Arts and Sciences					1009				132
Imaging Arts	Imaging Arts and Sciences					1011				140
Industrial Design	Imaging Arts and Sciences					1009				135
Medical Illustration	Health Sciences and Technology					1299				122
Metals and Jewelry Design	Imaging Arts and Sciences					1009				133
Non-toxic Printmaking	Imaging Arts and Sciences	1009								135
Print Media	Imaging Arts and Sciences						0699			137
Visual Communication Design	Imaging Arts and Sciences					1009				136
Business, Management, and Communication										
Accounting	Business			0502						38
Business Administration–Executive	Business			0506						36
Business Administration–Online Executive *†	Business			0506						37
Business Administration–Traditional	Business			0506						33
Communication and Media Technologies	Liberal Arts						0605.00			160
Engineering Management	Engineering				0913					97
Entrepreneurship and Innovative Ventures	Business						0506			38
Environmental, Health and Safety Management *†	Applied Science and Technology						0420			9
Facility Management *†	Applied Science and Technology						0599			10
Finance	Business						0504			39
Finance in Health Care *†	Health Sciences and Technology	1202								123
Health Systems Administration *†	Health Sciences and Technology						1202			121
Hospitality and Tourism Management	Applied Science and Technology						0510.1			14
Human Resource Development *†	Applied Science and Technology						0515			18
Leadership in Health Care * ‡	Health Sciences and Technology	1202								‡
Management	Business						0513			40
Manufacturing Leadership *†	Engineering						0599			92
Organizational Learning *†	Applied Science and Technology	0515								17
Product Development †	Engineering						0599			95
Project Management *†	Center for Multidisciplinary Studies	0506								176
Service Leadership and Innovation *†	Applied Science and Technology						0599			16, 17
Training, Design and Assessment *†	Applied Science and Technology	0515								18
Computing and Information Sciences										
Big Data Analytics	Computing and Information Sciences	0702								63
Bioinformatics	Science						0499			191
Computer Engineering	Engineering						0999			88
Computer Science	Computing and Information Sciences						0701			51
Computing and Information Sciences	Computing and Information Sciences		1701							53
Computing Security	Computing and Information Sciences						0799			55
Game Design and Development	Computing and Information Sciences						0799			52
Human-Computer Interaction *†	Computing and Information Sciences						0799			57
Information Assurance	Computing and Information Sciences	0799								57
Information Sciences and Technologies	Computing and Information Sciences						0699			59
Medical Informatics	Computing and Information Sciences						1217			60
Networking, Planning and Design *†	Computing and Information Sciences	0702								63
Networking and Systems Administration *†	Computing and Information Sciences						0702			61
Software Engineering	Computing and Information Sciences						0999			64
Visual Communication Design	Imaging Arts and Sciences					1009				136
Web Development	Computing and Information Sciences	0699								34

* Online learning option available.
† Executive education option available.
‡ This program is not admitting new students in 2014-15.

Graduate Programs of Study		Degree and HEGIS Code								
		Adv. Cert.	Ph.D.	MBA	ME	MFA	MS	MST	M.Arch.	Page #
Engineering and Engineering Technology										
Architecture	Institute for Sustainability								0202	220
Computer Engineering	Engineering						0999			88
Electrical Engineering	Engineering						0909			90
Engineering	Engineering		0901							83
Engineering Management	Engineering				0913					97
Facility Management *†	Applied Science and Technology						0599			10
Industrial and Systems Engineering	Engineering				0913		0913			91, 97
Manufacturing and Mechanical Systems Integration	Applied Science and Technology						0913			11
Manufacturing Leadership *†	Engineering						0599			92
Materials Science and Engineering	Science	0915					0915			186
Mechanical Engineering	Engineering				0910		0910			93
Microelectronic Engineering	Engineering						0999			94
Microelectronics Manufacturing Engineering *†	Engineering				0999					99
Microsystems Engineering	Engineering		0999							85
Packaging Science	Applied Science and Technology						4999			12
Product Development †	Engineering						0599			95
Software Engineering	Computing and Information Sciences						0999			64
Sustainable Engineering	Engineering				0999		0999			96, 100
Sustainable Systems	Institute for Sustainability						4904			219
Systems Engineering	Engineering				0913					100
Telecommunications Engineering Technology *	Applied Science and Technology						0925			13
Vibrations	Engineering	0910								102
Health Sciences										
Finance in Health Care *†	Health Sciences and Technology	1202								123
Health Systems Administration *†	Health Sciences and Technology						1202			121
Leadership in Health Care *‡	Health Sciences and Technology	1202								‡
Medical Illustration	Health Sciences and Technology					1299				122
Medical Informatics	Computing and Information Sciences						1217			60
Multidisciplinary										
Professional Studies *†	Center for Multidisciplinary Studies						4999			174
Science, Mathematics, and Imaging Science										
Applied and Computational Mathematics	Science						1799			193
Applied Statistics *†	Science	1702					1702			87
Astrophysical Sciences and Technology	Science		1912				1912			194
Bioinformatics	Science						0499			191
Chemistry	Science						1905			184
Color Science	Science		1999.20				1099.20			197
Environmental Science	Liberal Arts						0420			192
Environmental, Health and Safety Management *†	Applied Science and Technology						0420			9
Imaging Science *†	Science		1999.20				1999.20			188
Lean Six Sigma *†	Engineering	1702								101
Materials Science and Engineering	Science						0915			186
Medical Informatics	Computing and Information Sciences						1217			60
Sustainability	Institute for Sustainability		4904							219
Sustainable Systems	Institute for Sustainability						4904			219
Social Sciences, Humanities, and Education										
Art Education (Visual Art–All Grades)	Imaging Arts and Sciences							0831		134
Communication and Media Technologies	Liberal Arts						0605.00			160
Criminal Justice	Liberal Arts						2209			162
Engineering Psychology	Liberal Arts	2099								164
Environmental Science	Liberal Arts						0420			192
Environmental, Health and Safety Management †	Applied Science and Technology						0420			9
Experimental Psychology	Liberal Arts						2099			162
Human Resource Development *†	Applied Science and Technology						0515			18
Professional Studies *†	Center for Multidisciplinary Studies						4999			174
School Psychology	Liberal Arts	0826.02					0826.02			163
Science, Technology and Public Policy	Liberal Arts						2102			165
Secondary Education of Students Who Are Deaf or Hard of Hearing	National Technical Institute for the Deaf						0803			180
Sustainability										
Architecture	Institute for Sustainability								0202	220
Sustainability	Institute for Sustainability		4904							219
Sustainable Engineering	Engineering				0999		0999			100
Sustainable Systems	Institute for Sustainability						4904			219

* Online learning option available.
† Executive education option available.
‡ This program is not admitting new students in 2014-15.

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 seven 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 100 Ph.D. faculty members who are experts in a wide range of fields that are influenced by imaging, computing, science, engineering, and sustainability.

Doctoral programs of study

RIT offers seven 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 understanding and 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, the pre-eminent academic laboratory in the U.S. devoted to the study of color science. For more than 30 years its faculty and staff have educated students and conducted cutting-edge research in the field. Since the inception of the program, graduates have been in high demand and enjoy a 100 percent placement rate in industrial and academic positions.

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.

Engineering: The doctorate program in engineering prepares the next generation of engineering leaders to tackle some of the most daunting and complex problems facing our society. The program's goal is to produce engineering graduates who are subject matter experts in a knowledge domain within an engineering discipline. Instead of restricting graduates to individual engineering fields (e.g., chemical, computer, electrical, industrial, mechanical, etc.) the program provides students with the flexibility to become subject matter experts and engineering innovators in an open-architecture environment, fostering intellectual growth along both interdisciplinary pathways and within the bounds of conventional engineering disciplines. With this approach, the program develops world-class researchers who can capitalize on the most promising discoveries and innovations, regardless of their origin within the engineering field, to develop interdisciplinary solutions for real-world challenges.

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 phenomena, 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, perceptual 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 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
rit.edu/cast

Programs of Study

* Executive leader option: This program is 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 research, the latest uses of technology, and current management theories and educational philosophies.

Admission requirements

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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/
Todd Dunn, Department Chair
(585) 475-7213, john.morelli@rit.edu
Joseph Rosenbeck, Graduate Program Director
(585) 475-6469, jmrcem@rit.edu

Program overview

Management of environmental, health and safety issues has changed significantly in the past twenty years. The emergence of voluntary standards and codes of conduct, including international standards, coupled with the need to manage costs and limited resources has resulted in a trend to move beyond regulatory compliance. Now, companies work toward sustainability through the use of integrated environmental, health and safety management systems, which are woven into key business processes.

Although they are distinct disciplines, environmental management, occupational health, and workplace safety share many technical, regulatory, and organizational characteristics. Today's professionals now need to be educated in all three areas.

The MS degree in environmental, health and safety management is designed for professionals or those planning a career in the field. The curriculum provides a solid foundation in both the technical and managerial aspects of developing, designing, and implementing environmental, health and safety management systems that can move organizations toward a more sustainable and socially responsible future.

Curriculum

The program consists of 33 credit hours and may be competed through online learning, which requires only one visit to the RIT campus for a three-day executve leader session, or via a combiation of online and traditionl courses. The curriculum consists of core courses, professional electives, and a choice of either a graduate thesis, project, or exam.

Environmental, health and safety management (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
ESHS-720	EHS Management§	3
ESHS-740	EHS Management System Design	3
ESHS-755	Corporate Social Responsibility	3
ESHS-760	Integrating EHS Management	3
ESHS-780	EHS Management System Evaluation and Auditing	3
	Professional Electives	6
ESHS-788, 790	Thesis Planning, Thesis	6
Total Semester Credit Hours		**33**

§ For students completing the online only format of this program, EHS Manangement (ESHS-720) is the executive leader course completed during the on-campus portion of the program.

Environmental, health and safety management (graduate project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
ESHS-720	EHS Management§	3
ESHS-740	EHS Management System Design	3
ESHS-755	Corporate Social Responsibility	3
ESHS-760	Integrating EHS Management	3
ESHS-780	EHS Management System Evaluation and Auditing	3
	Professional Electives	9
ESHS-797	Graduate Project	3
Total Semester Credit Hours		**33**

§ For students completing the online only format of this program, EHS Manangement (ESHS-720) is the executive leader course completed during the on-campus portion of the program.

Environmental, health and safety management (comprehensive exam option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
ESHS-720	EHS Management§	3
ESHS-740	EHS Management System Design	3
ESHS-755	Corporate Social Responsibility	3
ESHS-760	Integrating EHS Management	3
ESHS-780	EHS Management System Evaluation and Auditing	3
	Professional Electives	12
ESHS-795	Comprehensive Exam	0
Total Semester Credit Hours		**33**

§ For students completing the online only format of this program, EHS Manangement (ESHS-720) is the executive leader course completed during the on-campus portion of the program.

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 9 semester hours of college-level science course work, with at least 3 semester credit hours in each of the following categories: chemistry, biology, and physics.
- 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 semester.

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. However academic and experiential gaps in any of these areas can 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 (GRE) scores are not required; however, applicants may submit test scores to support their candidacy.

Transfer credit

With the permission of the department, relevant graduate course work may be transferred into the program, per the maximum number of credit hours allowed.

Additional information

International students

International students enrolled in courses at the RIT campus are required to take at least two traditional classroom courses and one or two online courses per semester.

Facility Management, MS

http://www.rit.edu/cast/cetems/
Todd Dunn, Department Chair
(585) 475-7213, gtdite@rit.edu
Jeffrey Rogers, Program Head
(585) 475-4185, jmrceh@rit.edu

Program overview

Physical assets can represent a significant financial investment for an organization. Careful attention must be paid to the development, operation, and maintenance of these facilities. Well-trained managers keep these valuable assets operating in an efficient and cost-effective manner.

Today's facility managers must be knowledgeable about organizational behavior, strategic planning, business continuity, emergency preparedness planning, environmental, health and safety management, architectural/engineering design, real-estate planning, space programming, human-resource management, financial management, construction management, technology management, and asset management. They should also have experience using the latest digital communication and analytical tools in the field. The facility management profession is a broad-based technology management field that requires individuals to have depth and breadth in their education and, eventually, their work experience in order to enhance the quality of life aspects within the work environment.

The MS degree in facility management prepares students to work in a supervisory and management capacity where they will oversee the conceptualization, planning, programming, design, construction, operation, maintenance, and decommissioning activities throughout the entire life-cycle of the critical physical assets across an organization. Graduates will be able to intelligently communicate facility issues with corporate officers, customers, contractors, vendors, and employees. The program was designed by a panel of experienced facility management professionals and designed to provide students with a solid managerial foundation in the technical, human, and financial aspects of the field.

Accreditation

The program's curriculum was developed using the educational standards established by the International Facility Management Association (IFMA) and is accredited by the IFMA Foundation.

Curriculum

The program consists of 33 credit hours of graduate study and is available predominately through online learning, although some courses and electives are available as on-campus classes. The curriculum consists of core courses and professional electives (chosen from the program or other departments). Students choose either a graduate thesis or project to complete the program. For those choosing the thesis, an applied research topic should complement the student's interests, professional position, or career aspirations.

Facility management (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
ESHS-725	EHS Accounting and Finance	3
ESHS-750	EHS and FM 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
	Thesis Planning, Thesis	6
Total Semester Credit Hours		**33**

Facility management (graduate project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
ESHS-725	EHS Accounting and Finance	3
ESHS-750	EHS and FM 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	6
	Graduate Project	3
Total Semester Credit Hours		**33**

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. 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) 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 semester.

GRE scores are not required. However, applicants who do not meet the above requirements 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 full-time through online learning in two to three semesters. Part-time students may take five to six semesters to complete the program. 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.

Transfer credit

With the permission of the department, relevant graduate course work may be transferred into the program, per the maximum number of credit hours allowed.

Manufacturing and Mechanical Systems Integration, MS

http://www.rit.edu/cast/mmetps/graduate-programs/ms-in-manufacturing-and-mechanical-systems-integration

S. Manian Ramkumar, Interim Department Chair, Graduate Program Director
(585) 475-6081, smrmet@rit.edu

Program overview

The master of science in manufacturing and mechanical systems integration is a multidisciplinary degree designed for individuals who wish to achieve competence in the effective integration of the manufacturing, design, quality, and management functions found in many manufacturing enterprises. Students elect a concentration in automated manufacturing, electronics packaging, management systems, product development, or quality management.

The program is offered by the department of manufacturing and mechanical engineering technology in collaboration with the Saunders College of Business and the industrial and systems engineering department and the Center for Quality and Applied Statistics within the Kate Gleason College of Engineering.

Curriculum

The program consists of 36 semester credit hours and is comprised of core courses, a concentration, electives, and a capstone project, thesis, or comprehensive examination. Students may be required to take additional prerequisite courses depending on their background and elected concentration. The program director may approve the waiver of courses in the prerequisite 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 two semesters of study.

Electives

Students in the thesis option will take one elective; those in the capstone project option will complete two electives, and those in the comprehensive examination option will complete three electives. Courses selected must be any course from another concentration, any course from another graduate program (if approved by the program director and faculty member teaching the course), and any independent study course if approved by the student's program director

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

COURSE		SEMESTER CREDIT HOURS
First Year		
MFET-650	Manufacturing and Mechanical Systems Fundamentals	3
CQAS-670	Designing Experiments for Process Improvement	3
GRCS-702	Graduate Writing Strategies	3
GRCS-701	Research Methods	3
	Concentration Courses	6
CQAS-682	Lean Six Sigma Fundamentals	3
ACCT-703	Accounting for Decision Makers	3
MFET-788	Thesis Planning	3
Second Year		
DECS-714	Project Management	3
	Concentration Course	3
MFET-790	Thesis	3
Total Semester Credit Hours		**36**

Manufacturing and mechanical systems integration (capstone project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MFET-650	Manufacturing and Mechanical Systems Fundamentals	3
CQAS-670	Designing Experiments for Process Improvement	3
GRCS-702	Graduate Writing Strategies	3
GRCS-701	Research Methods	3
	Concentration Courses	6
CQAS-682	Lean Six Sigma Fundamentals	3
ACCT-703	Accounting for Decision makers	3
Second Year		
DECS-714	Project Management	3
	Concentration Course	3
	Elective	3
Choose one of the following:		3
MFET-797	Capstone Project	
CQAS-683	Lean Six Sigma Project	
Total Semester Credit Hours		**36**

Manufacturing and mechanical systems integration (comprehensive exam option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MFET-650	Manufacturing and Mechanical Systems Fundamentals	3
CQAS-670	Designing Experiments for Process Improvement	3
GRCS-702	Graduate Writing Strategies	3
GRCS-701	Research Methods	3
CQAS-682	Lean Six Sigma Fundamentals	3
ACCT-703	Accounting for Decision Makers	3
	Concentration Courses	6
Second Year		
DECS-714	Project Management	3
	Concentration Course	3
	Electives	6
MFET-795	Comprehensive Examination	0
Total Semester Credit Hours		**36**

Concentrations

COURSE		SEMESTER CREDIT HOURS
Automated manufacturing		
ISEE-710	Systems Simulation	3
MFET-670	Manufacturing Automation Controls	3
MFET-685	Robots and CNC in Integrated Manufacturing	3
Electronics packaging		
MFET-655	Electronics Packaging Fundamentals	3
MFET-765	Advanced Concepts in Electronics Packaging	3
TCET-740	Fiber Optics Telecommunications Technology	3
Management systems		
MGMT-740	Organizational Behavior and Leadership	3
MGMT-742	Technology Management	3
	Operations and Supply Chain Management	3
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
Quality management		
CQAS-621	Statistical Quality Control	3
CQAS-741	Regression Analysis	3
MCET-620	Robust Design	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 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.
- 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 79-80 (Internet-based) is required. International applicants must also submit scores from the Graduate Record Exam (GRE). A score of 1,200 (V&Q) and an analytical writing score of 3.5 or higher are required. Applicants with low GRE scores may be admitted conditionally; but 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/cast/packaging/ms-in-packaging-science.php
Deanna Jacobs, Graduate Program Director
(585) 475-6801, dmjipk@rit.edu

Program overview

The MS program in packaging science is designed to meet the needs of professionals who are employed in the field or 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 program, graduates from 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 36 credit hours comprised of six required core courses, elective courses, plus a thesis or 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 upper-level undergraduate courses may be used to fulfill elective credit. Students, with adviser permission, may include Independent Study as part of their elective credits. However, independent study may not be used toward the 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

The thesis option requires 6 credit hours while the project option is 3 semester credit hours. Students choosing the project option are required to complete 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 roles as contributors in the workplace. The thesis option is for students seeking to pursue careers 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 proposal idea and whether it meets the program's requirements as a graduate project or thesis.

Packaging science (research thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
PACK-742	Distribution Systems	3
GRCS-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
PACK-790	Research Thesis	6
Total Semester Credit Hours		**36**

Packaging science (graduate project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
PACK-742	Distribution Systems	3
GRCS-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 Electives	6
PACK-797	Graduate Project	3
Total Semester Credit Hours		**36**

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 course 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 (GRE) 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 are appointed an academic adviser who 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. Students will choose a faculty adviser with approval from their program coordinator for their thesis or project. The faculty adviser guides the student on topic choice and works with the program coordinator for approval and timely completion of the thesis or project.

Telecommunications Engineering Technology, MS

http://www.rit.edu/ectet

Willilam P. Johnson, Graduate Program Director
(585) 475-2179, wpjiee@rit.edu

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. The MS in telecommunications engineering technology focuses on developing the advanced level of skill and knowledge needed by future leaders in the industry. The program is designed for individuals who seek advancement into managerial roles in the dynamic telecommunications environment.

Curriculum

The program requires 33 semester credit hours of study and includes eight core courses that introduce essential fundamental concepts and skills. Each student is required to complete either a capstone project or a master's thesis. The remaining credits consist of technical electives or other approved graduate courses.

Telecommunications engineering technology (thesis option), MS degree, typical course sequence

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
GRCS-701	Research Methods	3
TCET-740	Fiber Optic Telecommunications Technology	3
TCET-720	Telecommunications Concepts	3
TCET-760	Network Planning and Design	3
GRCS-702	Graduate Writing Strategies	3
Second Year		
	Electives	3
TCET-790	Thesis	6
Total Semester Credit Hours		**33**

Telecommunications engineering technology (graduate project option), MS degree, typical course sequence

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
GRCS-701	Research Methods	3
TCET-740	Fiber Optic Telecommunications Technology	3
TCET-720	Telecommunications Concepts	3
TCET-760	Network Planning and Design	3
GRCS-702	Graduate Writing Strategies	3
Second Year		
	Electives	6
TCET-797	Graduate Project	3
Total Semester Credit Hours		**33**

Telecommunications engineering technology (comprehensive exam option), MS degree, typical course sequence

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
GRCS-701	Research Methods	3
TCET-740	Fiber Optic Telecommunications Technology	3
TCET-720	Telecommunications Concepts	3
TCET-760	Network Planning and Design	3
GRCS-702	Graduate Writing Strategies	3
Second Year		
	Electives	9
TCET-795	Comprehensive Exam	0
Total Semester Credit Hours		**33**

Additional Information

Transfer credit

A limited number of credit hours may be transferred from an accredited institution to the program. Please consult the department chair for more information.

Other approved electives

All students may take three credit hours of graduate elective course work from other graduate programs subject to the approval of the graduate program director. Students often choose to include courses from Saunders College of Business, B. Thomas Golisano College of Computing and Information Sciences, or Kate Gleason College of Engineering. The number of elective credits depends on the student's choice of thesis, project, or comprehensive exam option.

Comprehensive Exam/Project/Thesis options

All students are required to complete a comprehensive exam at the conclusion of their course work. The comprehensive exam focuses on knowledge of the core competencies, theory and foundation principles, and application of this knowledge to a variety of scenarios. Students who wish to complete a capstone project or thesis under the supervision of a faculty adviser in place of the comprehensive exam must have the approval of the faculty and the graduate program director.

Research and cooperative education

Students 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 and Tourism Management, MS

http://www.rit.edu/cast/htm/graduate/

Carol Whitlock, Department Chair and Graduate Program Director
(585) 475-2353, cbwism@rit.edu

Program overview

The hospitality and tourism management program prepares students to step into numerous mid-level hospitality and tourism management and government policy positions. The program is focused on hospitality business planning, branding, economic management, and development of quality processes to deliver exceptional leadership within many service and corporate settings and at post-secondary academic institutions.

Curriculum

The program introduces major concepts associated with all aspects of hospitality, tourism, and business management, whether they are applied specifically to the hospitality-tourism industry or the wider service industry. Among the general concepts investigated are hospitality business development and marketing quality. Electives allow in depth study in specialized areas of hospitality manangement, such as resorts and attractions, travel and tourism, conventions and events, technology, and human resource development.

Students must complete a minimum of 30 credit hours. The curriculum is a combination of required core courses in hospitality and tourism management and elective courses chosen by the student to meet career interests and objectives. Students complete a graduate project or a comprehensive exam. A thesis option is available with approval. Course offerings generally are scheduled for evenings or via online learning to facilitate part-time students.

Core courses

Core courses explore essential hospitality and tourism business issues such as teamwork, strategic organizational change, financial and service performance metrics, development and marketing of resorts and attractions, and branding. 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.

Project/Capstone/Thesis options

Students must successfully complete a graduate project or comprehensive exam as a culminating experience allowing for demonstration of competencies in theory and applications for the discipline. Students work with the program adviser and/or program faculty to determine a topic for the graduate project and must arrange a faculty mentor for the project. The comprehensive exam option is open to all students. Students may request the thesis option, but must be approved and have secured a faculty mentor.

Hospitality and tourism management (capstone project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-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
HSPT-787	Capstone Project	3
Total Semester Credit Hours		**30**

Hospitality and tourism management (comprehensive exam option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-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
HSPT-794	Integrated Problem Solving	3
HSPT-795	Comprehensive Exam	0
Total Semester Credit Hours		**30**

Hospitality and tourism management (research thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-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	6
HSPT-790	Research Thesis	6
Total Semester Credit Hours		**30**

Electives

Elective courses provide students with an opportunity to individualize their graduate program 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 program. Courses may be taken from the service leadership and innovation program, the human resource development program, and the Saunders College of Business. Students are cautioned to observe course prerequisites in their selections.

Of the six credit hours of electives, students are relatively free to select courses they feel best meet their needs. All elective courses must be graduate-level. If previous course work exists, students may request a transfer of credits. A limited number of credit hours may be taken as independent study or practicum courses.

Admission requirements

To be considered for admission to the MS program in hospitality and 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,
- 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 80 (Internet-based) is required. International English Language Testing System (IELTS) scores will be accepted in place of the TOEFL. A minimum score of 6.5 is required. All international students will take the Michigan Test of English Proficiency upon arrival. A prescribed program in English and a reduced program course load may be required.

After a review by the program chair, applicants whose prior undergraduate work has been in areas other than hospitality or 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 semester.

Service Leadership and Innovation, MS

http://www.rit.edu/cast/servicesystems/service-leadership-and-innovation.php
Linda Underhill, Department Chair and Graduate Program Director
(585) 475-7359, lmuism@rit.edu

Program overview

The service leadership and innovation program provides students with the capability to transform their service organizations. Service is no longer a subset of manufacturing era thinking. The program includes core courses, concentration courses, and a comprehensive exam. Students may choose among three concentrations: engineering services, higher education, or service systems. Students, with permission, may complete a capstone project or thesis in place of the exam. These options require faculty and department chair approval.

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 informed by the program adviser and/or program faculty as to 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. If 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.

Curriculum

Service leadership and innovation (comprehensive exam option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-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**

Service leadership and innovation (capstone project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
SERQ-710	Evolving Contexts in Service	3
SERQ-720	Service Scenarios and Strategy Development	3
SERQ-722	Customer Centricity	3
SERQ-723	Service Analytics	3
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
Second Year		
	Concentration Courses	9
SERQ-711	Service Design and Implementation	3
SERQ-794	Integrated Problem Solving	3
	Capstone Project	0
Total Semester Credit Hours		**36**

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

COURSE		SEMESTER CREDIT HOURS
First Year		
GRCS-701	Research Methods	3
GRCS-702	Graduate Writing Strategies	3
SERQ-710	Evolving Contexts in Service	3
SERQ-720	Service Scenarios and Strategy Development	3
SERQ-722	Customer Centricity	3
SERQ-723	Service Analytics	3
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
Second Year		
	Concentration Courses	9
	Thesis	6
Total Semester Credit Hours		**36**

Concentrations

COURSE		SEMESTER CREDIT HOURS
Engineering services		
SERQ-740	Service Leadership Tools and Techniques	3
Choose two or three of the following:		
CQAS-682	Lean Six Sigma Fundamentals	3
ISEE-771	Engineering of Systems I	3
ISEE-723	Global Facilities Planning	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 undergraduate and graduate course work,
- Submit two professional recommendations,
- Submit a current resume,
- Have a minimum undergraduate GPA of 3.0 and 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 combined scores of 570 (paper-based) or 88-89 (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 unconditional acceptance is 6.5. Those who do not meet the minimum standards 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 9 semester credit hours of graduate course work in the progam.

Organizational Learning, Adv. Cert.

Program overview

The advanced certificate in organizational learning provides students with an in-depth understanding of how people learn. Courses cover the theories of instructional design, including the use of technology and its impact on curriculum design, and the development of courses for both classroom and online learning. The certificate is appropriate for chief knowledge officers, training directors, personnel new to the teaching field, and those who wish to embark on a career in teaching or training. All courses are offered via online learning to accommodate those who work.

Curriculum

Organizational learning, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
HRDE-710	Foundations of HRD	3
HRDE-720	Theories of Organizational Development	3
HRDE-721	Learning and Knowledge Management	3
HRDE-723	Group Dynamics and Leadership	3
HRDE-722	Talent Development	3
Total Semester Credit Hours		**15**

Admission requirements

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

- Hold a baccalaureate degree from an accredited institution,
- Have a minimum grade point average of 3.0 (B average or a first class degree from a foreign university),
- Submit transcripts (in English) of all previously completed undergraduate and graduate course work, and
- Complete a graduate application.

Service Systems, Adv. Cert.

Program overview

The advanced certificate in service systems offers service professionals cutting-edge skills, abilities, and applied service knowledge. The certificate heightens 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.

The certificate may be completed as a stand-alone credential or serve as an entry point for the MS program in service leadership and innovation.

Service systems, advanced certificate, typical course sequence

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-735	Data Mining in the Not-for-Profit, Public Sector	3
Total Semester Credit Hours		**12**

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.

Gainful employment

Information regarding costs and the U.S. Department of Labor's Standard Occupational Classification (SOC) code and occupational profiles for this program can be viewed at: rit/edu/programs/gedt/service-systems.

Training, Design and Assessment, 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 training, design and assessment provides professionals 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

Training, design and assessment, advanced certificate, typical course sequence

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 training, design and assessment, 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.

Human Resource Development, MS

http://www.rit.edu/cast/servicesystems/human-resources-development.php
Linda Underhill, Department Chair and Graduate Program Director
(585) 475-7359, lmuism@rit.edu

Program overview

The master of science degree in human resource development prepares students to influence and develop 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 are often experienced human resource practitioners eager to build new competencies in training, instructional design, talent and employee development; managers who want to encourage employees to reach their potential; and individuals interested in starting a career in the human resource development field. Courses are offered in the evening and online.

Curriculum

The degree requires a minimum of 36 credit hours. Students are required to complete a comprehensive exam at the conclusion of their course work. Students who wish to complete a graduate project or thesis in place of the exam must have the approval of the faculty and department chair.

Electives are chosen by the student and are used to fulfill their career interests. Courses may be taken in other graduate-level programs, with permission. A limited number of 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 who will work with the student to develop a plan of study.

Human resource development (comprehensive exam option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Design and Methods	3
GRCS-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
HRDE-794	Integrated Problemsolving	3
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
HRDE-795	Comprehensive Examination	0
Total Semester Credit Hours		**36**

Human resource development (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Design and Methods	3
GRCS-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
SERQ-770	Breakthrough Thinking, Creativity and Innovation	3
	Graduate Project	3
Total Semester Credit Hours		**36**

Human resource development (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
GRCS-701	Research Design and Methods	3
GRCS-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
	Thesis	6
Total Semester Credit Hours		**36**

Concentrations

COURSE		SEMESTER CREDIT HOURS
Organizational learning		
HRDE-720	Theories of Organizational Development	3
HRDE-721	Organizational Learning and Knowledge Management	3
HRDE-722	Talent Development	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 four 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 570 (paper-based) or 88 (Internet-based) are required. Scores from the International English Language Testing Systems (ILETS) will be accepted in place of the TOFEL. The absolute minimum score for unconditional acceptance is 6.5. Upon arrival at RIT, international students may be asked to take an English language proficiency exam. Those who do not meet the minimum standard will be required to take additional English language courses.

All required admission materials must be submitted and reviewed by faculty prior to the completion of 9 credit hours of graduate work in the program.

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

Todd Dunn, PE, BS, Dartmouth College; MSCE, University of California—Department Chair; 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 (India); 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 (United Kingdom)—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—Senior 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— Professor

Joseph M. Rosenbeck, CSP, BS, MS, 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

Miguel Bazdresch, BE, Western Institute of Technology and Higher Studies (Mexico); ME, National Polytechnic Institute (Mexico); Ph.D., National Higher School of Telecommunications (France)—Assistant Professor

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

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

Sungyoung Kim, BE, Sogang University (Korea); MM, Ph.D., McGill University (Canada)—Assistant Professor

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

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

Manufacturing and Mechanical Engineering Technology/Packaging Science

Martin Anselm, BS, University of New York College at Geneseo; MS, Clarkson University; Ph.D. Binghamton University—Assistant 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—Associate Professor

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

Spencer 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

Mark W. Olles, AAS, Monroe Community College; BS, Rochester Institute of Technology; Ph.D., University of Tennessee—Assistant Professor

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

Alan D. Raisanen, BS, Drake University; Ph.D. University of Minnesota—Assistant 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—Department Chair; Professor

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

Mark Williams, BS, MS, Rochester Institute of Technology—Lecturer

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

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

Jennifer DiGaetano, BS, MS, Rochester Institute of Technology—Lecturer

Muhammet Kesgin, Ph.D., Coventry University (United Kingdom)—Assistant Professor

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

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

Department of Service Systems

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

Patricia Poteat, BA, University of Rochester; MS, Rochester Institute of Technology; Ph.D., University of Rochester—Lecturer

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

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 chemistry and college level biology. Students who have completed ESHS-511 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. Students who have completed ESHS-310 may not take this course.) **Class 3, Credit 3 (S)**

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. Students who have completed ESHS-330 may not take this course.) **Class 3, Credit 3 (F)**

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. Students who have completed ESHS-350 may not take this course.)

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, record keeping, guarding, electrical safety, material handling, welding, fire prevention, excavation, medical surveillance, worker's compensation, inspection techniques, auditing, committees, incentives and voluntary programs. **Class 3, Credit 3 (S)**

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 out of classroom learning experiences required (team based). (ESHS-620 Occupational Safety or permission of department) **Lecture/Lab 4, Credit 3 (F, S)**

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. **Class 3, Credit 3 (F, S)**

ESHS-699 ESHS 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 semesters will be required. **Credit 0**

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 on site executive-leader format. (Matriculation into EHS management MS program or permission of department) **Class 3, Credit 3 (F)**

ESHS-722 EHS 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 EHS management MS program or permission of department) **Class 3, Credit 3 (S)**

ESHS-725 EHS 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 programs or permission of the department. **Class 3, Credit 3 (F)**

ESHS-740 EHS 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 permission of department) **Class 3, Credit 3 (S)**

ESHS-750 EHS 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 programs or permission of the department) **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 or facility management MS programs or permission of the department) **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. (This course is open to all graduate engineering technology, packaging, and environmental, health and safety management students or by permission of the department.) **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) (Matriculation into EHS management MS program or permission of department) **Class 3 , Credit 3 (S)**

ESHS-780 EHS Systems Review and Audit
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-660 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. (GRCS-701 Research Methods, GRCS-702 Graduate Writing Strategies and department approval) **Class 3, Credit 3 (F, S)**

ESHS-789 Special Topics in EHS Management
Subject offerings of new and developing areas of knowledge in environmental, health and safety management intended to augment the existing curriculum. Special topics courses are offered periodically. Watch for titles in the course listing each semester. **Class 1-3**

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-792 Continuation of Thesis
Continuation of Thesis

ESHS-794 Continuation of Graduate Thesis
Continuation of Graduate Thesis

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 percent to be successful. Students will have one additional opportunity to pass this examination if their initial attempt is unsuccessful. (Department approval is required) **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. (GRCS-701 Research Methods, GRCS-702 Graduate Writing Strategies and department approval) **Class 3, Credit 3 (F, S)**

ESHS-798 Continuation of Graduate Project
Continuation of Graduate Project

ESHS-799 ESHS Graduate Independent Study
ESHS Graduate Independent Study

Facility Management

FCMG-660 Principles and Practice in Facility Management
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-699 FCMG Co-op
FCMG Co-op

FCMG-720 EHS 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 & Practice in Facility Management or department approval) **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 approval) **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 approval) **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 and may begin work on their thesis. (GRCS-701 Research Methods, GRCS-702 Graduate Writing Strategies and adviser approval) **Class 3, Credit 3 (F, S)**

FCMG-789 Special Topics in Facilities Management
Subject offerings of new and developing areas of knowledge in Facilities Management intended to augment the existing curriculum. Special Topics courses are offered periodically. Watch for titles in the course listing each semester.

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 approval is required) **Class 3, Credit 0 (F, S)**

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. (GRCS-701 Research Methods, GRCS-702 Graduate Writing Strategies and adviser approval) **Class 3, Credit 3 (F, S)**

FCMG-799 Independent Study
A supervised investigation within a facility management area of student interest. Consent of the faculty sponsor and departmental approval are required. Students are limited to a maximum of three semester credit hours of independent study projects and two sections in any semester, and a maximum of six semester credit hours of independent study used to fulfill degree requirements.

Hospitality Management

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 Amentity 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 Graduate Special Topic
Graduate Special Topic

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 GRCS-701 Research Methods, Data Analysis, and GRCS-702 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 course work. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 6 (All Semesters)**

HSPT-791 Continuation of Project
Continuation of Project

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 percent in the course to be allowed to take the comprehensive exam. (Department approval) **Class 3, Credit 3 (F, S)**

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 percent 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 course work 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
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)**

HSPT-798 Continuation of Thesis
Continuation of Thesis

HSPT-799 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 1-4**

Human Resource Development

HRDE-702 Graduate Writing Strategies
Course replaced with GRCS-702

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, Credits 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, S)**

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 Theories 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**

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 or department approval) **Class 3, Credit 3**

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) **Class 3, Credit 3**

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 or department approval) **Class 3, Credit 3**

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 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 or department approval) **Class 3, Credit 3 (F, S)**

HRDE-733 Instructional Design and Technology in Human Resource Devlopment
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 or department approval) **Class 3, Credit 3 (F, Su)**

HRDE-740 Strategic HRD 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) **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) **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) **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) **Class 3, Credit 3 (F, S)**

HRDE-750 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, 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 Online Learning**
Online 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 online 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 course work 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-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. Completion of all HRDE core and required courses required. Students must receive a passing grade of at least 80 percent in the course to be allowed to take the comprehensive exam. **Class 3, Credit 3 (F, Su)**

HRDE-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. Completion of all HRDE core and required courses required. Students must receive a passing grade of at least 80 percent 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 course work. 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)**

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-700 **Principles of Engineering for PLTW Teachers**
This course provides the high school teacher with the course content material and pedagogical teaching strategies that will enable them to effectively teach PLTW's Principles of Engineering (POE) course in a 9-12 high school educational environment. POE exposes high school students to major concepts they'll encounter in a post-secondary engineering course of study. Topics include mechanisms, energy, statics, materials, and kinematics. They develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges, document their work and communicate solutions. This course is restricted to high school teachers who are attending Project Lead the Way Core Training. **LEL 4, Credit 4 (F, S, Su)**

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, REC 1, Credit 3 (F)**

MFET-670 Manufacturing Automation Control
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, REC 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, REC 1, Credit 3 (F)**

MFET-689 Special Topics in CAE
Subject offerings of new and developing areas of CAE knowledge in mechanical and manufacturing engineering technology intended to augment the existing curriculum. Special Topics courses are offered periodically.

MFET-699 Graduate Co-op
Work experience in manufacturing position appropriate to selected major in graduate program. Please see co-op adviser in the Office of Cooperative Education and Career Services Office. **Credit 0**

MFET-700 Introduction to Engineering Design for PLTW Teachers
This course provides the high school teacher with the course content material and pedagogical teaching strategies that will enable them to effectively teach PLTWs Introduction to Engineering Design (IED) course in a 9-12 high school educational environment. The major focus of IED is the engineering design process and its application. Through hands-on projects, high students will use industry standard 3D modeling software to design solutions to solve proposed problems, document their work using an engineer's notebook, and communicate solutions to peers and members of the professional community. This course is restricted to high school teachers who are attending Project Lead the Way Core Training. **LEL 4, Credit 4 (F, S, Su)**

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 & CNC in Integrated Manufacturing or equivalent experience, graduate standing or BS/MS student 4th 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-789 MFET Special Topics
Subject offerings of new and developing areas of knowledge in Manufacturing intended to augment the existing curriculum.

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-794 Continuation of Graduate Paper
Continuation of Graduate Paper

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 percent 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)**

MFET-798 Continuation of Capstone
Continuation of Capstone

MFET-799 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 1-3**

Packaging Science

PACK-699 Graduate Co-op
Work experience in packaging science position appropriate to selected major in graduate program. Please see co-op adviser in the Office of Cooperative Education and Career Services Office. **Credit 0**

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 (PACK-701) 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. Emphasises 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-750 **Packaging Materials, Processes and Applications**
This graduate level course is designed to present the theory, foundation principles and practices which form the basis of packaging science. **Class 3, Credit 3 (F)**

PACK-751 **Advanced Packaging Design**
The course develops knowledges of packaging design graphics and skills of package structure design. Topics covered are basics of engineering design graphics, technical sketch, project plan, design matrix, computer aided design (CAD) and rapid prototyping.. Emphasis is given to use SolidWorks—CAD software to design typical packaging structures. The design project focuses on developing a packaging structure from an idea to an actual prototype. **LEL 4, Credit 3 (S)**

PACK-752 **Advanced Computer Applications**
The course develops knowledge and skills in applying two computer software packages for packaging design: Artios CAD and Adobe Illustrator. Topics covered are builder and rebuilder, solid modeling and drawing, animation, coloring and painting. Emphasis is given to create a typical paperboard based carton with a proper structure and color usage. **LEL 4, 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 3, REC 1, Credits 3 (S)**

PACK-783 **Advanced 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, Rec 1, Credit 3 (S)**

PACK-789 **Packaging Science Special Topics**
Packaging Science Special Topics

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 course work. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 6 (F, S, Su)**

PACK-791 **Continuation of Thesis**
Continuation of Thesis

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 percent 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)**

PACK-798 **Continuation of Grad Project**
Continuation of Grad Project

PACK-799 **PS 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**

Service Leadership and Innovation

SERQ-699 **Graduate Co-op**
Grad Co-op

SERQ-700 **Research Methods**
Replaced with GRCS-701

SERQ-702 **Graduate Writing Strategies**
Taught in conjunction with Research Methods students will become articulate in a variety of 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 and a summary chapter of the results of the literature search. 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)**

SERQ-710 **Evolving Contexts in Service**
In this initial course in the service leadership and innovation graduate program systems thinking is used to explore the concepts of service in a theoretical, future oriented and practical framework. Service systems are examined from a relationship building framework emphasizing the customer-centric view, human and intellectual capital, asset management, technical interactivity and connectivity, and the process and experiential effects of service. **Class 3, Credit 3 (F, S, Su)**

SERQ-711 **Service Design and Implementation**
This course implements the use of selected design theories and processes to construct a customer co-created service system/process. Interactive design shapes and mediates the relationships in the service provision(s). In the course, students become experience innovators in a service system environment using design. **Class 3, Credit 3 (F, S, Su)**

SERQ-712 **Breakthrough Thinking, Creativity, and Innovation**
This is an introductory survey course on the dynamics of innovation. The course focuses on individual, team and organization-level human and systems dynamics that impact organizational innovation. Students gain awareness of, understanding and important skills in fostering multi-level organizational human ecologies conducive to the creation of innovation. Issues and challenges important to leaders and team leaders at all levels in an organization, entrepreneurs and talent management practitioners will be examined and explored. There is a required fee for this class to pay for the administration of the ISPI and IDNA evaluation instruments.**Class 3, Credit 3 (F, S, Su)**

SERQ-714 **Service Leadership and Innovation Practicum**
To gain experience in applied innovation students will observe, interact and discuss with service organizations how they develop and execute innovation strategies to enhance their service environment. This experience will require the student's visit the organization for a specified time period in locations arranged by the facilitator of the course. At the conclusion of the experience students will relate this benchmarking experience to innovation strategies in the service industries. Students will be responsable for related costs for this experience. (SERQ 712 Breakthrough Thinking and Innovation) **Class 0, Credit 0, (I)**

SERQ-720 **Service Scenario and Strategy Development**
The service world has many failures of large, once-successful companies that failed to accomplish the primary goal of every organization: consistently design and deliver value to customers and other key stakeholder groups in a highly competitive and ever-changing service environment. This course introduces the concepts, principles, and practices necessary to avoid failure by taking an action-oriented approach to planning, implementing, evaluating, and revising competitive strategy in service firms. The course will address basic concepts and principles of competitive strategy, the process of developing and implementing strategy in service-centered firms, development of robust, future-oriented strategies using learning scenarios, strategy mapping, and tools for strategy evaluation such as performance metrics, scorecards and dashboards. (SERQ-710 Evolving Contexts in Service) **Class 3, Credit 3 (F, S, Su)**

SERQ-722 Customer Relationship Management/customer Centricity
The Customer Centricity course allows the learner to manage within their organization interactions with valued customers across multiple channels, and provide options to maximize revenue, build foundations to increase customer experience/value and drive customer retention and commitment. The student will learn to identify strategies and implement beneficial relationships with customers by learning about service elements that are critical to consumers. (SERQ-710) **Class 3, Credit 3 (F, S)**

SERQ-723 Service Performance Metrics/service Analytics
Service Analytics is a specialization graduate course designed to build on the foundation of quantitative and qualitative skills necessary to ensure high levels of service quality, efficiencies and effectiveness in service organizations. The class will synthesize both current metrics and analytics, and develop new analytics associated with continuous improvement using a new set of Key Performance Indicators (KPI's) and will devise a service measurement scorecard utilizing and integrating best practices, metrics, analytics and other reporting methods us from many different industries and service sectors. (SERQ-710) **Class 3, Credit 3 (S, Su)**

SERQ-730 Project Management in NFP
Managing public sector projects is a complex, demanding process involving ethical considerations, leadership,the ability to understand complex rules and regulations, the politics of the administration and the vagaries of the budget process. This conceptual framework will address planning, selection of team members , contracts and agreements, monitoring and adjusting the project progress and completion of the project through turnkey stages. The end result of this process is to contribute to establishment of trust of the public, minimize failure and maximize success. (SERQ-710 Evolving Contexts in Service) **Class 3, Credit 3 (F, Su)**

SERQ-732 Service Quality in NFP
In the public sector service satisfaction is a major contributor to the success or failure of public administration. To engage stakeholders, gain their trust and earn an appropriate appraisal of service quality requires strategies appropriate for dealing with the public sector as well as what is generally used to assess service quality. To enable better quality performance outcomes in the public sector, students will learn a dynamic quality system thinking and modeling strategy to establish a service system to maximize success, minimize failures and overall improve the quality of services provided to the public sector. The outcome of this course is enhance the learners ability to provide the highest level of stakeholders satisfaction possible for services rendered in the public sector. (SERQ-710 Evolving Contexts in Service) **Class 3, Credit 3 (S, Su)**

SERQ-735 Data Mining in NFP
To gather information and analyze the information to inform decisions is the goal of every public sector administration. This data can drive success of the government or lead to its downfall. This course will explore data mining used in the public sector, how to gather it and utilize the results of the data collections to inform decisions that reflect the needs and desires of the stakeholders in this sector. (SERQ-710 Evolving Contexts in Service) **Class 3, Credit 3 (F)**

SERQ-740 Leadership Tools and Techniques
This course will allow students to be aware of and utilize tools and techniques to build and sustain leadership skills. The course approaches leadership development from a systems perspective examining and mastering proactive leadership approaches, understanding and using team building and team learning, examining various leadership techniques including, benchmarking, continuous improvement, Six Sigma and lean, gap analysis and more. Dialog and case analysis are used to enable all students to comprehend the myriad of tools available and be able to construct a stronger service organization. (SERQ-710 Evolving Contexts in Service) **Class 3, Credit 3 (F , S)**

SERQ-750 The Student Experience in Higher Education
This course explores the student experience in higher education. Since students are, arguably, a university's most important customer, how should institutions approach the student experience on and off campus? This course will prompt students to consider the wide range and types of colleges and universities around the world and the models used that form the college experience. These approaches impact students perceptions of the higher education university reputation, marketability, alumni giving, and retention. Topics for investigation include: (1) campus facilities and third places; (2) student services; (3) student activities and athletics; (4) teaching and learning; (5) campus traditions; and (6) assessment strategies. (SERQ 710 Contexts in Service) **Credit 3**

SERQ-751 Critical Systems in Higher Education
Higher education is a vital societal component in American and global societies and must be accessible to citizens. This course examines current and historical perspectives of the critical systems in higher education to fund, manage risk, and adhere to lawful practices and lead. All of these systems affect students in areas of accessibility, value, customer service, and the higher education experience. Included is an exploration of how price, cost, and value shape what is provided by and who attends college as well as reviewing current practices and events that continue to shape higher education. (SERQ 710 Contexts in Service) **Credit 3**

SERQ-755 Organization and Leadership in Higher Education
This course examines features of core functional areas of modern higher education. The course focuses on the administration of higher education institutions and includes 1) historical contexts for higher education 2) student experience; 3) academic and administrative issues; and 4) infrastructural concerns, including planning, technology, and facilities management. This course uses a survey perspective of these areas to provide a foundation for understanding the dimensions found within higher education. **Credit 3**

SERQ-780 Internship
This course provides the student with the opportunity to apply their graduate course work 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. (SERQ-710 Evolving Contexts in Service; SERQ-711 Service Design and Implementation; SERQ-722 Customer Centricity, SERQ-723 Service Analytics; SERQ-770 Breakthrough Thinking) **Class 3, Credit 3 (F, S, Su)**

SERQ-789 Special 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)**

SERQ-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 by taking thesis planning as soon as they have completed the prerequisites to allow them to finish the thesis when they have finished their course work. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. **Credit 1-6**

SERQ-791 Continuation of Research Thesis
Continuation of Research Thesis

SERQ-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 percent 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 course work 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 required to compete this graduation strategy) **Class 3, Credit 3 (F, Su)**

SERQ-795 Comprehensive Exam
Students will demonstrate synthesis and integration of the theories and foundation principles of their discipline to respond to questions found in the comprehensive examination. This demonstration will apply core knowledge to problem situations to be successful students must receive a passing grade of at least 80 percent. (12 semester hours or less of course work remaining to complete the program; completion of all core courses in the discipline; currently enrolled in the program; possess a program GPA of 3.0 or higher; no outstanding incomplete grades; student cannot be on academic/disciplinary probation. For disciplines requiring Integrative Problem Solving successful completion of that course. Department approval) **Credit 0, (F,Su)**

SERQ-797 **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. (Completion of all core and concentration courses) **Class 3, Credit 3 (F, S)**

SERQ-798 **Continuation of Capstone Project**
Continuation of Capstone Project

SERQ-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)**

Telecommunications Engineering Technology

TCET-661 **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. (MATH-211 Multivariable Calculus and DEQ) **Class 3, Credit 3 (F)**

TCET-699 **TCET Graduate Co-op**

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 eng. tech. 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 eng. tech. 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 eng. tech. MS program 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 eng. tech. MS program or permission of instructor) **Class 3, Credit 3 (F)**

TCET-745 **Fiber Optic Telecom 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 three 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 eng. tech. MS program or permission of instructor) **Class 3, Credit 3 (S)**

TCET-755 **Wireless Communications Techniques**
This course focuses on techniques for data transmission over the wireless channel. Students who take this course will start by learning about digital communications over the noisy channel, including how to model, simulate, and evaluate the system's performance. Then, they will move on to the wireless channel, which presents a new set of challenges, such as multipath fading. Students will learn techniques to achieve reliable, efficient communication over this channel, such as coding, diversity, and MIMO. Students will be assigned exercises where they'll use a computer and a software-defined radio to simulate, design and evaluate their own communications systems. (TCET-750 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 eng. tech. 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. (Co-req.: GRCS-701 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. (Co-req.: GRCS-701 Research Methods) **Credit 1-6 (All Semesters)**

TCET-894 **Continuation of Graduate Thesis**
Continuation of Graduate Thesis

TCET-895 **Continuation of Graduate Project**
Continuation of Graduate Project

Graduate Writing and Research Courses

GRCS-701 **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 research in applied 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. CAST and HLTH graduate students only. (Department approval.) **Class 3, Credit 3 (F, S)**

GRCS-702 **Graduate Writing Strategies**
Students will demonstrative written communication skills applied to research and outcome methods. These methods include knowledge of the use of data bases for research of a specified topic, use of appropriate references and citations, a written research proposal, a white paper, and a grant proposal. A search of the literature for a defined research topic, which includes an annotated bibliography to support the references used and a summary document for the results of the literature search. In addition students will critique professional journals in their field and write a summary analysis of these articles. **Class 3, Credit 3 (F, S)**

GRCS-703 **Graduate Writing Strategies-Global**
Students will demonstrative written communicatin skills applied to research and outcome methods. These methods include knowledge of the use of data bases for research of a specified topic, use of appropriate references and citations, a written research proposal, a white paper, and a grant proposal. A search of the literature for a defined research topic, which includes an annotated bibliography to support the references used and a summary document for the results of the literature search. In addition students will critique professional journals in their field and write a summary analysis of these articles. A total of 3 credits is required to satisfy the Graduate Writing Strategies requirement. **Class 1, Credit 1 (F, S)**

Saunders College of Business

Jacqueline Reynolds Mozrall, Interim Dean
saunders.rit.edu/

Programs of study

Online learning option available

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. 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 Simone Center for Student Innovation and Entrepreneurship. The center promotes, nurtures, and expands innovation and entrepreneurship through a three-pronged approach that combines interdisciplinary entrepreneurial curriculum, experiential learning, and entrepreneurship programs. The center offers:

- minors and concentrations in entrepreneurship, and innovation and commercialization, as well as courses in strategic growth and business creativity.
- cooperative education opportunities for students to advance a business concept through the RIT Student Business Lab or work for a startup company. Students also can earn credit through consulting opportunities with pre-seed and startup ventures.
- entrepreneurship programs such as the RIT Business Plan Competition, the RIT Entrepreneur's Conference, various workshops, a speakers series, and an extensive alumni network.

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 Student Incubator, business plan competitions, 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 of Business 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

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

Business Administration–Traditional, MBA

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 49 credit hours and consists of 17 courses, nine of which are devoted to core functional areas and eight available in concentration areas and as electives.

Curriculum

MBA degree (traditional), typical course sequence

COURSE		SEMESTER CREDIT HOURS
MGMT-601	Foundations of Business Ethics	1
MGMT-740	Organizational Behavior and Leadership	3
ACCT-603	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 Electives	24
Total Semester Credit Hours		**49**

Concentrations

Students must select at least one area of concentration. A concentration is a sequence of three to four courses in a specialized area of business, giving students in depth knowledge in a particular field. 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.

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. Digital marketing has given rise to an enormous need to understand the implications of these shifts for strategic initiatives in marketing and advertising.

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 (marketing, innovation, finance, accounting, etc.) within one coordinated value-creating initiative.

The concentration requires an applied entrepreneurial learning experience that may be satisfied through either the Field Experience in Business Consulting (MGMT-753) course or an approved commercialization project. These projects may involve students developing their own businesses or working with RIT incubator companies, local start-up firms, or RIT multidisciplinary commercialization projects.

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 of the following, if this is your primary concentration:		3
ACCT-709	Basic Taxation	
BLEG-612	Legal and Accounting Issues for New Ventures	
BLEG-730	Business Legal Concepts	
FINC-722	Financial Management II	
MGMT-742	Technology Management	
MKTG-763	Buyer Behavior	
MKTG-772	Internet Marketing: Strategy and Tactics	

Environmentally sustainable management

With a goal of familiarizing students with environmentally sustainable business practices, this concentration is attractive to those 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.

COURSE		SEMESTER CREDIT HOURS
MGMT-710	Managing for Environmental Sustainability	3
Choose two or three of the following:		6-9
ESHS-720	Environmental Health and Safety Management	
ESHS-750	ESH and FM Project Management	
ESHS-765	Product Stewardship	
ISEE-785	Fundamentals of Sustainable Engineering	
ISEE-786	Lifecycle Assessment/Costing	
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.

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. Regardless of size, nearly all enterprises operate globally: sourcing, producing, researching, and marketing worldwide. Suppliers and competitors are not only across the street, they are around the globe. Balancing 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. Manag-

ers 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.

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

* Topics may vary.

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 develop the essential analytical and decision-making skills for today's rapidly changing world. They learn why change is difficult, when to initiate change, and how to introduce and manage change in the workplace. These courses also prepare students for the demands of managing people and projects.

COURSE		SEMESTER CREDIT HOURS
MGMT-741	Managing Organizational Change	3
Choose two or three of the following:		6-9
BLEG-745	Legal and Ethical Issues in Technology Intensive Environments	
INTB-730	Cross-cultural Management	
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-755	Negotiations	
MGMT-756	Power and Influence	
MGMT-758	Seminar in Management*	
MGMT-763	Behavioral Skills for Managers and Professionals	
MGMT-775	Business Ethics and Corporate Social Responsibility	

* Topics may vary.

Management information systems

This concentration enhances students' understanding of modern information systems. It was designed for students who may not have a background in computers or information systems.

COURSE		SEMESTER CREDIT HOURS
MGIS-720	Information Systems Design	3
Choose two or three of the following:		6-9
MGIS-725	Data Management and Analytics	
MGIS-730	Information Technology Project Management	
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.

COURSE		SEMESTER CREDIT HOURS
MKTG-762	Advanced Marketing Management	3
MKTG-763	Buyer Behavior	3
Choose one or two of the following:		3-6
INTB-750	Global Marketing Management	
MKTG-758	Seminar in Marketing*	
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	
MKTG-778	Commercialization and Marketing of New Products	

* 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.

COURSE		SEMESTER CREDIT HOURS
MKTG-763	Buyer Behavior	3
MKTG-771	Marketing Research Methods	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

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.

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

Product commercialization

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

COURSE		SEMESTER CREDIT HOURS
MKTG-778	Commercialization and Marketing of New Products	3
Choose two or three of the following:		3-6
DECS-744	Project Management	
MGMT-762	Managing New Process and Product Development	
MKTG-763	Buyer Behavior	
MKTG-771	Marketing Research Methods	
MKTG-776	Product and Brand Management	

Quality and applied statistics

This concentration is for students interested in studying the technical aspect of managing quality (i.e., statistical quality control). Students 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.

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

Quality and organizational improvement
For students interested in learning more about the organizational and managerial (i.e., "soft") aspects of quality, this concentration will help students lead organizational change and manage quality improvement projects.

COURSE		SEMESTER CREDIT HOURS
DECS-745	Quality Control and Improvement	3
MGMT-741	Managing Organizational Change	3
Choose one or two of the following:		3-6
CQAS-621	Statistical Quality Control	
CQAS-682	Lean Six Sigma Project	
DECS-744	Project Management	
DECS-758	Seminar in Decision Sciences	
MGMT-770	Business Research Methods	

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 are typically 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.

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

Additional concentrations

In addition to business-related concentrations, several additional concentrations are available from outside Saunders College. Customized concentrations are also possible 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
Specifically designed for students employed in the health care environment, this concentration, offered by the College of Applied Science and Technology, introduces 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 last decade, leading to a higher 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, or 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 require-

ment 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 fall, spring, and summer semesters. 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 semester 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 49 credit hours, however, students may be able to waive MBA foundation courses. Prior academic preparation must be from an institution accredited by AACSB International and the course work must be equivalent to RIT's 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 9 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 (3.0) 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 (MGMT-070). 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 course, Professional Skills Seminar (MGMT-070), 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

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, 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. 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 15 months of alternating weekends (all day Fridays and Saturdays), two one-week on-campus sessions, and a one-week international study trip.

The curriculum focuses on core business concepts, providing fundamental skills, knowledge, and perspectives in accounting, statistics, leadership, finance, and economics. The program develops skills in cross-functional analysis 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.

Executive MBA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-806	Team Building and Ethics (August)	1
ACCT-801	Accounting and Organizational Goals	2
ACCT-802	Managerial Accounting	2
DECS-810	Statistical Analysis for Managers	2
MGMT-810	Leadership	2
MGMT-800	Leadership Development I	1
ESCB-840	Microeconomics and Pricing	2
MGMT-804	Critical Thinking for Decision Makers	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-889	Capstone Consulting Project I (summer)	3
MGMT-801	Leadership Development II (summer)	1
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
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 college or university,
- Submit official transcripts (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 program's week-long sessions occur in the summer and spring, and the international trip takes place in the student's final semester. Business owners or individuals may sponsor themselves.

Business Administration–Online Executive, MBA

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

Program overview

The online executive MBA is a challenging and demanding program 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.

The 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 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 solid network of influential peers.

Curriculum

This is a 17-month program with all courses completed online. Students can begin the program in the fall or spring semester. The following course sequence is based on a student who begins their studies in the fall semester.

Online executive MBA degree, typical course sequence

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
MGMT-800	Leadership Development I	1
ESCB-840	Microeconomics and Pricing	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
ESCB-841	Macroeconomics	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
DECS-864	Systems Support for Operations	2
MGMT-889	Capstone Consulting Project I	3
Second Year		
MKTG-865	Managing New Product Commercialization	2
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 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 bachelor's degree from an accredited college or university,
- 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

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 fulfills the educational 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 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 outside of business, economics, statistics, or accounting.

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

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 Services	3
ACCT-708	Auditing and Professional Responsibility	3
ACCT-707	Advanced Accounting	3
Total Semester Credit Hours		**30**

Accounting, MBA degree (for applicants with no previous business, economics, or statistics course work), typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-601	Foundations of Business Ethics	1
MGMT-740	Organizational Behavior and Leadership	3
ACCT-603	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-645	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 Services	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) 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 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 semester for students from the United States, and up to 10 weeks prior for international students applying for student visas.

Entrepreneurship and Innovative Ventures, MS

saunders.rit.edu/programs/graduate/entrepreneurship/

Program overview

The master of science degree in entrepreneurship and innovative ventures 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 30 credit hours consisting of:

- six required core courses designed to increase a student's knowledge of accounting, organizational behavior and leadership, technology management, entrepreneurship, marketing, and product commercialization;
- Two courses that allow students to pursue organizational, research, product, or project management expertise; and
- Electives that provide students will additional background in areas of interest.

Entrepreneurship and innovative ventures, MS degree, typical course sequence

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 courses:		6
DECS-744	Project Management	
GRDE-711	Design Theory and Methods Seminar	
MGMT-735	Management of Innovation in Products and Services	
MGMT-742	Technology Management	
MKTG-776	Product and Brand Management	
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 taken at RIT may be in courses outside the Saunders College.

Admission requirements

To be considered for admission to the MS program in entrepreneurship and innovative ventures, 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, 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 semester 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.

Finance, MS

saunders.rit.edu/graduate/ms_finance.php

Program overview

The master of science degree in finance prepares students for managerial careers in corporate finance, investment analysis and portfolio management, financial consulting, and financial institutions. 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 semester.

Curriculum

The program of study consists of 10 courses and a field exam. Candidates must successfully complete the comprehensive field exam.

Finance, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ACCT-603	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) 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. This 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 semester for students from the United States, and up to 10 weeks prior for international students applying for student visas.

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.

Management, MS

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 three tracks of study: global management, leadership, or technology management.

Full-time students must begin the program in the fall semester in order to complete the program in 12 months. Part-time students may enter the program in any semester.

Curriculum

The program consists of 10 courses, including business electives chosen by the student. Students must pass a comprehensive examination at the end of the program or pass Graduate Project (MGMT-791), which is considered one of the business electives.

Management, MS degree, (global management option), typical course sequence

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MGMT-735	Managing of Innovation in Products and Services	3
INTB-710	Global Business Opportunities and Threats	3
INTB-780	Global Issues and Strategies	3
MGMT-755	Negotiations	3
MGMT-775	Business Ethics and Corporate Social Responibility	3
Choose one of the following courses:		3
INTB-730	Cross-cultural Management	
FINC-760	Finance in a Global Environment*	
INTB-750	Global Marketing Management	
	Business Electives	6
	Free Eletive	3
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, (leadership option), typical course sequence

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MGMT-735	Managing of Innovation in Products and Services	3
MGMT-XXX	Managerial Skills	3
MGMT-755	Negotiations	3
MGMT-775	Business Ethics and Corporate Social Responsibility	3
MGMT-741	Managing Organizational Change	3
Choose one of the following courses:		3
MGMT-710	Managing for Environmental Sustainability	
MGMT-XXX	Advanced Topics in Technology Management	
MGMT-720	Entrepreneurship and New Venture Creation	
MGMT-753	Field Experience in Business Consulting	
	Business Electives	6
	Free Elective	3
Total Semester Credit Hours		**30**

Management, MS degree, (technology management option), typical course sequence

COURSE		SEMESTER CREDIT HOURS
MGMT-740	Organizational Behavior and Leadership	3
MGMT-735	Managing of Innovation in Products and Services	3
MGMT-720	Entrepreneurship and New Venture Creation	3
MGMT-755	Negotiations	3
MGMT-775	Business Ethics and Corporate Social Responsibility	3
MGMT-XXX	Advanced Topics in Technology Management	3
Choose one of the following courses:		3
MGMT-762	Managing New Process and Product Development	
MKTG-778	Commercialization and Marketing of New Products	
DECS-744	Project Management	
	Business Electives	6
	Free Elective	3
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. This requirement is waived for native speakers of English or for candidates submitting transcripts from American institutions. For additional information on the IELTS, visit www.ielts.org.

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Jacqueline Reynolds Mozrall, BS, Rochester Institute of Technology; MS, North Carolina State University; Ph.D., State University of New York at Buffalo—Interim Dean

Qiang (John) Tu, BS, MS, Xi'an Jiaotong University (China); Ph.D., University of Toledo—Associate Dean

Lisa Boice, BA, MBA, Long Island University; JD, Hofstra University School of Law—Assistant Dean for Student Services

Accounting

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R. Mithu Dey, BBA, Howard University; MBA, Ph.D., George Washington University; CPA, Maryland—Associate Professor

William T. Evans, BS, Rensselaer Polytechnic Institute; MBA, University of Rochester—Senior Lecturer

Philip C. Gelsomino II, BS, Rochester Institute of Technology; CPA, New York—Visiting Lecturer

Roberta L. Klein, BS, State University College at Brockport; MBA, Rochester Institute of Technology; CPA, New York—Lecturer

Qian Song, B.Sc., M.Sc., Qingdao University (China); 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—Assistant Professor

Ke-an Wu, BS, Jiangxi University of Finance and Economics (China); MS, Catholic University Leuven (Belgium); Ph.D., University of Oregon—Assistant Professor

Rong Yang, BS, MS, Tianjin University of Finance and Economics (China); MBA, Ph.D., Rutgers University—Associate Professor

Decision Science

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John E. Ettlie, BS, MS, Ph.D., Northwestern University—Benjamin Forman Chair for Research; Professor

A. Erhan Mergen, BS, Middle East Technical University (Turkey); MS, Ph.D., Union College—Professor

William J. Stevenson, BS, MBA, Ph.D., Syracuse University—Associate Professor

Finance and Economics

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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—Professor

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Hao Zhang, BA, MA, Xiamen University (China); Ph.D., State University of New York at Buffalo—Assistant Professor

Management and International Business

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Richard DeMartino, BA, Roanoke College; MPA, Ph.D., University of Virginia—Simone Chair for Innovation and Entrepreneurship; Associate Professor

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Sandra L. Rothenberg, BS, Syracuse University; MS, Ph.D., Massachusetts Institute of Technology—Director, Saunders College Institute of Business Ethics; Public Policy Department Chair; Professor

Delmonize Smith, BBA, Faulkner University; MS, Troy University; Ph.D., University of Alabama—Associate Professor

Zhi Tang, BA, Shandorun University (China); MA, Fudon University (China); Ph.D., University of Alabama—Associate Professor

Donald O. Wilson, BS, Oklahoma State University; MS, MPA, University of Southern California; Ph.D., University of California at Irvine—Director, EMBA Program; Assistant Professor

Management Information Systems

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Sean William Hansen, BA, Harvard University; MBA, Ph.D., Case Western Reserve University—Assistant Professor

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Qiang (John) Tu, BS, MS, Xi'an Jiaotong University (China); Ph.D., University of Toledo—Associate Dean

Yang Yu, BS, MS, Ph.D., Beijing University of Aeronautics & Astronautics (China); Ph.D., Texas Tech University—Assistant Professor

Marketing

Victor J. Perotti, BS, MS, MA, Ph.D., The Ohio State University—Department Head; Professor

Robert B. Boehner, BA, MA, Siena College; JD, University of North Carolina at Chapel Hill—Senior Lecturer

Adriana M. Bóveda-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

Laurie Dwyer, BS, St. Lawrence University; MBA, Rochester Institute of Technology—Senior Lecturer

Neil Hair, BS, University of Wales (United Kingdom); MS, Sheffield Hallam University (United Kingdom); Ph.D., Cranfield University (United Kingdom)—Associate Professor

V. Myles Landers, BS, Berry College; Ph.D., The University of Alabama—Assistant 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 (India); MBA, Ph.D., Southern Illinois University—Assistant Professor

Weidong Rong, BBS, Massey University (New Zealand); MACC, Ph.D., Saint Louis University—Visiting Assistant Professor

John D. Ward, BS, Georgia Institute of Technology; MS, Purdue University—Senior Lecturer

Accounting

ACCT-603 **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-645 **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-603 or equivalent) **Credit 3 (S)**

ACCT-704 **Corporate Financial Reporting I**
A comprehensive exposure at an intermediate level to financial accounting theory and practice under U.S. Generally Accepted Accounting Principles. Emphasis is placed on applying underlying accounting theory to complex accounting and reporting problems. The effects of alternative accounting methods are considered. International financial reporting standards are introduced as they relate to course subject matter. (ACCT-603 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 liabilities and contingencies, stockholders' equity, earnings per share, pensions, leases, revenue recognition, income tax accounting, and the statement of cash flows. International financial reporting standards are introduced as they relate to course subject matter. (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-603 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-704 or equivalent) **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-603 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-603 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 co-requisite) **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-603, FINC-721) **Credit 3 (F)**

ACCT-741 Cases in Forensic 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-603) **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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from semester to semester.(Depends on topic) **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)**

ACCT-799 Independent Study Accounting
The student will work independently under the supervision of a faculty adviser. (Department approval) **Credit 3 (F, S, Su)**

ACCT-801 Accounting and Organizational Goals
This course provides an understanding of how accounting helps organizations achieve their goals. Special emphasis is given to the resolution of controversial accounting issues within the context of a firm's goals. Topics include standards and practices of financial reporting, financial statements, inventories, long-term assets, bonds and other liabilities, and stockholders' equity. **Credit 2 (F)**

ACCT-802 Managerial Accounting
Managerial Accounting emphasizes identifying and applying the techniques used by managerial accountants to measure the cost of goods and services produced by the firm. The course focuses on understanding how managerial accounting is used to help organizations achieve their goals. (ACCT-801) **Credit 2 (F)**

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. **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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from semester to semester. (Instructor determined) **Credit 3**

BLEG-799 Independent Study - Business Legal
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

Decision Sciences

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)**

DECS-758 Seminar in Decision Sciences
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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from semester to semester. (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)**

DECS-799 **Independent Study Decision Sciences**
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

DECS-810 **Statistical Analysis for Managers**
This course introduces concepts for interpreting and analyzing data as a tool for assisting managers in making complex business decisions. Topics to be covered include: review of descriptive statistics, normal distribution, sampling distributions, estimation, test of hypothesis for single and two populations, linear regression, multiple regression and model building. The application of appropriate statistical tools will be required. **Credit 2 (F)**

DECS-864 **Systems Support for Operations**
This course focuses on the application of information technology to gain greater efficiency and effectiveness from operational and managerial processes and systems. The conceptual foundations of operations, supply chain management and information technology are surveyed and contemporary approaches analyzed from a managerial perspective. **Credit 2 (Su)**

DECS-875 **Business Simulation**
Teams of students manage a company in a computer simulated oligopoly industry, competing against companies managed by other student teams. The overall purpose of the Business Simulation Course is to enhance the participant's ability to make effective business decisions, encourage cross-functional thinking, foster strategic and systems thinking, and enhance team building and reinforce continuous improvement opportunities. (MGMT-818, FINC-845) **Credit 2 (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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from semester to semester. (Instructor determined) **Credit 3 (F, S)**

ESCB-799 **Independent Study Economics**
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

ESCB-840 **Microeconomics and Pricing**
This course introduces microeconomic concepts and how they can be employed to examine business decisions such as pricing under conditions of uncertainty. Models and applications are employed that describe the efficient allocation of resources within a firm. Topics include supply and demand, consumer behavior, production, cost and pricing. **Credit 2 (F)**

ESCB-841 **Macroeconomics**
Fundamental macroeconomic theories will be examined to explain and predict changes in economic growth, employment, inflation, consumer spending, business investment, and foreign trade. Financial markets, domestic and foreign, will be examined to understand changes in interest rates and exchange rates. The likely affects of government spending, taxes, and Federal Reserve Bank policies on the economy and business will be evaluated. **Credit 2 (F)**

Finance

FINC-605 **Financing New Ventures**
A focus 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-603 pre or co requisite) **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 (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. (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, hedging methods. (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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from semester to semester. (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 co-requisite: FINC-721) **Credit 3 (F, S)**

FINC-790 **Field Exam**
All MS-Finance students take a field exam at the end of their program. This course provides basic help to students taking this exam. (all required finance courses in the MS- ininance program) **Credit 1 (F, S, Su)**

FINC-799 **Independent Study Finance**
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

FINC-845 **Valuation and Capital Budgeting**
The course introduces financial concepts of risk, return and valuation. The main application studied in this course, Capital Budgeting, arises in the corporate setting where managers allocate scarce resources to projects. Basic issues of capital budgeting covered include cash flow estimation and valuation techniques. Advanced issues include sensitivity analysis and the consideration of real options. (ACCT-802, pre- or co-requisite DECS-810) **Credit 2 (S)**

FINC-846 **Financial Planning and Analysis**
This is the second-part of a two-course corporate finance sequence for EMBA students. The overall theme is one of strategic control of corporate assets and liabilities. The five topics covered in this course are: (a) long-term financial planning, corporate financing and cost of capital, (b) short-term financial planning and the analysis of short-term assets and liabilities, (c) risk management and the corporate use of derivatives, (d) the analysis of international activities, and (e) corporate control activities. Three topics are explored in depth: short-term financial management, capital structure and dividend policy, and risk and hedging. Short-term financial management includes the topics of credit analysis, financial forecasting and planning, working capital management and cash flow management. (FINC-845) **Credit 2 (S)**

FINC-850 **International Finance**
This course examines how the international environment affects the practice of corporate finance by using a combination of theory and cases. 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. (FINC-846) **Credit 2 (F)**

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 offshoring, role of non-governmental organizations (NGOs), etc. It will emphasize faculty-directed student research projects. (INTB-710) **Credit 3 (S)**

INTB-799 **Independent Study - International Business**
The student will work independently under the supervision of a faculty adviser. (Instructor approval)

INTB-820 **International Business**
The primary objective of the course is to examine the strategies, concepts, theories, and practices associated with conducting international business. It seeks to develop practical and theoretical problem solving skills needed in the global business environment. **Credit 2 (F)**

INTB-825 **International Study Seminar**
This international study tour is an integral part of semester long focus on the strategic and operational issues facing organizations in a global competitive environment. Students will engage in lectures, plant visits, and interviews with international corporate managers. Students will apply the insights gained from their previous and concurrent course work. This seminar offers students an inside view of individual companies and industries, and some of the broader economic, political, social, and cultural factors that influence business opportunities and practices in a particular region of the world. (Co-requisite: INTB-820) **Credit 2 (F)**

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-699 **Honors Co-op**
One semester of paid MBA-related work experience. (Departmental approval required) **Credit 0 (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-603, 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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from semester to semester. (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)**

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 one-credit course in Business Ethics. This course should not be taken by MBA students who take the one-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 adviser 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 for this course. A final grade for both the Innovation Project and Innovation Capstone courses will be assigned upon completion of the capstone course. 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. (Permission of the program director) **Credit 3 (F, S)**

MGMT-795 Innovation Capstone
Students work with faculty and industry advisers 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 advisers 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)**

MGMT-799 Independent Study Management
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

MGMT-800 Leadership Development I
This course builds on the assessment activities that are part of course MGMT-806. Each student participates in a 360-degree leadership assessment process. Based on this formal review, personal development plans are created and serve as dynamic documentation of individual professional progress. Students arrange individual counseling sessions with a leadership coach. Students then take action on the feedback received in order to develop self awareness. (Prerequisite or co-requisite: MGMT-806) **Credit 1 (Su)**

MGMT-801 Leadership Development II
This course is a continuation of MGMT-800. Leadership Development II requires student to explore and expand their potential as leaders. Through self and peer assessment, one-on-one coaching, career counseling, and written assignments, students develop leadership goals and create a plan to realize those goals. Students arrange individual counseling sessions with a leadership coach. (MGMT-800) **Credit 1 (F)**

MGMT-802 Leadership Development Skills III
This course is a continuation of 0102-801. In Leadership Development Skills II, students formally assess their leadership skills, meet individually with a leadership coach, and produce a written Leadership Development Plan that outlines their goals and an action plan to achieve them. In Leadership Development Skills III, students revisit these activities at the end of the EMBA program to access their progress in achieving their goals and to prepare for successful careers in their organizations. Students arrange individual counseling sessions with a leadership coach (MGMT-801) **Credit 1 (F)**

MGMT-804 Critical Thinking for Decision Making
An introduction to the issues related to managerial problem solving, planning, decision making and implementation in complex organizations. The goal of the course is to help students think systematically about the practice of general management and how managers translate ideas into action. The types of decisions faced by executives and the various approaches available to managers for solving cross-functional, organizational-wide problems are examined. Students learn and practice essential skills required of general managers including critical thinking, problem solving, and oral and written communication. **Credit 2 (F)**

MGMT-805 Current Topics Seminar
Current topics seminars offer an in-depth examination of current events, issues and problems. 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. (Topic-dependent) **Credit 2 (F)**

MGMT-806 Team Building and Ethics
During this one-week course, students will understand how to motivate and lead teams as well as how to support the leadership of others. Students will undertake a critical evaluation of the ethical responsibilities of managers and corporations. Each incoming student joins a study group of around four or five students selected for diversity of skills and experience. This course also serves as a general orientation for incoming EMBA students. **Credit 1 (Su)**

MGMT-810 Leadership
This course focuses on the role of the general manager as a leader in an organization. The course addresses analytical and behavioral strategies and techniques for leadership by examining problem-solving models, personal values, and communications. The emphasis is on the interpersonal skills needs to express different leadership styles and behaviors. Cases, exercises, and class discussions will be used to examine and explore opportunities for managers to become more effective as leaders in modern organizations. (MGMT-806) **Credit 2 (F)**

MGMT-818 Strategic Thinking I
The primary theme of this course is to examine how firms can achieve superior financial performance through the establishment of a sustainable competitive advantage at the business level. Contemporary theories of strategic management will be discussed and critically examined for their relevance to the problems facing many of today's managers. Topics include analysis of industry attractiveness, value-chain analysis, core competencies, and business-level strategies. (ESCB-840, FINC-845) **Credit 2 (S)**

MGMT-819 Strategic Thinking II
This course covers corporate-level strategy and strategy implementation. The focus of the course is on the strategy of the firm as a whole, and the interrelations between different divisions. Topics will include related and unrelated diversification, and the various means of engaging in diversification, mergers and acquisitions, joint ventures, and strategic alliances. Contemporary theories of strategic management will be discussed and critically examined for their relevance to the problems facing many of today's managers. (MGMT-818) **Credit 2 (S)**

MGMT-860 Executive Leadership Series
The course explores leadership topics in depth with an emphasis on current management and leadership issues. During each class a community leader guest lectures on topics of leadership. Past speakers have included senior-level executives from local industry, government, and not-for-profit organizations. (MGMT-810) **Credit 2 (F)**

MGMT-861 Managing Technology, Innovation and Research
This course deals with the responsibilities and challenges faced by managers responsible for research and innovation within high- technology firms. Topics will include: the critical role of innovation, internal technology assessments, technology transfer, the selection and management of R&D projects, and the identification of and management of disruptive technologies and business models. Particular attention will be given to overcoming systemic barriers to innovation. (MGMT-818) **Credit 2 (Su)**

MGMT-862 **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-810) **Credit 2 (S)**

MGMT-889 **Capstone Consulting Project I**
Teams of students analyze specific operational problems or improvement opportunities in client organizations. Under the guidance of a faculty supervisor, teams identify relevant issues, collect data, develop alternatives and make recommendations to the client. The project, a two-course equivalent, is the capstone experience of the Executive MBA program. (MGMT-818, FINC-846, MKTG-851) **Credit 3 (Su)**

MGMT-890 **Capstone Consulting Project II**
This course is a continuation of MGMT-889. Teams of students analyze specific operational problems or improvement opportunities in client organizations. Under the guidance of a faculty supervisor, teams identify relevant issues, collect data, develop alternatives and make recommendations to the client. The project, a two-course equivalent, is the capstone experience of the Executive MBA program. (MGMT-889) **Credit 3 (F)**

MGMT-999 **Graduate Co-op**
One semester of paid MBA-related work experience. (Departmental approval required) **Credit 0 (F, S, Su)**

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-711 **Managing Service Systems**
Service science is a new, interdisciplinary field that addresses the shift to the service and information-based economy. Students in this course investigate the nature of services and the need for interdisciplinary approaches to services innovation. Students will explore the role of information technology in the design, management, delivery and evaluation of services and apply these concepts to a specific industry, such as health care, IT services or financial services. **Credit 3 (F)**

MGIS-712 **Service-oriented Information Systems**
Recent advances in service-oriented IT, such as Web services, are playing an increasing role in implementation and innovation with service systems. This course provides an overview of these technologies and their role in service systems. Students will explore Web services and service-oriented architectures and examine their usage in service systems to implement business processes and to develop, deliver, manage and innovate in services. **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 and Analytics**
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 Project Management**
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 co-requisite: 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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from semester to semester. (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)**

MGIS-799 **Independent Study Management Information Systems**
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

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 semester will be announced prior to the course offering. These seminars may be repeated for credit since topics normally vary from semester to semester. (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)**

MKTG-799 Independent Study Marketing
The student will work independently under the supervision of a faculty adviser. (Instructor approval) **Credit 3 (F, S, Su)**

MKTG-851 Marketing Strategy
A general management perspective on the critical impact of marketing in organizations. Topics include an overview of the marketing process, market research, segmentation, and target markets. The focus is on the process of creating, communicating, and delivering customer value through the marketing mix. The course is structured around the managerially controllable elements of product, price, promotion and distribution, plus the interrelationships of these elements. (Pre- or co-requisite: MGMT-818) **Credit 2 (S)**

MKTG-865 Managing New Product Commercialization
This course emphasizes the marketing and product strategy 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 product development process, developing the marketing plan for launching new products, and managing the product life cycle. Best practices in activities required for successful new product commercialization are reviewed. (MKTG-851) **Credit 2 (Su)**

B. Thomas Golisano College of Computing and Information Sciences

Andrew L. Sears, Dean
rit.edu/gccis

Programs of Study

Online learning option available
** Program offered jointly with the Univ. of Rochester.*

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 15 baccalaureate and master's degrees in a variety of computing disciplines, as well as a doctorate in computing and information sciences. 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, human-computer interaction and accessibility, gaming, simulation, computing security, 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 and outstanding faculty.

Admission requirements

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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 performing use-inspired research 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 research across disciplines and is a leader in innovation in a variety of computing fields. Students and faculty partner on cutting edge research that is often multidisciplinary and which positions students for success in their chosen field of study. Research focuses include human-computer interaction, medical informatics, computing security, and game design and development, among others. The doctorate program is the leading research arm of the college.

Facilities

The college houses extensive laboratories dedicated to the study and research of computing. There are more than 2,000 workstations and more than 50 classrooms, labs, and studio labs for the study of every major computing platform. Labs are available to students for 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's dedicated Security Lab is isolated from the rest of the campus's networks to allow the in-depth study of viruses, firewalls, and other computer vulnerabilities. Additional labs include an Entertainment Lab for 3D modeling, game and interactive media development; a Mobile Computing and Robotics

Lab for the research and development of portable devices; and an Artificial Intelligence lab dedicated to the understanding of human reactions and processing.

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

cs.rit.edu/
Hans-Peter Bischof, 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 afternoons and evenings to accommodate part-time students. Full-time students take three or four courses per semester and may be able to complete the course work in three semesters. For full-time students who are required to take additional bridge courses may be able to complete the course work in four semesters. Part-time students take one or two courses per semester and may be able to complete the course work in four to five semesters. The time required to complete a master's project is one semester, but can vary according to the student and the scope of the topic. Two semesters is typical.

Curriculum

The program consists of 30 credit hours of course work, which includes either a thesis or a project. Students complete one core course, three courses in a cluster, four electives, and a thesis. For those choosing to complete a project in place of a thesis, students complete one additional elective.

Clusters

Students select three cluster courses from the following areas:

Computer graphics and visualization
The computer graphics and visualization cluster provides the technical foundations for graduate studies in computer graphics and image understanding. Areas for further study include graphics programming, rendering and image synthesis, computer animation and virtual reality, image processing and analysis, and data visualization.

Data manangement
The data management cluster studies the foundational data management and knowledge discovery challenges prevalent in design, analysis, and organization of data. The courses cover general database issues including database design, database theory, data management, and data mining.

Distributed systems
This area studies systems formed from multiple cooperating computers, including the analysis, design, and implementation of distributed systems, distributed middleware, and computer networking protocols, including security.

Intelligent systems
Intelligent systems encompasses the study of algorithms and architectures that enable effective decision making in complex environments. Courses cover computer vision, robotics, virtual theater, sensor networks, data mining, document recognition, and the theoretical foundations of decision-making (e.g. Markov chains and the properties of voting protocols).

Languages and tools
The languages and tools cluster combines language design and implementation together with architecture and the use of software development tools. Students specializing in this cluster gain a broad understanding of theoretical and applied knowledge.

Security
The security cluster spans topics from networking to cryptography to secure databases. By choosing different domains in which to study security students gain a broad understanding of both theoretical and applied knowledge.

Theory
The theory cluster studies the fundamentals of computation, which includes complexity theory to determine the inherent limits of computation, communication, and cryptography and the design and analysis of algorithms to obtain optimal solutions within those limits.

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 from 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/project

Students may choose the thesis or project option as the capstone to the program. Students who choose the project option must register for the Project course (CSCI-788). Students will participate in required in-class presentations that will be critiqued. A summary project report and public presentation of the student's project (in poster form) will occur at the end of the semester.

Computer science (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
CSCI-665	Foundations of Algorithms	3
	Cluster Courses	9
	Elective Courses	12
CSCI-790	Thesis	6
Total Semester Credit Hours		**30**

Computer science (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
CSCI-665	Foundations of Algorithms	3
	Cluster Courses	9
	Elective Courses	15
CSCI-788	Project/Colloquium	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.

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, software design methodology, introductory computer architecture, operating systems, and programming language concepts).

Additional information

Bridge courses

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 successfully complete the recommended bridge courses with a grade of B (3.0) 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. Bridge program courses are not counted as part of the 30 credit hours required for the master's degree. During orientation, bridge exams are conducted. These exams are the equivalent to the finals of the bridge courses. Bridge courses will be waived if the exams are passed.

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 OS X; 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/

Tona Henderson, Director
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Jessica Bayliss, Graduate Program Director
(585) 475-2507, jdbics@rit.edu

Program overview

The master of science degree in game design and development explores 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, game engines, interactive narrative, and game design. The degree is specifically for students who aspire to careers within the professional gaming 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. During the second year, 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 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 required courses, advanced electives and a capstone experience.

Capstone experience

During the second year, students complete a team-based capstone experience where students present and defend their work. This presentation includes a faculty review, which constitutes the capstone defense, a public presentation, and a demonstration.

Game design and development, MS degree, typical course sequence

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
IGME-795	Game Industry Themes and Perspectives	1
	Advanced Electives	9
Second Year		
IGME-788	Capstone Design	3
	Advanced Electives	6
IGME-695	Colloquium in Game Design and Development	1
IGME-789	Capstone Development	3
Total Semester Credit Hours		**33**

Advanced electives

Students choose five of the following advanced electives:

IGME-670	Digital Audio Production
IGME-671	Interactive Game Audio
IGME-680	IGM Production Studio
IGME-681	Innovation and Invention
IGME-720	Social and Pervasive Game Design
IGME-730	Game Design and Development for Casual and Mobile Platforms
IGME-740	Game Graphics Programming
IGME-750	Game Engine Design and Development
IGME-760	Artificial Intelligence for Gameplay
IGME-790	Graduate Seminar in IGM
IGME-796	Advanced Topics in Game Design*
IGME-797	Advanced Topics in Game Development*
IGME-799	Independent Study

* Advanced topics are offered in subjects as diverse as game networking and player motivation.

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. International applicants also are required to submit scores from the Graduate Record Exam (GRE).

Due to the cohort nature of the program, students are admitted in the fall semester only. Admission to the program is highly competitive. While GRE scores are not required, students may submit scores to strengthen their application. 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.

Computing and Information Sciences, Ph.D.

rit.edu/gccis/phd
Pengcheng Shi, Director
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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 cyber-infrastructure 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 the comprehensive integration of hardware, data, networks, and digitally-enabled sensors to provide secure, efficient, reliable, accessible, usable, and interoperable suites of software and middleware services and tools. The 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, cyber-services and virtual environments, and learning and knowledge management.

Intra-disciplinary knowledge

There are three intra-disciplinary computing knowledge areas: infrastructure, interaction, and informatics.

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.

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/organiza-

tional 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 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.

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 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
- Communication and networking
- Computer vision and pattern recognition
- Database and data mining
- Graphics and visualization
- Grid and cloud computing
- Human-computer interaction
- Programming languages
- Machine learning
- Security and cryptology
- Software engineering

Domain applications

- Access technology
- Biomedical computing
- Computational astrophysics
- Environmental informatics
- Green computing
- Imaging and image informatics
- Cognitive sciences
- Service sciences
- Social computing

Curriculum

The program requires a minimum of 60 credit hours beyond the baccalaureate level comprised of graduate-level course work, including seminar attendance and research credits.

Required courses

Students will complete 18 credit hours of required foundation and core elective courses and 2 credit hours of teaching skills courses.

Electives

Elective courses provide foundation support of the student's dissertation research area. These courses will come from cyberinfrastructure courses, domain courses, and other electives.

Dissertation and research

Students are required to conduct original research that leads to peer-reviewed publications.

Computing and information sciences, Ph.D. degree, typical course sequence

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		
CISC-890	Dissertation and Research	0
Total Semester Credit Hours		**60**

Assessments

Each student must pass three assessment examinations in the following order:

Research potential assessment: qualifying exam

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: candidacy exam

This is an oral 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 optional 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 at least two letters of academic and/or professional recommendation. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- 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 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 is required.

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 9 credit hours towards the degree requirements. The transfer credit evaluation will not be made until after the research potential assessment. 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.

Computing Security, MS

rit.edu/gccis/computing security
Sumita Mishra, Graduate Program Director
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Program overview

Developers of computing systems and practitioners in all computing disciplines need an understanding of the critical importance of building security and survivability into the hardware and software of computing systems they design, rather than trying to add it on once these systems have been designed, developed, and installed.

The MS in computing security gives students an understanding of the technological and ethical roles of computing security in today's society and its importance across the breadth of computing disciplines. Students can develop a specialization in one of several security-related areas by selecting technical electives under the guidance of a faculty adviser. The program enables students to develop a strong theoretical and practical foundation in secure computing, preparing them for leadership positions in both the private and public sectors of the computing security industry, for academic or research careers in computing security, or to pursue a more advanced degree in a computing discipline.

Curriculum

The program is designed for students who have an undergraduate computing degree in an areas such as computing security, computer science, information technology, networking, 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.

The curriculum consists of three required core courses, up to 6 technical electives (depending on the capstone option chosen), and a capstone thesis, project, or capstone course for a total of 30 semester credit hours.

Electives

Students are required to choose up to six technical electives from the following courses.

CSEC-730	Advanced Computer Forensics
CSEC-731	Web Server and Application Security Audits
CSEC-732	Mobile Device Forensics
CSEC-733	Information Security Risk Management
CSEC-741	Sensor and SCADA Security
CSEC-742	Computer System Security
CSEC-743	Computer Viruses and Malicious Software
CSEC-744	Network Security
CSEC-750	Covert Communications
CSEC-751	Information Security Policy and Law
CSEC-759	Enterprise Security Solutions

Computing security (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CSEC-601	Research Methods and Proposal Development	3
CSEC-603	Enterprise Security	3
CSEC-604	Cryptography and Authentication	3
	Technical Electives	12
CSEC-790	MS Thesis	3
Second Year		
	Technical Elective	3
CSEC-790	MS Thesis	3
Total Semester Credit Hours		**30**

Computing security (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CSEC-601	Research Methods and Proposal Development	3
CSEC-603	Enterprise Security	3
CSEC-604	Cryptography and Authentication	3
	Technical Electives	15
Second Year		
	Technical Elective	3
CSEC-791	MS Project	3
Total Semester Credit Hours		**30**

Computing security (capstone course option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CSEC-601	Research Methods and Proposal Development	3
CSEC-603	Enterprise Security	3
CSEC-604	Cryptography and Authentication	3
	Technical Electives	15
Second Year		
	Technical Elective	3
CSEC-793	Capstone in Computing Security	3
Total Semester Credit Hours		**30**

Admission requirements

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

- Hold a baccalaureate degree in computing security, computer science, software engineering, information technology, networking, 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 equivalent to a 3.0/4.0,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a minimum of two recommendations from individuals who are well-qualified 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 undergraduate study 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), statistics, natural sciences (physics, chemistry, etc.), and computing (programming, computer networking theory and practice, and systems administration theory and practice).

Bridge program

Students whose undergraduate preparation or employment experience does not satisfy the prerequisites required for the program may make up deficiencies through additional study. Bridge course work, designed to close gaps in a student's preparation, can be completed either before or after enrolling in the program as advised by the graduate program director. Generally, formal acceptance into the program is deferred until the applicant has made significant progress through this additional preparation.

If completed through academic study, bridge courses must be completed with a grade of B (3.0) or better. Courses with lower grades must be repeated. Bridge courses are not counted toward the 30 credit hours required for the master's degree. However, grades earned from bridge courses taken at RIT are included in a student's graduate grade point average.

A bridge program can be designed in different ways. Courses may be substituted based upon availability, 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-time basis, on-campus only.

Faculty

The program faculty are actively engaged in consulting and research in various areas of secure computing and information assurance, such as cryptography, databases, networking, and secure software development, and critical infrastructure security. There are opportunities for students to participate in research activities towards capstone completion or as 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.

rit.edu/gccis/computingsecurity
Sumita Mishra, Graduate Program Director
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Program overview

This advanced certificate provides the fundamental knowledge and expertise in network security and forensics necessary for 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 a court of law, as well as assessing the extent of the damage to an organization. Courses taken as part of this certificate can transfer into the MS program in computing security.

Curriculum

Information assurance, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CSEC-744	Network Security	3
CSEC-603	Enterprise Security	3
CSEC-742	Computer System Security	3
CSEC-730	Advanced Computer Forensics	3
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate 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 theory and practice, systems administration, programming (C/C++), and OS scripting,
- Have a minimum grade point average of 3.0 (B average or a first class degree from a foreign university),
- Submit transcripts (in English) of all previously completed undergraduate and graduate course work, and
- Complete a graduate application.

While GRE scores are not required, they are strongly recommended for applicants with an undergraduate GPA that is lower than required. Relevant employment experience can strengthen a candidate's application for admission.

This certificate is intended for part-time study; therefore RIT cannot issue I-20 paperwork. Currently, courses are only offered on-campus.

Human-Computer Interaction, MS

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Program overview

Human-computer interaction (HCI) 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 degree 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 is an individual, a group, an organization, or a society. Human, technological, and organizational concerns are interwoven throughout the curriculum and addressed in team- and project-based learning experiences.

Curriculum

The program is comprised of four required core courses, up to three program electives (depending upon capstone option chosen), two application domain courses, and a capstone project or thesis.

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 plus interaction design, interface prototyping, and usability evaluation.

Electives

Student choose up to three electives, depending on which capstone option they choose to complete.

HCIN-700	Current Topics in HCI
HCIN-705	Topics in HCI for Biomedical Informatics
HCIN-715	Agent-based and Cognitive Modeling
HCIN-720	Designing User Experiences for Internet-enabled Devices
HCIN-722	Human Computer Interaction with Mobile Devices
HCIN-730	User-Centered Design Methods
HCIN-735	Collaboration, Technology, and the Human Experience
PSYC-712	Graduate Cognition
PSYC-715	Graduate Perception

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. A special topics option is also available, with faculty approval, for individuals with interest in other HCI-related areas.

Bioinformatics	
HCIN-705	Topics in HCI for Biomedical Informatics
ISTE-772	Knowledge Discovery for Biomedical Informatics
eLearning technologies	
HCIN-660	Fundamentals of Instructional Technology
HCIN-661	Interactive Courseware
Ergonomics and safety	
ISEE-731	Advanced Topics in Human Factors and Ergonomics
ISEE-732	Systems Safety Engineering
Geographic information science and technology	
ISTE-740	Geographic Information Science and Technology
ISTE-744	Thematic Cartography and Geographic Visualization
Smart device application design and development	
HCIN-720	Designing User Experiences for Internet-enabled Devices
HCIN-722	Human Computer Interaction with Mobile Devices
Website development	
ISTE-645	Foundations of Web Technologies I
ISTE-646	Foundations of Web Technologies II

Thesis/Capstone project

Students may complete a thesis or capstone project. (Student who choose the capstone will complete one additional elective.) This experience is meant to be an empirical study of a HCI problem, 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 publicly disseminated in an appropriate professional venue.

Human-computer interaction (capstone project option), MS degree, typical course sequence

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	6
HCIN-630	Usability Testing*	3
	Program Electives	6
Second Year		
	Program Elective	3
HCIN-795	MS HCI Project	3
Total Semester Credit Hours		**30**

Human-computer interaction (thesis option), MS degree, typical course sequence

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	6
HCIN-630	Usability Testing	3
	Program Electives	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 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 experience in interactive multimedia development. These competencies may be demonstrated by previous course work, technical certifications, or comparable work experience. Bridge courses are available to fulfill any gaps in an applicant's qualifications. Applicants will be made aware of any areas where additional course work may be necessary.

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.

Online option

The program can be completed on campus or online.

Information Sciences and Technologies, MS

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Pete Lutz, Graduate Program Director
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Program overview

The Internet has brought a new kind of democracy where all information is created equal. No longer the sole province of experts and the traditional media, it has become grassroots, viral, and global. The sheer volume and lightning speed of information transfer has changed how the world communicates, educates, learns, and ultimately solves problems. As the Web and its related technologies evolve, users will need help in managing these new tools.

Graduate study in a computing discipline that only focuses on traditional computing approaches is not flexible enough to meet the needs of the real world. New hardware and software tools are continually introduced into the market. IT professionals must have a specific area of expertise as well as be adaptable and ready to tackle to the next new thing—or just as often, retrofit available technologies to help their users adapt to the latest trends. The MS in information sciences and technologies provides an opportunity for in-depth study to prepare for today's high-demand computing careers. Companies are drowning in data—structured, semi-structured, and unstructured. Big data is not just high transaction volumes; it is also data in various formats, with high velocity change, and increasing complexity. Information is gleaned from unstructured sources—such as Web traffic or social networks—as well as traditional ones; and information delivery must be immediate and on demand.

As the users' advocate, IT professionals also need the critical thinking skills to problem-solve in a wide variety of computing situations, combined with an understanding of the needs of their audience. Just knowing how technology works is no longer enough. Today, computing professionals need to know how to make it all work.

The information sciences and technologies program addresses the Web systems and integration technologies, and the information management and database technology pillars, of the IT academic discipline, along with the additional option of discovery informatics. A special topics option is available to support the creation of a customized area of study. The program is offered full- or part-time, on-campus only.

Curriculum

The program consists of 30 semester credit hours of graduate study and includes four core courses, four or five track or domain electives (depending upon capstone option chosen), and either a capstone experience, thesis, or project.

Track or domain electives

Students choose track or domain electives from the following tracks. With permission of the graduate program director, students may select the special topics track to fulfill the track or domain electives requirement. See the graduate program director for more information.

Analytics	
ISTE-724	Data Warehousing
ISTE-771	XML Programming
ISTE-780	Data-driven Knowlegde Discovery
ISTE-782	Visual Analytics
PSYC-640	Graduate Statistics
Information Manangement and Database Technology	
ISTE-721	Information Assurance Fundamentals
ISTE-722	Database Connectivity and Access
ISTE-724	Data Warehousing
ISTE-726	Database Management and Access
ISTE-728	Database Performance and Tuning
Web Systems and Integration Technologies	
ISTE-721	Information Assurance Fundamentals
ISTE-750	Internet Middleware Design anf Implementation
ISTE-754	Client Design and Development
ISTE-756	Server Design and Development
ISTE-771	XML Programming

Capstone options

Students may choose between a course-based capstone, a thesis, or a project that builds upon their domain study. The course-based capstone option is 3 semester credit hours. Students who choose this option are required to complete one additional track or domain elective. The thesis and project capstone options are both 6 semester credit hours.

Information sciences and technologies (capstone experience option), MS degree, typical course sequence

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
	Track or Domain Electives	12
Second Year		
	Track Elective	3
ISTE-795	Capstone in Information Sciences and Technologies	3
Total Semester Credit Hours		**30**

Information sciences and technologies (thesis or project options), MS degree, typical course sequence

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
	Track or Domain Electives	9
Choose one of the following:		3
ISTE-790	Thesis in Information Sciences and Technologies	
ISTE-791	Project in Information Sciences and Technologies	
Second Year		
	Track Elective	3
Choose one of the following:		3
ITSE-790	Thesis in Information Sciences and Technologies	
ISTE-791	Project in Information Sciences and Technologies	
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in information sciences and technologies, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution,
- Have a minimum cumulative GPA of 3.0/4.0,
- 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. Scores from the GRE are strongly recommended for applicants whose undergraduate grade point average is less than 3.0.

Additional information

Prerequisites

It is expected that prospective students will have a background in fundamental information technology concepts including object-oriented programming, website development, database theory and practice, and statistics. Students without the necessary background should complete the prerequisites before applying to the program. However, 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 prerequisite bridge courses as prescribed by the graduate program director. The bridge courses are not part of the 30 semester credit hours required for the master's degree. Grades for bridge courses are not included in a student's GPA if the courses are taken before matriculation; they are included if completed after matriculation. Since bridge programs 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

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Program overview

Medical informatics, also known as health IT, studies the nature of medical data and the use of information technology to manage health-related information in medical practice, education, and research. With increases in the application and uses of information technology in the medical industry, there is an unprecedented need for professionals who can combine their knowledge of computing and of health care to improve the safety and quality of care delivery, as well as to help control costs.

Medical informatics is an emerging profession that applies the creative power of information technology to the information and data 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. Professionals in the field require computing expertise; an understanding of formal medical terminology, clinical processes, and guidelines; and an understanding of how information and communication systems can be used to successfully deliver patient information in various health care settings.

The program is offered jointly by RIT and the University of Rochester's School of Medicine and Dentistry. Students choose to matriculate at either university, study jointly, and receive a diploma bearing the seals of both institutions. Courses are scheduled so that students can attend offerings at each university without conflict.

The program is offered on a full- or part-time basis. A full-time student can complete the program in approximately two years. For part-time students, completion may take three to four years.

Curriculum

The program is comprised of ten required core courses, three technical electives chosen by the student, and a course-based capstone experience. Depending upon the student's background, some of the core courses may be replaced. For example, a physician may be allowed to replace Practice of Health Care with a more beneficial course. Similarly, a database professional may be allowed to replace the foundation database course.

Medical informatics, MS degree, typical course sequence

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	3
Second Year		
MEDI-788	Capstone in Medical Informatics*	3
MEDI-707	Clinical Decision Support	3
	Technical Electives	6
ISTE-762	Software Economics	3
MEDI-702	Perspectives of Health Informatics	3
Total Semester Credit Hours		**39**

* The capstone course is purposely scheduled for the fall semester of the second year since the prerequisites are the first-year courses. Students may complete their capstone work in the following spring term should additional time be needed.

Admission requirements

To be considered for admission into the MS program in medical informatics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree, a graduate degree, MD, RN, or other professional degree from a regionally accredited institution,
- Have a minimum GPA of 3.0,
- 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 have equivalent work experience,*
- Have knowledge of 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, 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.

* These competencies may be demonstrated through previous course work, 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 program director for course selection and planning 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. The program accepts students for fall semester entry 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

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Pete Lutz, Graduate Program Director
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Program overview

Trends in network communications–unifying wired and wireless infrastructures, Cloud computing, scalability, collaboration tools, and security–can only be coalesced into reliable communication services if there are highly educated and technically proficient networking and system administration professionals who understand both traditional and emerging communication technologies as well as how to apply these technologies to organizational needs and opportunities.

The explosion in ubiquitous computing today means an increased need for greater efficiency and for better management oversight in the provision of IT services. Network environments are not only becoming increasingly complex, there is a greater recognition of the power of information technology to be a strategic enabler of corporate growth and adaptation.

The master of science program in networking and system administration is designed to provide both the knowledge and the technical skills needed to successfully compete in this environment. It is uniquely focused to address current issues in networking and systems administration through investigation of both the theoretical and the practical aspects of this continually evolving field. Course work examines the organizational and technological issues involved in enterprise scale networking, including emerging network technologies, network processing, high performance computing, network programming, and security.

The program is intended to prepare graduates to assume leadership positions in for-profit and not-for-profit organizations dealing with evolving networking solutions or to continue their education through advanced degrees. It is available for full- and part-time study in both an online format as well as a traditional on-campus setting.

Curriculum

The program consists of two required core courses, a three-course knowledge domain sequence, up to four technical electives (depending upon the capstone option chosen), and a capstone thesis or project.

Knowledge domains

Students are required to complete a three-course sequence in one of the following knowledge domains.

Management	
ACCT-703	Accounting for Decision Makers
DEC-744	Project Management
MGMT-740	Organizational Behavior and Leadership
Professional	
NSSA-620	Emerging Computing and Networking Technologies
NSSA-621	Design and Deployment of Wireless Networks
NSSA-622	Carrier Networks
Research	
NSSA-610	Advanced Wired Networking Concepts
NSSA-611	Adv. Topics in Wireless Networks and Technologies
NSSA-612	Network Modeling and Analysis

Electives

Students are required to choose up to four electives from the following choices.

NSSA-710	Network Management
NSSA-711	Advanced Routing Protocols
NSSA-712	Advanced Storeage Technologies
NSSA-713	Enterprise Service Provisioning
NSSA-714	Advanced Large Scale Computing
NSSA-715	Network Design and Performance
NSSA-716	Enterprise Mobile Computing

Networking and system administration (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-602	Enterprise Computing	3
	Knowledge Domain Courses	9
	Electives	6
NSSA-790	MS Thesis	3
Second Year		
	Elective	3
NSSA-790	MS Thesis	3
Total Semester Credit Hours		**30**

Networking and system administration (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
NSSA-601	Research Methods and Proposal Development	3
NSSA-602	Enterprise Computing	3
	Knowledge Domain Courses	9
	Electives	9
Second Year		
	Elective	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 system administration, candidates must fulfill the following requirements:

- Hold a baccalaureate 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 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 must have solid backgrounds in computer programming (C++ required); networking and systems administration theory and practice; and statistics. Students whose undergraduate preparation or industrial experience does not satisfy these prerequisites can make up deficiencies through additional study. The graduate program director will make recommendations on prerequisite course work. Formal acceptance into the program may be possible even though the applicant must complete bridge courses.

Bridge courses are not part of the required curriculum for the master's degree. Grades for these courses are only included in the student's GPA if courses are completed after matriculation. 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 more information.

Study options

This program may be completed on a full- or part-time basis, through on-campus instruction or via online learning. Full-time students may be able to complete the program in two years; part-time students may take approximately four years.

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.

Big Data Analytics, Adv. Cert.

Carol Romanowski, Program Coordinator
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Program overview

Big data is noted for its volume, varieties of data types, and rapid accumulation. Big data has become a catchphrase to describe data collections that are so large they are not amenable to processing or analysis using traditional database and software techniques. The advanced certificate in big data analytics is a multidisciplinary program intended for professionals with BS degrees in computing or other diverse fields such as finance, retail, science, engineering, or manufacturing—areas where knowledge of how to analyze big data is necessary. The advanced certificate is also meant for students who would like a formal qualification in this area. The program allows professionals with a bachelor's degree to enhance their career opportunities and professional knowledge with targeted graduate course work in a focused area without making a commitment to an MS program.

Curriculum

The goal of the program is to develop expertise in managing and analyzing big data. The program consists of two required courses and two elective courses selected by the student in topic areas related to big data.

Big data analytics, advanced certificate, typical course sequence

COURSE		CR. HRS.
Required Courses		
CSCI-620	Introduction to Big Data	3
CSCI-720	Big Data Analytics	3
Electives–Choose two of the following:		
CSCI-621	Database System Implementation	3
CSCI-622	Secure Data Management	3
CSCI-652	Distributed Systems*	3
CSCI-654	Foundations of Parallel Computing*	3
CSCI-721	Data Cleaning and Preparation	3
CSCI-729	Topics in Data Management*	3
ISTE-724	Data Warehousing	3
ISTE-780	Data-driven Knowledge Discovery	3
Total Credit Hours		**12**

* These courses requires the approval of the program coordinator before students may register for the course.

Admission requirements

To be considered for admission to the advanced certificate in big data analytics, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in science, computing, engineering, or related majors from an accredited college or university;
- Have a minimum GPA of 3.0;
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work;
- Have acceptable college level credit or practical experience in probability and statistics, computer programming in a high-level language, and database systems; and
- Complete a graduate application.

Networking, Planning and Design, Adv. Cert.

ist.rit.edu/
Pete Lutz, Graduate Program Director
(585) 475-6162, Peter.Lutz@rit.edu

Program overview

The advanced certificate in networking, planning and design provides the knowledge and expertise needed to seek careers that require foundation knowledge of enterprise network architectures and administration, emerging network technologies, the network design process, and project management. Students completing this certificate will be able to design and implement plans for sophisticated network design projects; understand and work with emerging technologies in networking and system administration; and develop, test, and implement a network model that simulates the performance of an enterprise scale network.

The program consists of four courses, all of which may be applied to the MS in networking and system administration.

Curriculum

Networking, planning and design, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
NSSA-602	Enterprise Computing	3
DECS-744	Project Management	3
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 networking, 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 (B average 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.

While GRE scores are not required, they are strongly recommended for applicants seeking admission whose undergraduate GPA does not meet the minimum requirement. Relevant work experience can also strengthen a candidate's application for admission.

Additional information

Study options

Courses are available both on campus and online. This certificate is intended for part-time study; therefore, RIT cannot issue I-20 paperwork. International students may study part-time through online learning.

Web Development, Adv. Cert.

ist.rit.edu/
Pete Lutz, Graduate Program Director
(585) 475-6162, Peter.Lutz@rit.edu

Program overview

As interactive technologies advance, the ways in which we communicate change—and the importance of enhancing the communication experience within electronic environments increases. The advanced certificate in Web development provides an opportunity for students to gain firsthand knowledge and expertise in the art and science of interactive multimedia design. In this certificate, students explore the theories of interactive computing, fundamentals of interactive design, Web and multimedia programming, and the impact of networked technologies in Web communications.

Curriculum

Projects include the development of websites and interactive multimedia applications. Students have at their disposal a variety of computer, video, and digitizing equipment in our state-of-the-art interactive media laboratories.

Web development, advanced certificate, typical course sequence

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**

Admission requirements

To be considered for admission to the advanced certificate in Web 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 average) or equivalent,
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course work,
- Submit a resume,
- Complete a personal statement,
- Submit two professional recommendations, and
- Complete a graduate application.

This certificate is intended for part-time, on-campus study; therefore, RIT cannot issue I-20 paperwork.

Additional information

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 one year of study. Bridge courses are available to complete any requirements missing from the applicant's credentials.

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.

Software Engineering, MS

se.rit.edu/grad
Stephanie Ludi, Graduate Program Director
(585) 475-7407, salvse@rit.edu

Program overview

The master of science in software engineering is designed to attract 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 students with the opportunity to match their graduate education with their professional goals.

Curriculum

The program comprises 36 semester credit hours, anchored by either a thesis or a capstone project.

Software engineering (thesis option), MS degree, typical course sequence

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

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
	Electives	6
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.

Professional experience developing software is preferred, but candidates without a background in computing will be considered. Additional bridge course work will be required, and may extend time to graduation.

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.

Andrew L. Sears, BS, Rensselaer Polytechnic Institute; Ph.D., University of Maryland—Dean; Professor

Anne Haake, BA, Colgate University; MS, Rochester Institute of Technology; MS, Ph.D., University of South Carolina—Associate Dean for Research and Scholarship; Professor

Michael A. Yacci, BS, Ithaca College; MS, Rochester Institute of Technology; Ph.D., Syracuse University—Associate Dean for Academic Affairs; Professor

Wiley McKinzie, BA, University of Wichita; MS, State University of New York at Buffalo—Professor

Computer Science

Mohan Kumar, BE, Bangalore University (India); MTech, Ph.D., Indian Insitute of Science (India)—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—Associate Professor

Ivona Bezakova, BS, Comenius University (Slovakia); Ph.D., University of Chicago—Associate Professor

Hans-Peter Bischof, BS, MS, University of Ulm (Germany); Ph.D., University of Osnabrück (Germany)—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—Professor

James Heliotis, BS, Cornell University; Ph.D., University of Rochester—Professor

Edith Hemaspaandra, BS, MS, Ph.D., University of Amsterdam (Netherlands)—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 (South Korea); Ph.D., Purdue University—Associate Professor

Xumin Liu, BE, Dalian University (China); ME, Jinan University (China); Ph.D., Virginia Polytechnic Institute—Assistant Professor

Stanislaw Radziszowski, MS, Ph.D., University of Warsaw (Poland)—Professor

Rajendra K. Raj, BS, Indian Institute of Technology (India); 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

Carol Romanowski, BS, MS, Ph.D., University of Buffalo—Associate Professor

Paul Tymann, BS, MS, Syracuse University—Professor

Walter A. Wolf, BA, Wesleyan University; MS, Rochester Institute of Technology; MA, Ph.D., Brandeis University—Professor Emeritus

Richard Zanibbi, BA, MS, Ph.D., Queens University (Canada)—Associate Professor

Computing Security

Bo Yuan, BS, MS, Shanghai Normal University (China); Ph.D., State University of New York at Binghamton—Department Chair; Associate Professor

Daryl Johnson, BS, St. John Fisher College; MS, Rochester Institute of Technology—Associate Professor

Sumita Mishra, BS, Patna University (India); BS, Ph.D., State University of New York at Buffalo—Assistant Professor

Yin Pan, BS, MS, Shanghai Normal University (China); MS, Ph.D., State University of New York at Binghamton—Associate Professor

William Stackpole, BS, Roberts Wesleyan College; MS, Rochester Institute of Technology—Associate 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

Information Sciences and Technologies

Stephen Zilora, BS, University of Rochester; MS, New Jersey Institute of Technology—Department Chair; Associate Professor

Catherine I. Beaton, BA, BEd, MITE, Dalhousie University (Canada)—Associate Professor

Daniel S. Bogaard, BFA, Indiana University; MS, Rochester Institute of Technology—Undergraduate Program Coordinator; Associate Professor

Sean Boyle, BS, 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

Deborah Gears, BS, Empire State College; AAS, 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

Vicki Hanson, BA, University of Colorado; MA, Ph.D., University of Oregon—Distinguished Professor

Bruce H. Hartpence, BS, MS, Rochester Institute of Technology—Associate Professor

Lawrence Hill, BS, MS, Rochester Institute of Technology—Associate Professor

Edward Holden, BA, State University College at Oswego; MBA, Rochester Institute of Technology—Associate Professor

Jai Kang, BS, Seoul National University (South Korea); MA, Kent State University; MS, Georgia Institute of Technology; Ph.D., State University of New York at Buffalo—Associate Professor

Daniel Kennedy, BS, MS, Rochester Institute of Technology —Lecturer

Jeffrey A. Lasky, BBA, MBA, City College of New York; MS, University of Minnesota—Professor

Jim Leone, BS, University of Cincinnati; MA, Ph.D., Johns Hopkins University—Professor

Peter Lutz, BS, St. John Fisher 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

Tae (Tom) Oh, BS, Texas Tech University; MS, Ph.D., Southern Methodist University—Associate Professor

Sylvia Perez-Hardy, BS, MBA, Cornell University—Associate Professor

Evelyn P. Rozanski, BS, State University College at Brockport; MS, Syracuse University; Ph.D., State University of New York at Buffalo—Professor Emeritus

Nirmala Shenoy, BE, ME, University of Madras (India); Ph.D., University of Bremen (Germany)—Professor

Brian Tomaszewski, BA, University at Albany; MA, State University of New York at Buffalo; Ph.D., Pennsylvania State University—Assistant Professor

Ronald P. Vullo, BS, LeMoyne College; Ed.M., Ph.D., University at Buffalo—Associate Professor

Elissa M. Weeden, BS, MS, Rochester Institute of Technology—Associate Professor

Michael A. Yacci, BS, Ithaca College; MS, Rochester Institute of Technology; Ph.D., Syracuse University—Professor

Qi Yu, BS, Zhejiang University (China); ME, National University of Singapore (Singapore); Ph.D., Virginia Polytechnic Institute—Assistant Professor

Interactive Games and Media

Tona Henderson, BS, Southwest Missouri State University; MS, University of Missouri—Director; Associate Professor

Jessica Bayliss, BS, California State University at Fresno; MS, Ph.D., University of Rochester—Graduate Program Director; 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 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

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

Andrew Phelps, BFA, Bowling Green State University; MS, Rochester Institute of Technology—Professor

David I. Schwartz, BS, MS, Ph.D., University of Buffalo—Undergraduate Program Coordinator; Associate Professor

David Simkins, BA, Earlham College; MS, Ph.D., University of Wisconsin-Madison—Assistant 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—Associate Professor

Stephanie A. Ludi, BS, MS, California Polytechnic State University at San Luis Obispo; Ph.D., Arizona State University—Graduate Program Director; 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

Mehdi Mirakhorli, BS, Teacher Training University (Iran); MS, National University (Iran); Ph.D., DePul University—Assistant Professor

Meiyappan Nagappan, BE, Amma University (India); MS, Ph.D., North Carolina State University—Assistant Professor

Thomas Reichlmayr, BS, MS, Rochester Institute of Technology—Associate Professor

Computing and Information Sciences

Pengcheng Shi, BS, Shanghai Jiao Tong University (China); 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

Anne Haake, BA, Colgate University; MS, Rochester Institute of Technology; MS, Ph.D., University of South Carolina—Professor

Wei Le, BS, Zhejiang University (China); MS, Ph.D., University of Virginia—Assistant Professor

Linwei Wang, BS, Zhejiang University (China); M.Phil., Hong Kong University of Science and Technology (Hong Kong); Ph.D., Rochester Institute of Technology—Assistant Professor

Computer Science

CSCI-602 Intersession Advanced C++ Program
The goal of the course is to fill the student gaps of knowledge in CSCI-603 Advanced C++ and Program Design. Topics include but are not limited to: UML, Inheritance, Memory Management, Templates, Function Pointers, and Operator Overloading. There will be several programming homework assignments. The course will meet 8 hours per week, in two-hour sessions, four days a week. Prerequisites: Only students who received a "C" in CSCI-603 Advanced C++ and Program Design can register for this course.

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. This course serves as a bridge course for graduate students and cannot be taken by undergraduate students without permission from the CS undergraduate program coordinator.

CSCI-604 Intersession Advanced Java Programming
The goal of the course to is fill the student gaps of knowledge in CSCI-605 Advanced Java Programming. Topics include but are not limited to: Collection Framework, Threads, Synchronization, Network Programming, and Remote Method Invocation. There will be several programming homework assignments. The course will meet eight hours per week, in two-hour sessions, four days a week. Prerequisites: Only students who received a "C" in CSCI-605 Advanced Java Programming can register for this course.

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. Programming assignments are an integral part of the course. This course serves as a bridge course for graduate students and cannot be taken by undergraduate students without permission from the CS undergraduate program coordinator. (Prerequisite: 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 Introduction to Big Data
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. Big data exploration and management projects, a term paper and a presentation are required. (STAT-145 Introduction to Statistics I or equivalent; and CSCI-603 Advanced C++ and Program Design or CSCI-605 Advanced Java Programming 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 Introduction to Big Data, or CSCI-320 Principles of Data Management and CSCI-420 Principles of Data Mining, or permission of instructor) **Class 3, Credit 3 (F)**

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 Introduction to Big Data, 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 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. Course offered every other year. (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, CSCI 605, and CSCI 661, with B or better in all courses) or equivalent or permission of instructor **Class 3, Lab 0, Credit 3 (F)**

CSCI-660 Intersession Foundations of Computer Science Theory
The goal of the course is to fill the student gaps of knowledge in CSCI-661Foundations of Computer Science Theory. Topics include but are not limited to: DFAs and NFAs, Regular Expressions and Kleene's Theorem, Myhill-Nerode and Minimization, Pumping Lemma for Regular Languages, CFLs and PDAs, Pumping Lemma for Context-Free Languages, Turing Machines, Complexity. The course will meet eight hours per week, in two-hour sessions, four days a week. (Only students who received a "C" in CSCI-661 Foundations of Computer Science Theory can register for this course.)

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. This course serves as a bridge course for graduate students and cannot be taken by undergraduate students without permission from the CS undergraduate program coordinator. (MATH-190 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-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. Course offered evry other year. (CSCI-661 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. (None) **Class 3, Credit 3 (F, S. Su)**

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. (None) **Class 3, Credit 3 (F, S, Su)**

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, WI)**

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 (Fall, 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. Course offered every other year. (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 (Fall, 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 Big Data Analytics
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 Introduction to Big Data, 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 Introduction to Big Data, 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 or security clusters, or both. (Varies) **Class 3, Credit 3 (F, S)**

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 (Spring, 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 (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 (Fall, 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, computational vision and acoustics, security, or some combination of these three clusters. Course offered every other year. (Varies) **Class 3, Credit 3 (F)**

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 and CSCI 605, with B or better in both courses; or CSCI 141, CSCI 142, and CSCI 243 and CSCI 661 or equivalent; or permission of instructor) **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. (Varies) **Class 3, Credit 3 (Varies)**

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. (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 (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. (Varies) **Class 3, Credit 3 (Varies)**

CSCI-788 Computer Science MS Project
Project capstone of the master's degree program. Students select from a set of possible projects and confirm that they have a project adviser. Students enroll in a required colloquium component that meets weekly, during which they present information, related to their projects. Projects culminate with delivery of a final report and participation in a poster session open to the public. (Permission of project adviser and graduate coordinator) **Class 3, Credit 3 (F, S, Su)**

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, WI)**

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 instructor and department) **Credit 1-3 (F, S, Su, WI)**

CSCI-900 Continuation of Thesis

CSCI-901 Continuation of Project

CSCI-909 Proposal Development
MS Students who are preparing for their capstone experience.

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. Prerequisites: Limited to students in the Ph.D. program. **Class 2, Credit 2 (F)**

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 research questions, conducting literature reviews, selecting appropriate methodologies, data sampling, analyzing statistics, qualitative techniques, technical writing research papers, and presentation skills. (Knowledge in probability and statistics, or permission of instructor) **Class 3, 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). (Knowledge in probability and statistics calculus, and computer programming or permission of instructor) **Class 3, Credit 3 (F)**

CISC-830 Cyberinfrastructure Foundations
Cyberinfrastructure 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. (Knowledge in data structure and object-oriented design, or permission of instructor) **Class 3, Credit 3 (S)**

CISC-835 Connectivity
This course studies commonalities underlying a variety of networks including social networks, communication networks, biological networks, the Web, and even an abstract model of networks like graphs. Topics include basic graph theory, graph algorithms, fundamental and emerging concepts in networking, and the analytical and heuristic tools that people use to develop and analyze connectivity in networks. Computing and programming exercises will be required to provide hands-on experience with selected tools and technologies. (CSCI-651 or equivalent knowledge in concepts and principles of computer networks, or permission of instructor.) **Class 3, Credit 3 (S)**

CISC-849 Ph.D. Seminar
Current advances in computing and information sciences. **Credit 1-3 Prerequisite: (set by instructor) Class 1-3, Credit 1-3 (F, S)**

CISC-860 Optimization Methods
In this course, the basic knowledge and skills of optimization will be introduced. Students will learn how to recognize, formulate, and solve linear and nonlinear optimization problems. The concentration will be focused on the algorithms and applications, with the necessary theories presented in a comprehensive way. The characteristics of linear and nonlinear programming problems will be discussed with the corresponding solutions, such as the simplex method and Karmarkar's method for linear optimization, and Newton's method and Powell's method for nonlinear optimization. Students are required to complete a project on a given problem, or a problem of their own choices but approved by the course instructor, to gain practical experience. (Knowledge in linear algebra and calculus, experiences in computer programming/MATLAB, or permission of instructor) **Class 3, Credit 3 (F)**

CISC-861 Numerical Methods
This course introduces the knowledge and skills of numerical methods. Numerical methods are the bases of computational analysis to approximate complicated formulations whose analytical solutions are unavailable or infeasible. Numerical methods provide computational algorithms to solve mathematical problems, for example, integration, differentiation, and large systems of linear or nonlinear equations. The course is focused on the algorithms and applications, presented with the rationales, benefits, and limitations so that students can choose the appropriate methods with the highest computational efficiency, stability, and accuracy based on the characteristics of the problems. Students are required to complete a project on a given problem, or a problem of their own choice but approved by the course instructor, to gain practical experience. (Knowledge in linear algebra and calculus, experiences in computer programming/MATLAB, or permission of instructor) **Class 3, Credit 3 (S)**

CISC-862 Computational Modeling and Simulation
Everyone uses modeling and simulation even without being aware of it. This course talks about mathematical and computational modeling and simulation as the tools to solve complex problems in the real world. Topics are divided by the category of modeling method: phenomenological models vs. mechanistic models. For mechanistic models, the course will cover differential equations (including variational principle to construct the differential equations, solutions to ordinary differential equations (ODE), and classical ODE systems) and cellular automaton in detail, and mention other mechanistic models. Similarly, for phenomenological models, the course will cover regression and neural networks in detail, and introduce other phenomenological models such as networks and power-law distributions. In parallel, paper review and discussion will serve as case studies of modeling of real-world complex systems, illustrating application domains. Course projects are required. (Knowledge in probability and statistics, linear algebra and calculus, experiences in computer programming/MATLAB, or permission of instructor.) **Class 3, Credit 3 (S)**

CISC-863 Statistical Machine Learning
This course will cover supervised learning (linear methods, template methods, neural networks, decision trees, support vector machines), unsupervised learning (clustering, principal and independent components analysis), and related ideas (optimization, learning theory, Bayesian techniques, regularization, cross-validation, and the bias-variance tradeoff). Each student will complete several problem sets, including both mathematical and computer implementation problems. (Knowledge in probability and statistics, linear algebra and calculus, experiences in computer programming, or permission of instructor. Familiarity with a numerical mathematics package (e.g. Matlab, Maple, Mathematica) is helpful but not required.) **Class 3, Credit 3 (F)**

CISC-864 Medical Imaging and Image Informatics: Principles and Algorithms
Tomographic medical images, along with computer-aided image processing and understanding methods, have been widely utilized in clinical practice for health evaluation and disease detection. This course focuses on the principles of medical imaging technology, i.e. physiological origins, data acquisition and image formation, as well as algorithmic strategies for quantitative understanding of various medical images. It provides students with a general physics-signal-system understanding of the medical imaging modalities. The course also addresses the clinical needs, the technical problems, and the rationales and strategies of quantitative image analysis. Current and potential clinical applications will be used as illustrations throughout the course. The course also strives to demonstrate the general process of conducting applied research, from problem finding through scientific analysis, solution proposal, implementation, experimentation and evaluation. (Knowledge in probability and statistics, linear algebra, calculus, and image processing/computer vision, experiences in computer programming or MAT/LAB, or permission of instructor.) **Class 3, Credit 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 Ph.D. Director) **Credit variable (F, S, Su)**

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, Credit 0 (F, S)**

CISC-897 Ph.D. Research Co-op
This course provides an opportunity for Ph.D. 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; permission of the Ph.D. director) **Credit 0 (F, S, Su)**

CISC-898 Continuation of Dissertation and Research
Students will continue their 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) on research directions and activities. (Successful completion of dissertation proposal defense and adviser approval; permission of the Ph.D. director) **Class 0, Credit 0 (F, S)**

CISC-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. director. (Permission of the instructor and Ph.D. director) **Credit 1-6 (F, S, Su)**

Computing Security

CSEC-601 Research Methods and Proposal Development
It is important that students in this graduate program be able to perform in depth literature review, understand and apply different fundamental research methods in computing security areas. This course is designed to help students in this direction. Students will be encouraged to investigate the continuing computing security problems, that arise due to vulnerabilities in software and hardware, and malicious cyber-attacks by adversaries. 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)**

CSEC-603 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. **Class 3, Credit 3 (F, S)**

CSEC-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 cryptographic 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)**

CSEC-699 Graduate Co-op
Students perform paid professional work related to the field of computing security. 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 in computing security degree. **Credit 0 (F, S, Su)**

CSEC-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 platforms, under multiple file systems. Therefore, students must posess a knowledge of availabale filesystems on both platforms. **Class 3, Credit 3 (F, S)**

CSEC-731 Web Server and Application Security Audits
This course discusses the processes and procedures to perform a technical security audit of Web servers and Web-based applications. Students will not only explore Web servers and applications/services threats, but also apply the latest auditing techniques to identify vulnerabilities existing in or stemming from Webservers and applications. Students will write and present their findings and recommendations in audit reports on Web servers and application vulnerabilities. To be successful in this course students should be knowledgeable in a scripting language and comfortable with the administration of both Linux and Windows platforms. **Class 3, Credit 3 (S)**

CSEC-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. To be successful in this course students should be knowledgeable in basic networking, systems, and security technologies. **Class 3, Credit 3 (F, S)**

CSEC-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 teams to conduct risk assessments based on selected case studies or hypothetical scenarios. Finally, they will write and present their risk assessment reports and findings. **Class 3, Credit 3 (F, S)**

CSEC-741 Sensor and SCADA Security
This course is designed to provide students with 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 technologies that manage and control much of the infrastructure that we depend on every day 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. To be successful in this course students should be knowledgeable in basic networking, systems, and security technologies. **Class 3, Credit 3 (S)**

CSEC-742 Computer System Security
The importance of effective security policies and procedures coupled with experience and practice is emphasized and reinforced through research and practical assignments. Organization and management of security discipline and response to threats is studied. Case studies of effective and failed security planning and implementation will be examined and analyzed. The issues influencing proper and appropriate planning for security and response to attacks will be studied. To be successful in this course students should be knowledgeable in networking, systems, and security technologies. **Class 3, Lab 0, Credit 3 (F)**

CSEC-743 Computer Viruses and Malicious Software
Computer malware is a computer program with malicious intent. In this course, students will study the history of computer malware, categorizations of malware such as computer viruses, worms, Trojan horses, spyware, etc. Other topics include, but are not limited to, basic structures and functions of malware, malware delivery mechanism, propagation models, anti-malware software, its methods and applications, reverse engineering techniques. Students will conduct research to understand the current state of the computer malware defense and offense. **Class 3, Credit 3 (S)**

CSEC-744 Network Security
Students will examine the areas of intrusion detection, evidence collection, network auditing, network security policy design and implementation as well as preparation for and defense against attacks. The issues and facilities available to both the intruder and data network administrator will be examined and evaluated with appropriate laboratory exercises to illustrate their effect. The students will be provided with an understanding of the principles and concepts of wired and wireless data network security. Students will perform a series of laboratory or homework experiments in order to explore various mechanisms for securing data networks including physical layer mechanisms, filters, applications and encryption. Students will engage in attack/defend scenarios to test their deployments against other teams. Students should be knowledgeable in networking technologies. **Class 3, Credit 3 (F, S)**

CSEC-750 Covert Communications
Students will be introduced to the history, theory, methodology and implementation of various kinds of covert communications. Students will explore future techniques and uses of covert communications. More specifically students will explore possible uses of covert communications in the management of botnets. To be successful in this course students should be knowledgeable in networking, systems, and securitl technologies. **Class 3, Credit 3 (F, S)**

CSEC-751 Information Security Policy and Law
This course explores information security policy development and deployment as well as laws (US and International) that impact information security. Students in this class will develop policies and analyze how policy impacts an organization. Students will also determine how federal, state, and international laws impact the information security policies of an organization. **Class 3, Credit 3 (F, S)**

CSEC-759 Graduate Seminar in Computing Security
This course explores current topics in computing security. It is intended as a place holder course for faculty to experiment new course offerings in computing security undergraduate program. Course specific details change with respect to each specific focal area proposed by faculty. **Class 3, Credit 3 (F, S)**

CSEC-790 MS Thesis
This course is a capstone course in the MS in computing security program. It offers students the opportunity to investigate a selected topic and make an original contribution which extends knowledge within the computing security domain. As part of their original work students will write and submit for publication an article to a peer reviewed journal or conference. Students must submit an acceptable proposal to a thesis committee (chair, reader, and observer) before they may be registered by the department for the MS Thesis. Students must defend their work in an open thesis defense and complete a written report of their work before a pass/fail grade is awarded. (Permission of department) **Credit 1-6 (F, S, Su)**

CSEC-791 MS Project
This course is a capstone course in the MS in computing security program. It offers students the opportunity to investigate a selected topic within the computing security domain. The student may complete a project for real world application or in a laboratory environment. Students must submit an acceptable proposal to a project committee (chair, and reader) before they may be registered by the department for the MS project. Students must defend their work in an open project defense and complete a written report of their work before a letter grade is awarded. (Permission of department) **Credit 1-3 (F, S, Su)**

CSEC-793 **Capstone for Computing Security**
Students will apply their knowledge learned through the program to solve real world problems various areas of computing security. Large size projects will be defined for students to work on throughout the semester. At the end of semester students will present their results and demonstrate their knowledge and skills in problem solving and critical thinking in a setting open to the public. (Permission of department) **Class 3, Credits 1-3 (F, S)**

CSEC-799 **Independent Study**
A student works with a faculty member to devise a plan of study on a topic in various areas of computing security. Deliverables, evaluation methods, and number of credits need to be specified in a written proposal. A final report and presentation in the form of a poster sesssion is expected and graded at the end of the term. (Permission of the instructor and department) **Credit 1-3 (F, S, Su)**

CSEC-900 **Continuation of Thesis**

CSEC-901 **Continuation of Project**

CSEC-909 **Proposal Development**
This course is part of a capstone experience for graduate students who are beginning the capstone experience. Students will submit an accepted proposal as a prerequisite for the formal thesis. (Permission of the graduate adviser) **Credit 0**

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 a high level language, one statistics course) **Class 3, 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, Credit 3 (F)**

ISTE-608 **Database Design and Implementation**
This course provides 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 two-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, a data theory course, and a Web development course). **Class 3, 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, a database theory course, a course in Web development, and a statistics course) **Class 3, Credit 3 (F, S)**

ISTE-645 **Foundations of WebTechnologies 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 website publishing). (One year of programming in an object-oriented language) **Class 3, Credits 3 (S)**

ISTE-646 **Foundations of WebTechnologies 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 Websites. 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) **Class 3, 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 program director 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, 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. (A database theory class) **Class 3, 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. (A database theory course) **Class 3, 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. (A database theory course) **Class 4, Credit 3 (F, Sp)**

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) **Class 4, 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&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&T theory, concepts, and research trends such as spatial reasoning, spatiotemporal data representation, and spatial analysis. **Class 3, 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) **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 (APIs) 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 & implementation of APIs & 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, Credit 3 (S)**

ISTE-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) **Class 3, 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) **Class 3, 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 and ISTE-612) **Class 3, Credit 3 (F)**

ISTE-760 Design, Development, and Deployment of Applications
What's the difference between writing an application for a school project and writing an application for mass marketing? What makes an application production-ready? In this course we will look at several factors that must be considered including help systems, installation routines, code design, and error handling. Students will need to have had one year of programming in a high-level language to be successful in this course. **Class 3, Credit 3 (F)**

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, Credit 3 (F)**

ISTE-771 XML Programming
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 an object-oriented language) **Class 3, 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. (One year of programming in an object-oriented language) **Class 3, Credits 3 (S)**

ISTE-773 XML Transformation and Presentation
This course will explore techniques and technologies for transforming XML documents using XSLT and XSL-FO or other frameworks. 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 XSLT. Students will implement projects to present XML data using a variety of transformation tools and technologies. (Prerequisites: ISTE-610) **Class 3, 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 and PSYC-640). **Class 3, 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). **Class 3, 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 program director) Class 0, **Credits 1-3 (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) **Credit 1-3 (F, S, Su)**

ISTE-795 Capstone in Information Sciences and Technologies
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 large scale system development projects. 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 course work; or permission of graduate program director) **Class 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, graduate program director, and department) **Credit 1-3 (F, S, Su)**

ISTE-900 Continuation of Thesis
Continuation of Thesis

ISTE-901 Continuation of Project
Continuation of Project

ISTE-909 Proposal Development
This course supports the proposal development process for graduate students who are beginning the thesis experience. Students begin the development of an accepted proposal as a prerequisite for formal thesis registration. (Permission of the graduate program director) **Credit 0**

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. (A statistics course) **Class 3, 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, Credit 3 (F, Su)**

HCIN-620 Information and Interaction Design
Designing meaningful relationships among 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. (Knowledge of an interface prototyping tool) **Class 3, 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 and HCIN-610) **Class 3, 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. (One year of programming in a high-level language) **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, 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, one year of object-oriented programming) **Class 3, 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, 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) **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, client-side Web programming experience) **Class 3, 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, 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, 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, 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 and HCIN-610) **Class 3, Credit 3 (S)**

HCIN-795 MS HCI Project
In this course, students will apply the theories and methodologies to the investigation of 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 a capstone committee and graduate program director) **Credit 1-3 (S)**

HCIN-796 MS HCI Thesis
Students electing a research capstone experience will work closely with an adviser on a current research project or one self-developed and guided by the adviser. (Permission of the capstone committee and the graduate program director) **Credit 1-3 (F, S, Su)**

HCIN-900 Continuation of Human Computer Interaction Thesis

HCIN-901 Continuation of Human Computer Interaction Thesis

HCIN-909 Proposal Development
This course is part of a capstone experience for graduate students who are just beginning the thesis topic development process. Students must submit an accepted proposal as a prerequisite for formal thesis work. (Permission of the program director) **Credit 0 (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. (University of Rochester) **Class 3, 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; University of Rochester) **Class 3, Credit 3 (F)**

MEDI-704 Practice of Health Care
This 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; University of Rochester) **Class 3, 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; University of Rochester) **Class 3, 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; University of Rochester) **Class 3, Credit 3 (S)**

MEDI-710 American Health Policy and Politics
This course examines the formation and evolution of American Health policy from an historical perspective. Concentrating on developments from the early 20th century to the present, the focus will be political forces and institutions and historical and cultural contexts. Among the topics covered are periodic campaigns for national health insurance, the creation of Medicare and Medicaid and the further evolution of these programs, the rise to dominance of economists in the shaping of health policy, incremental and state-based vs. universal and federal initiatives, the formation and failure of the Clinton administration's health reform agenda, and national health reform during the Obama administration. Seminar readings will rely heavily on Paul Starr's "The Social Transformation of American Medicine" and Theodore Marmor's "The Politics of Medicare" (2nd edition), but will also include many journal articles and some primary source documents. (MEDI-701; University of Rochester) **Class 3, Credit 3**

MEDI-711 Introduction to U.S. Health Care System
In this course, we examine the organization, financing, delivery, and performance of the U.S. health care system. The inherent tradeoffs between access to care, cost, quality, and outcomes are considered from the perspective of the main actors in the system, i.e. patients, providers (physicians, hospitals, etc.), health plans, insurers and payers. Topics include: need and access to care; health care insurance and financing; Medicare and Medicaid; managed care; service delivery; long-term care; public health; quality of care, and others. The aim of the course is to help students deepen their understanding of the health care system, strengthen their ability to synthesize the literature and assess key current policy issues, and to further develop their critical thinking skills. (MEDI-701, University of Rochester course) **Class 3, Credit 3 (F)**

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, a database theory course, and one year of object-oriented programming) **Class 3, 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, 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, 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 course work 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, Credit 3 (F)**

MEDI-900 Continuation of Capstone
Continuation of Capstone

MEDI-909 Proposal Development
This course is part of a capstone experience for graduate students who are beginning the capstone experience. Students will submit an accepted proposal as a prerequisite for the formal thesis. (Permission of the graduate adviser) **Credit 0,**

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 Digital Design in Motion and GAMEDES-MS) **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 Webproduction. (Graduate standing in GAMEDES-MS) **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 and 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 Game Development Processes and IGME-603 Gameplay and Prototyping) **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. **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)**

IGME-900 **Continuation Capstone Design**

IGME-901 **Continuation Capstone Development**

Networking, Security and Systems Administration

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-605 **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 Web services hosting. (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. (Communications and network theory) **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. (one statistics course) **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. (One statistics course) **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) **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. (Communications and network theory) **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. (Communications and network theory) **Class 3, Credit 3 (S)**

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) **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) **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) **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) **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) **Class 3, Credit 3 (S)**

NSSA-789 **Graduate Seminar in Networking and System Administration**
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. **(F, S, Su)**

NSSA-790 **MS Thesis**
This course is a capstone course in the MS in computing security program. It offers students the opportunity to investigate a selected topic and make an original contribution which extends knowledge within the computing security domain. As part of their original work students will write and submit for publication an article to a peer reviewed journal or conference. Students must submit an acceptable proposal to a thesis committee (chair, reader, and observer) before they may be registered by the department for the MS Thesis. Students must defend their work in an open thesis defense and complete a written report of their work before a pass/fail grade is awarded. (Permission of department) **Credit 1-3 (F, S, Su)**

NSSA-791 **MS NSSA Project**
This course is a capstone course in the MS NSA and MS computing security programs. It offers students the opportunity to investigate a selected topic within the NSSA domain. The student will do this using and an applied laboratory approach. Students must submit an acceptable proposal to a project committee (chair, and reader) before they may be registered by the department for the MS NSSA project. Students must defend their work in an open project defense and complete a written report of their work before a letter grade is awarded. (Permission of department.) **Class 0, Lab 0, Credits 1-3 (F, S, Su)**

NSSA-900 **Continuation of Thesis**

NSSA-901 **Continuation of Project**

NSSA-909 **Proposal Development**
This course is part of a capstone experience for graduate students who are beginning the capstone experience. Students will submit an accepted proposal as a prerequisite for the formal thesis. (Permission of the graduate adviser) **Credit 0**

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, and completion of a computer science programming sequence is needed for enrollment. **Class 3, 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, 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 project(s). (Departmental Approval) **Class 3, 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. Completion of all bridge courses and 17 semester hours of graduate courses are required for enrollment. (Department approval) **Class 0, Credit 0 (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, Credit 3 (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. (Department approval) **Class 3, 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, 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, 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, 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) **Class 3-6, Credit 6 (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) **Class 0-1, 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, 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) **Class 3, Credit 6 (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 (SWEN-794, 795), if extra time if needed. The student continues to work closely with his/her adviser and thesis committee. (Department approval) **Class 0-1, 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. (Completion of nine semester hours is needed for enrollment) **Class 3, Credit 3 (F, S, Su)**

Kate Gleason College of Engineering

Harvey J. Palmer, Dean
rit.edu/kgcoe

Programs of Study

Online learning option available

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 includes a research experience and leads to either employment in industry or graduate study at the doctoral level. The master of engineering degree is generally considered a terminal degree 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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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 are committed to continuous learning and professional growth, and most are actively engaged in fundamental and/or applied research projects to extend the boundaries of knowledge within their discipline. A key characteristic of graduate study in the Kate Gleason College is the close working relationship between the faculty and graduate students on research, thesis, and graduate project work. Each graduate student is assigned a faculty adviser who supervises the student's progress toward degree completion and guides the student in achieving their educational goals.

Facilities

The college provides students with state-of-the-art laboratories for a broad range of specializations, including machine tools and manufacturing, 3D printing, 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.

Research

Engineering faculty are active in numerous research areas, which often take place across engineering disciplines and involves other RIT colleges, local health care institutions, and major industry partners. Much of the research is inspired by the broad-based challenges within four key industry domains that will have a transformational impact on our society in the coming decades: telecommunications, health care, energy, and transportation. A sampling of current research includes 3D printing and advanced manufacturing, industry ergonomics, optics and photonics, micro-machines, electrochemical heating, signal and image processing, cardiovascular biomechanics, robotics and control, VLSI design, electron beam lithography, computer architecture, multimedia information systems, object-oriented software development, and more.

Externally sponsored projects are a vital and integral component of RIT's educational and research activities. These projects add to the body of knowledge, enhance professional development, and 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. RIT's major public sponsors include the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE), the Department of Defense (DOD and DARPA), the Department of Education (USDE), the National Aeronautics and Science Administration (NASA), and New York State.

Study options

Full-time study: Students may matriculate on either a full- or part-time basis. A full-time student will generally take between 9 and 15 credits per semester, depending upon their research or graduate project activity, and can complete the requirements for a master's degree in one calendar year. A full-time student in a master of engineering degree program may choose to alternate academic semesters with an internship (if applicable).

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 while maintaining full-time 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 6 semester credits per semester. A student who wishes to register for more than 6 semester credits must obtain the approval of his or her adviser and the department head.

Nonmatriculated status: Individuals may take graduate courses as a nonmatriculated student 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 9 semester credits.

Engineering, Ph.D.

Shanchieh Jay Yang, Program Contact
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Program overview

The doctorate program in engineering prepares the next generation of engineering leaders to tackle some of the most daunting and complex problems facing our society.

The program's goal is to produce engineering graduates who are subject matter experts in a knowledge domain within an engineering discipline and who can compete successfully with those who have earned discipline-specific doctorates in engineering. Instead of restricting graduates to individual engineering fields (e.g., chemical, computer, electrical, industrial, mechanical, etc.) the program provides students with the flexibility to become subject matter experts and engineering innovators in an open-architecture environment, fostering intellectual growth along both interdisciplinary pathways and within the bounds of conventional engineering disciplines. With this approach, the program develops world-class researchers who can capitalize on the most promising discoveries and innovations, regardless of their origin within the engineering field, to develop interdisciplinary solutions for real-world challenges.

The Ph.D. in engineering requires each student to address fundamental technical problems of national and global importance for the 21st Century. Four key industries–health care, communications, energy, and transportation–are addressed specifically. These industries impact every individual on the planet and are the focus areas doctoral candidates and faculty will contribute to through study and research.

Curriculum

The curriculum for the doctorate in engineering provides disciplinary and interdisciplinary courses, research mentorship, and engineering focus area seminars. Students are expected to have a disciplinary-rooted technical strength to conduct and complete independent, original, and novel collaborative interdisciplinary research contributing to one of the four industrial and/or societal focus areas. The program is comprised of 66 credit hours: 30 course credits, 6 engineering focus area credits, and 30 research credits.

Core courses

Students will complete the following core courses: Interdisciplinary Research Methods, Engineering Analytics Foundation, and Engineering Analytics Elective.

Discipline foundation courses

Foundation courses build depth within a disciplinary field of engineering, such as mechanical engineering, electrical and microelectronics engineering, computer engineering, industrial and systems engineering, chemical engineering, or biomedical engineering.

Industry focus area courses

Beginning with the course Translating Discovery into Practice, this rigorous set of four engineering courses provides students with comprehensive coverage of engineering challenges and solution approaches in the four key industry areas associated with the program: health care, energy, communications, and transportation. Students choose a focus area and

complete the corresponding set of courses. Students can also take additional courses from their selected industry as electives.

Focus area electives

Students complete at least three focus area electives. These courses, selected from courses within current RIT degree programs and associated with the focus area of study chosen by the student, provide specialized knowledge and skill-sets relevant to the student's dissertation research.

Engineering, Ph.D. degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
	Engineering Analytics Foundation	3
	Interdisciplinary Research Methods	3
	Translating Discovery Into Practice	3
	Discipline Foundation Courses	9
	Engineering Analytics Elective	3
	Engineering Focus Area Seminars	2
	Dissertation Research	3
Second Year		
	Cross-disciplinary Electives	9
	Dissertation Research	9
	Engineering Focus Area Seminars	2
Third Year		
	Dissertation Research	18
	Engineering Focus Area Seminars	2
Fourth Year		
	Continuation of Dissertation	0
	Engineering Focus Area Seminars	0
Total Semester Credit Hours		**66**

Comprehensive exam

Students complete a comprehensive exam at the end of their first year of study. The exam evaluates the student's aptitude, potential, and competency in conducting Ph.D. level research.

Dissertation proposal

Students must present a dissertation proposal to their dissertation committee no sooner than six months after the comprehensive exam and at least six months prior to the candidacy exam. The proposal provides the opportunity for the student to elaborate on their research plans and to obtain feedback on the direction and approach to their research from his/her dissertation committee.

Candidacy exam

The candidacy exam provides comprehensive feedback to the student regarding their dissertation research progress and expected outcomes prior to defense of their full dissertation.

Dissertation presentation and defense

Each doctoral candidate will prepare an original, technically sound, and well-written dissertation. They will present and defend their dissertation and its accompanying research to their dissertation committee.

Admission requirements

To be considered for admission to the Ph.D. program in engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in an engineering discipline from an accredited university,
- Submit a resume highlighting educational background and experiences,
- Submit a Statement of Purpose for Research,
- 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 at least two letters of academic and/or professional recommendation. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- Participate in an on-campus or teleconference interview (when aaplicable), 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 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.

Additional information

Residency

All students in the program must spend at least three years as resident full-time student before completing the degree.

Microsystems Engineering, Ph.D.

http://www.rit.edu/kgcoe/program/microsystems-engineering
Bruce Smith, Director
(585) 475-2295, bruce.smith@rit.edu

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 program provides 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:

- Next-generation nanoelectronics including: development of new techniques, processes and architectures for nanoelectronic and nano-optoelectronic devices exploration into new materials research including germanium, III-V materials, carbon annotubes, and spintronics
- Photovoltaic research in silicon, compound semiconductor, and organic solar cells
- Photonics and nanophotonics imaging, communications, and sensing research including couplers, micro-lasers, microdetectors, integrated silicon waveguides, silicon spectrometers, and biosensors
- 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
- Scaled micro- and nano- electronics for integration into biomedical systems
- New and improved technologies in organic electronic components and devices
- Anaomaterials research including carbon nanotubes, nanoparticles, quantum dots, self-assembly materials and their applications in electronics, optics, and materials science
- 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 materials, process, devices, components, and systems. RIT is an internationally recognized leader in education and research in the fields of microsystems and nanoscale engineering.

The curriculum is structured to provide a sound background and a thorough foundation in engineering and science through world-class education in the innovative application of educational technologies and research experiences.

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 renowned, multidisciplinary faculty that shares resources and expertise over a wide variety of micro- and nao-scale tehcnologies. The program is administered by core faculty from RIT's colleges of engineering and science.
- Unique state-of-the art research laboratories have been developed to provide a focus for microsystems and nanoscale engineering research across traditional disciplinary boundaries. A semiconductor and microsystems fabrication clean-room constitute part 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 have discovered exciting opportunities in new technology frontiers.

Curriculum

A total of 66 credit hours of combined graduate course work and research are required for completion of the program. The course work requires a combination of foundation courses, major and minor technical area courses, and electives. The student must pass the Qualifying Exam, the Candidacy Exam, the Candidacy Exam, and the Dissertation Defense Exam to complete the degree requirements.

Phase 1: The first phase prepares students with the foundation in science and engineering required for the program as well as to determine the student's ability to do independent research. This includes the foundation and specialization courses taken during the first year together with the successful completion of the Qualifying Exam. The Qualifying Exam tests the student's ability to think and learn independently, to critically evaluate current research work in microsystems engineering, and to use good judgment and creativity to determine appropriate directions for future research work.

Phase 2: The second phase continues students course work and preliminary dissertation research. Much of this course work will support the dissertation research to be conducted in the third phase. This 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 Candidacy Examination.

Phase 3: The third phase includes the completion of the experimental and/or theoretical work needed to complete the student's dissertation along with the required publication of results. The Research Review Milestone is held as a meeting during this phase, as is the Defense of the Dissertation, which consists of a public oral presentation and examination.

The course work requirements 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 (MCEE-601), Introduction to Nanotechnology and Microsystems (MCSE-702), Material Science for Microsystems Engineering (MCSE-703), and Theoretical Methods in Materials Science and Engineering (MTSE-704).

Major technical interest area

Students complete a sequence of three courses (9 credit hours) in the major technical research area and a sequence of two courses (6 credit hours) in a support area.

Minor technical interest areas

Students complete a two-course sequence in a minor technical area which should be outside of the student's undergraduate degree major (6 credit hours).

Elective courses

Students complete at least two elective courses, in addition to the foundation and technical interest courses (6 credit hours).

General course requirements

The total number of credit hours required for the degree depends upon the highest degree level completed by the student before entering the program. Students entering without prior graduate work must complete a minimum of 39 credit hours of course work as outlined above. A minimum of 18 research credits and a total of 66 total credits are required. Credits beyond the minimum of 39 course and 18 research requirements can be taken from either category to reach the 66 credit total.

Students entering the program with a master's degree may be permitted up to 18 course credit hours toward those 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.

Microsystems engineering, Ph.D. degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MCSE-702	Introduction to Nanotechnology and Microsystems	3
MCEE-601	Microelectronics I	3
	Major Technical Area Electives (A)	6
MCSE-703	Material Science for Microsystems Engineering	3
MTSE-704	Theoretical Methods in Materials Science and Engineering	3
Second Year		
	Major Technical Area Elective A	3
	Minor Technical Area Electives	6
	Technical Elective	3
MCSE-890	Doctoral Dissertation (Research and Thesis)	2
Third Year		
	Technical Elective	3
	Major Technical Area Electives (B)	6
MCSE-890	Doctoral Dissertation (Research and Thesis)	7
Fourth Year		
MCSE-890	Doctoral Dissertation (Research and Thesis)	18
Total Semester Credit Hours		**66**

Advising

Doctoral students' work is overseen by an adviser, the advisory committee, and the program's director.

Program of study

Students should prepare a program of study after passing the Qualifying Exam and no later than the spring semester 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. Leading up to or upon completion of the Candidacy exam, the student's adviser and advisory committee may add additional course work requirements to ensure the student is sufficiently prepared to carry out and complete their dissertation research.

Qualifying examination

Every student must take the Qualifying 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 Candidacy Examination.

Research proposal

A research topic chosen by the student and their 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.

Candidacy examination

The Candidacy 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.

Research review milestone

The Research Review Milestone is administered by the student's adviser and the advisory committee between the time the student passes the Candidacy Exam and registers for the Dissertation Defense. This normally occurs approximately six months prior to the Dissertation Defense.

Dissertation defense and examination

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 completer a graduate application and 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, and (if applicable) a graduate GPA of 3.5 or higher,
- Submit Graduate Record Exam (GRE) scores, with minimum requirements of 156 (verbal), 156 (quantitative) and 3.5 (writing),
- Submit at least two letters of academic and/or professional recommendation. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- International applicants whose native language is not English are required to submit scores from the Test of English as a Foreign Language (TOEFL).

Applied Statistics, MS

http://www.rit.edu/kgcoe/program/applied-statistics
Peter Bajorski, Graduate Program Chair
(585) 475-7889, pxbeqa@rit.edu
Rebecca Ziebarth, Graduate Coordinator
(585) 475-2033, razeqa@rit.edu

Program overview

The MS program in applied statistics is available to both full- and part-time students with courses available both on-campus and online. Cooperative education is optional. The program is intended for students who do not wish to pursue a degree beyond the MS. However, a number of students have attained doctorate degrees at other universities.

Curriculum

The program requires 30 credit hours and includes five core courses, four electives, and a capstone.

Core courses

There are five required core courses. Students, in conjunction with their advisers' recommendations, should take the core courses early in the program.

Focus areas

- Data Mining
- Design of Experiments
- Engineering Applications
- Health Care Applications
- Imaging Applications of Statistics
- Industrial Applications of Statistics

Electives and capstone

Elective courses are chosen by the student with the help of their adviser. These courses are usually department courses but may include (along with transfer credits) up to 6 credit hours from other departments that are consistent with students' professional objectives.

The 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. Students, with adviser approval, may choose to write a thesis as their capstone.

Applied statistics, MS degree, typical course sequence

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	3
Second Year		
	Electives	9
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 (minimum 3.0 GPA strongly recommended),
- Have a satisfactory background in mathematics (one year of university-level calculus) and statistics (preferably two courses in probability and statistics)
- 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.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Scores from the Graduate Record Exam (GRE) are not required, however submitting scores may support the admission of an applicant who is deficient in certain admission requirements.

Additional information

Lean Six Sigma Black Belt

Students may earn a Lean Six Sigma Black Belt by completing one or two additional courses and by successfully completing an approved Lean Six Sigma project at the student's organization or, alternatively, at an organization that will sponsor the student.

Grades

Students must attain an overall program grade-point average of 3.0 (B), with no more than two grades of C, for graduation.

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.

Computer Engineering, MS

http://www.rit.edu/kgcoe/program/computer-engineering-0
Shanchieh Jay Yang, Department Head
(585) 475-2987, jay.yang@rit.edu
Dhireesha Kudithipudi, Graduate Coordinator
(585) 475-5085, dxkeec@rit.edu

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 30 semester credit hours and includes Analytical Topics (CMPE-610), two restricted core courses, five graduate electives, two to three semesters of graduate seminar, and six semester credit hours of thesis research. Core courses and graduate electives provide breadth and depth of knowledge to conduct meaningful thesis research.

The Computer Engineering Graduate Seminar (CMPE-795) provides students with exposure to a variety of research topics presented by researchers from within RIT, from industry, and from other universities. Students are expected to conduct graduate level thesis research under the supervision of a primary faculty adviser and thesis committee.

Computer engineering, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CMPE-610	Analytical Topics in Computer Engineering	3
Choose two of the following restricted core courses:		6
CMPE-630	Digital Integrated Circuit Design	
CMPE-655	Multiple Processor Systems	
CMPE-660	Reconfigurable Computing	
CMPE-670	Data and Communication Network	
CMPE-685	Computer Vision	
	Graduate Electives*	15
CMPE-795	Graduate Seminar	0
Second Year		
CMPE-796	Thesis Proposal Seminar	0
CMPE-790	Thesis	6
Total Semester Credit Hours		**30**

* At least two graduate electives must come from the computer engineering department.

Graduate electives

Students select five graduate electives from within the following research tracks. Students are encouraged to choose most of their graduate electives within a single track. At least two of the electives must be from the computer engineering department (Please note: Computer engineering department courses begin with the prefix CMPE). Courses not included in the lists below may be considered with approval from the department.

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.

CMPE-655	Multiple Processor Systems
CMPE-660	Reconfigurable Computing
CMPE-655	Performance Engineering of Real-time and Embedded Systems
CMPE-731	Design and Testing of Multi-core Chips
CMPE-750	Advanced Computer Architecture
CMPE-755	High Performance Architectures
CSCI-652	Distributed Systems
CSCI-654	Foundations of Parallel Computing
CSCI-742	Compiler Construction

Integrated 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 and other emerging devices at the massive-scale. Such nanocomputers open unimaginable opportunities as well as challenges to computer engineers. This research focuses on designing computers with emerging novel technologies in the presence of severe physical constraints; investigating dynamic reconfigurability to exploit the power of nano-scale electronics for building reliable computing systems; and studying the applicability of emerging technologies to address challenges in computing hardware of the future.

CMPE-630	Digital Integrated Circuit Design
CMPE-655	Multiple Processor Systems
CMPE-730	Advanced Digital Integrated Circuit Design
CMPE-731	Design and Testing of Multi-core Chips
CMPE-750	Advanced Computer Architecture
EEEE-602	Random Signals and Noise
EEEE-610	Analog Electronics
EEEE-620	Design of Digital Systems
EEEE-712	Advanced Field Effect Devices
EEEE-713	Solid State Physics
EEEE-720	Advanced Topics in Digital Systems Design
EEEE-726	Mixed Signal IC Design
EEEE-730	Advanced Analog IC Design

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 as well as security assurance presents exciting challenges for engineers and scientists. Resilient to environmental uncertainty, system failures, and cyber attacks requires advances in hardware, software, and networking techniques. The research track in networks and security focuses on intelligent wireless and sensor networks, cryptographic engineering, and predictive cyber situation awareness.

CMPE-661	Hardware and Software Design for Cryptographic Applications
CMPE-670	Data and Communication Networks
CMPE-770	Wireless Networks
CSCI-642	Secure Coding
CSCI-662	Foundations of Cryptography
CSCI-720	Big Data Analytics
CSCI-734	Foundations of Security Measurement and Evaluation
CSCI-735	Foundations of Intelligent Security Systems
CSCI-736	Neural Networks and Machine Learning
CSCI-762	Advanced Cryptography
CSEC-743	Computer Viruses and Malicious Software
CSEC-744	Network Security
EEEE-602	Random Signals and Noise
EEEE-693	Digital Data Communication
EEEE-797	Wireless Communication
NSSA-612	Network Modeling and Analysis
NSSA-711	Advanced Routing Protocols
NSSA-715	Network Design and Performance

Computer vision and machine intelligence

Visual information is ubiquitous and ever more important for applications such as robotics, health care, human-computer interaction, biometrics, surveillance, games, entertainment, transportation, and commerce. Computer vision focuses on extracting information from image and video data for modeling, interpretation, detection, tracking, and recognition. Machine intelligence methods deal with human-machine interaction, artificial intelligence, agent reasoning, and robotics. Algorithm development for these areas spans image processing, pattern recognition, and machine learning, and is intimately related to system design and hardware implementations.

CMPE-680	Digital Image Processing Algorithms
CMPE-685	Computer Vision
CSCI-713	Applied Perception in Graphics and Visualization
CSCI-715	Applications in Virtual Reality
CSCI-719	Topics in Computer Graphics
CSCI-720	Big Data Analytics
CSCI-731	Advanced Computer Vision
EEEE-647	Artificial Intelligence Explorations
EEEE-670	Pattern Recognition
EEEE-685	Principles of Robotics
EEEE-780	Digital Video Processing
EEEE-781	Image and Video Compression
IMGS-756	Advanced Digital Image Processing

Signal processing, 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.

CMPE-663	Real-time and Embedded Systems
CMPE-664	Modeling of Real-time Systems
CMPE-665	Performance Engineering of Real-Time and Embedded Systems
EEEE-602	Random Signals and Noise
EEEE-610	Analog Electronics
EEEE-661	Modern Control Theory
EEEE-733	Robust Control
EEEE-765	Optimal Control
EEEE-768	Adaptive Signal Processing
EEEE-793	Error Detection and Error Correction
EEEE-794	Information Theory
MATH-781	Wavelets and Applications

Additional graduate-level math courses may be used as electives

Students may choose among the following graduate-level math courses to fulfill elective credits. Students must consult with their adviser and obtain department approval for the use of these or other graduate level math courses as electives.

ISEE-601	Systems Modeling and Optimization
ISEE-701	Linear Programming
ISEE-702	Integer and Nonlinear Programming
MATH-603	Optimization Theory
MATH-605	Stochastic Processes
MATH-611	Numerical Analysis
MATH-651	Combinatorics and Graph Theory I

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 students obtain experiences in reviewing related work of others in the field, as well as conducting meaningful independent research under a faculty mentor.

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.

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) or International English Language Testing System (IELTS).

Electrical Engineering, MS

http://www.rit.edu/kgcoe/program/electrical-engineering-0
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. Students may choose among the following six options: communication, control, digital systems, integrated electronics, MEMs, or signal and image processing.

All students are expected to attend the Electrical Engineering Graduate Seminar for every semester they are on campus. The MS degree is awarded upon the successful completion of a minimum of 30 semester credit hours, including a 6 credit hour thesis. Students have the option of doing a 3 credit hour graduate paper in place of the thesis. In this case an additional course is required.

Curriculum

Electrical engineering (communication focus area), MS degree, typical course sequence

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-795	Graduate Seminar	0
EEEE-797	Wireless Communication	3
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (control focus area), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-669	Fuzzy Logic and Applications	3
EEEE-661	Modern Control	3
EEEE-765	Optimal Control Course	3
EEEE-766	Multivariable Modeling	3
EEEE-795	Graduate Seminar	0
Second Year		
	Electives	6
EEEE-790	MSEE Thesis	6
EEEE-795	Graduate Seminar	0
Total Semester Credit Hours		**30**

Electrical engineering (digital systems focus area), MS degree, typical course sequence

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
EEEE-795	Graduate Seminar	0
	Elective	3
Second Year		
	Electives	6
EEEE-795	Graduate Seminar	0
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (MEMs focus area), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
EEEE-603	Matrix Methods in Electrical Engineering	3
EEEE-602	Random Signals and Noise	3
EEEE-689	Fundamentals of MEMs	3
EEEE-661	Modern Control Theory	3
MCEE-770	Microelectromechanical Systems	3
EEEE-787	MEMs Evaluation	3
EEEE-795	Graduate Seminar	0
Second Year		
EEEE-718	Design and Characterization of Microwave Systems	3
	Elective	3
EEEE-795	Graduate Seminar	0
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (integrated electronics focus area), MS degree, typical course sequence

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
EEEE-795	Graduate Seminar	0
	Elective	3
Second Year		
EEEE-726	Mixed-Signal IC Design	3
	Elective	3
EEEE-795	Graduate Seminar	0
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

Electrical engineering (signal and image processing focus area), MS degree, typical course sequence

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-670	Pattern Recognition	3
EEEE-780	Digital Video Processing	3
EEEE-795	Graduate Seminar	0
Second Year		
	Electives	6
EEEE-795	Graduate Seminar	0
EEEE-790	MSEE Thesis	6
Total Semester Credit Hours		**30**

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 fields outside of electrical engineering may be considered for admission, however, they may be required to complete bridge courses to ensure they are adequately prepared for graduate studies in electrical engineering.

Additional information

Graduation requirements

Students must maintain a minimum 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.

Industrial and Systems Engineering, MS

http://www.rit.edu/kgcoe/program/industrial-engineering-0
Marcos Esterman, Graduate Program Director
(585) 475-6922, mxeeie@rit.edu

Program overview

The master of science degree in industrial and systems engineering allows students to customize their course work while working closely with industrial and systems 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 30 semester credit hours of study. This includes eight courses and a 6 semester credit hour thesis. All students are required to complete at least two semesters of Graduate Seminar (ISEE-795, 706).

Industrial and systems engineering, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-601	Systems Modeling and Optimization	3
ISEE-771	Engineering of Systems I	3
ISEE-795, 796	Graduate Seminar I, II	0
ISEE-760	Design of Experiments	3
	Electives	9
Second Year		
	Electives	6
ISEE-790	Research and Thesis	6
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in industrial and systems engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science from an accredited institution,
- Have a minimum cumulative undergraduate GPA of 3.0,
- 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 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. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required.

Manufacturing Leadership, MS

http://www.rit.edu/kgcoe/program/manufacturing-leadership
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 an online format where students continue to work while taking classes. The program can also be taken on a full-time basis, and several courses are available on-campus.

Manufacturing leadership is a highly focused program developed jointly by the 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.

Curriculum

Manufacturing leadership, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MGMT-740	Organizational Behavior and Leadership	3
ISEE-771	Engineering of Systems I	3
Choose one of the following:		3
ISEE-750	Systems and Project Management	
BUSI-710	Project Management	
CQAS-682	Lean Six Sigma Fundamentals	3
Choose one of the following:		3
ACCT-603	Accounting for Decision Makers	
ACCT-794	Cost Management in Technical Organizations	
Second Year		
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	
Elective	**Non-Business Elective**	**3**
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,
- Have a minimum cumulative grade point average of 3.0,
- Have at least two years of experience in a manufacturing-related organization or business environment,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit one professional recommendation,
- Submit a current resume, and
- Complete a graduate application.

Exceptions to admission requirements 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. Areas that need strengthening may be addressed by guided reading, independent study, or formal course work.

Format

Students may start the program during any semester and complete the course work at their own pace. Classes are all available online but several courses may be taken on-campus for local or full-time students.

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.

Mechanical Engineering, MS

http://www.rit.edu/kgcoe/mechanical/program/graduate-ms/overview
Edward C. Hensel, Department Head
(585) 475-2162, echeme@rit.edu

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 30 semester credit hours (24 semester credit hours of course work and 6 semester credit hours of thesis). A limited number of 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. An adviser will review course work for possible transfer credit. Upon matriculation into the MS program, the student should formulate a plan of study in consultation with an adviser.

Curriculum

The program includes core courses, focus area courses, elective courses, and a thesis. All full-time students are required to attend the weekly graduate seminar each semester they are on campus.

Mechanical engineering, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
MECE-601	Math I For Engineers	3
MECE-602	Math II For Engineers	3
	Focus Area Courses	9
	Electives	9
MECE-790	MSME Thesis	6
MECE-795	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 9 semester 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, 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, mechanics, thermo-fluids, and controls.

Thesis

Students should prepare and present a formal thesis proposal to their faculty adviser prior to completing their course work. 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 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 302 (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).

Microelectronic Engineering, MS

http://www.rit.edu/kgcoe/program/microelectronic-engineering-0
Robert Pearson, Program Director
(585) 475-2923, repemc@rit.edu

Program overview

The objective of the master of science degree in microelectronic engineering is to provide an opportunity for students to perform graduate-level research as they prepare for entry into either the semiconductor industry or a doctoral program. The degree 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.

Program 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 semester of study and still complete the MS degree in two years. Prerequisite courses do not count toward the required graduate courses.

Curriculum

The program consists of nine core courses, two graduate electives, and a thesis. The curriculum has been designed for students who do not have an undergraduate degree in microelectronic engineering. Students who have an undergraduate degree in microelectronic engineering will develop a custom course of study with their graduate adviser.

Thesis

A thesis is normally 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 (four academic semesters and one summer term).

Microelectronic engineering, MS degree, typical course sequence

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.

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 an 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 fields outside of electrical and microelectronic engineering may be considered for admission; however, bridge courses may be required to ensure the student is adequately prepared for graduate study.

Product Development, MS

http://www.rit.edu/kgcoe/program/product-development
Mark W. Smith, Director
(585) 475-7102, mark.smith@rit.edu
Christine Fisher, Graduate Program Director
(585) 475-7971, mpdmail@rit.edu

Program overview

The master of science in product development is a leadership program designed for engineers, scientists, technical managers, and other experienced professionals who aspire to mid- and senior-level positions associated with product innovation. The program integrates business and engineering courses consistent with cross-functional, end-to-end product development, as well as the systems perspective critical to conceive, create, launch, and support today's complex product portfolios.

To stay on the cutting edge, the program was designed by academic and industry leaders and integrates formal education with state-of-the-art research and industrial best practices. Electives and a capstone project provide flexibility to tailor the program's content to specific learning objectives of students and sponsoring organizations.

Product development, MS degree, typical course sequence

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-603	Accounting for Decision Makers	3
Choose one of the following:		3
ISEE-750	Systems and Project Management	
BUSI-710	Project Management	
Second Year		
MKTG-761	Marketing Concepts and Commercialization	3
DESC-743	Operations and Supply Chain Management	3
ISEE-797	MPD Capstone I	3
ISEE-798	MPD Capstone II	3
Elective	**Engineering or Business Elective**	**3**
Elective	**Engineering Elective**	**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 (or equivalent) in engineering (or a related scientific or technical field),
- Have a minimum cumulative grade point average of 3.0,
- Have at least two years of experience in product development or a related business environment,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit one professional recommendation,
- Submit a current resume, 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 the Graduate Record Exam (GRE).

Additional information

Prerequisites

Students must possess knowledge and skills at the introductory level in applied probability and statistics. Areas that need strengthening may be addressed by guided reading, independent study, or formal course work.

Format

Students may start the program during any semester and complete the course work at their own pace. Classes are available online with several courses available on-campus for local students.

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.

Sustainable Engineering, MS

http://www.rit.edu/kgcoe/program/sustainable-engineering
Brian Thorn, Program Director
(585) 475-6166, bkteie@rit.edu

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 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. Course work 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:

- Heighten awareness of issues in areas of sustainability (e.g., global warming, ozone layer depletion, deforestation, pollution, ethical issues, fair trade, gender equity, etc.).
- Establish a clear understanding of the role and impact 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.
- Demonstrate a capacity to distinguish professional and ethical responsibilities associated with the practice of engineering.

Curriculum

Technical in nature, the program equips 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 33 semester credit hours of course work comprised of five required core courses; two graduate engineering electives in an area of interest such as energy, modeling, manufacturing and materials, transportation and logistics, or product design and development; two social context or environmental technology electives; two semesters of Graduate Seminar I, II (ISEE-795, 796); and a thesis. This research-oriented program is designed to be completed in two years.

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, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-785	Fundamentals of Sustainable Engineering	3
ISEE-771	Engineering of Systems I	3
MECE-629	Renewable Energy Systems	3
ISEE-795	Graduate Seminar I	0
ISEE-786	Lifecycle Assessment	3
	Engineering Electives	6
ISEE-796	Graduate Seminar II	0
Second Year		
ISEE-787	Dsign for the Environment	3
	Environmental Technology Elective	3
	Social Context Elective	3
ISEE-790	Research and Thesis	6
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 institution in engineering, mathematics, or science,
- Submit official transcripts (in English) from all previously completed undergraduate and graduate course work,
- Have a minimum GPA of 3.0,
- 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.

Engineering Management, ME

http://www.rit.edu/kgcoe/program/engineering-management
Marcos Esterman, Graduate Program Director
(585) 475-6922, mxeeie@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 Saunders College of Business. The program combines technical expertise with managerial skills to focus on the management of engineering and technological enterprises. Students understand the technology involved in engineering projects and the management process through which the technology is applied. The objective 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 gain valuable knowledge in areas such as organizational behavior, finance, and accounting.

Curriculum

Engineering management, ME degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-750	Systems and Project Management	3
ISEE-771	Engineering of Systems I	3
ACCT-603	Accounting for Decision Makers	3
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		**33**

Admission requirements

To be considered for admission to the ME program 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 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. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required.

Industrial and Systems Engineering, ME

http://www.rit.edu/kgcoe/program/industrial-engineering-1
Marcos Esterman, Graduate Program Director
(585) 475-6922, mxeeie@rit.edu

Program overview

The master of engineering in industrial and systems engineering focuses on the design, improvement, and installation of integrated systems of people, materials, 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 and systems engineering is the optimization of the system, regardless of whether the activity engaged in is a manufacturing, distribution, or a service-related capacity. Students graduate with a variety of skills in the areas of applied statistics/quality, ergonomics/human factors, operations research/simulation, manufacturing, and systems engineering.

Curriculum

Industrial and systems engineering, ME degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-601	Systems Modeling and Optimization	3
ISEE-771	Engineering of Systems I	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 program in industrial and systems engineering, candidates must fulfill the following requirements:

- Hold a baccalaureate degree in engineering, mathematics, or science from an accredited institution,
- Have a minimum cumulative undergraduate GPA of 3.0,
- 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 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. Minimum scores of 550 (paper-based) or 80 (Internet-based) are required.

Mechanical Engineering, ME

http://www.rit.edu/kgcoe/mechanical/program/graduate-meng/overview
Edward C. Hensel, Department Head
(585) 475-5181, echeme@rit.edu

Program overview

The master of engineering in mechanical engineering is a 30 credit hour degree program. It is intended to be a terminal degree program designed for those who do not expect to pursue a doctoral degree but who wish to become a leader within the mechanical engineering field. This degree is particularly well-suited for students who wish to study part time, for those interested in updating their technical skills, or for those not focused on a research-oriented master of science thesis. A conventional thesis is not required for the program. In its place, students complete a capstone experience, which may be a design project leadership course, a well-organized and carefully chosen industrial internship, or an independent study project. A research methods course may also fulfill the capstone experience; however, this option is primarily intended for students who are considering a transition to the MS program in mechanical engineering. (Courses taken within the ME program are transferrable to the MS program.)

Curriculum

In addition to the two required courses, students choose three courses from 10 different focus areas and four elective courses. Up to three courses may be taken outside the mechanical engineering department. Students may complete the program's requirements within one calendar year with summer study. Students may also augment their education through cooperative education employment opportunities. Although co-op is not a requirement of the program, it does give students an opportunity to gain employment experience within the field.

Mechanical engineering, ME degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
MECE-601	Math I For Engineers	3
MECE-602	Math II For Engineers	3
	Focus Area Courses	9
	Electives	12
Choose one of the following:		3
MECE-730	Design Project Leadership*	
MECE-777	Internship†	
MECE-792	Project‡	
MECE-701	Research Methods§	
MECE-795	Graduate Seminar	
Total Semester Credit Hours		**30**

* Design Project Leadership (MECE-730) is intended for students enrolled in the accelerated BS/MEng program.
† Internship (MECE-777) is intended for part-time students.
‡ Project (MECE-792) is intended for students enrolled full time in the ME program.
§ Research Methods (MECE-701) is intended for students planning to transition to the MS degree.

Focus areas

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-752	Tribology Fundamentals	3
MECE-758	Intermediate Engineering Vibrations	3

Business			
ACCT-603	Accounting for Decision Makers	3	
MGMT-740	Organizational Behavior and Leadership	3	
Choose one of the following:			3
ACCT-706	Cost Management		3
INTB-730	Cross Cultural Management		3
MGMT-742	Technology Management		3
MGMT-761	Managing Research and Innovation		3

Controls		
MECE-643	Classical Controls	3
Choose two of the following:		6
MECE-743	Digital Control Systems	
MECE-744	Nonlinear Control Systems	
EEEE-661	Modern Control Theory	
EEEE-733	Robust Control	

Manufacturing		
Choose three of the following		
MECE-643	Classical Control	3
ISEE-626	Contemporary Production Systems	3
ISEE-720	Production Control	3
ISEE-740	Design for Manufacture and Assembly	3
ISEE-741	Rapid Prototyping and Manufacturing	3
ISEE-745	Manufacturing Systems	3

Mechanics and design		
Choose three of the following:		
MECE-620	Introduction to Optimal Design	3
MECE-644	Introduction to Composite Materials	3
MECE-752	Tribology Fundamentals	3
MECE-754	Fundamentals of Fatigue and Fracture	3
MECE-785	Mechanics of Solids	3

Product development		
Choose three of the following:		
ISEE-750	Systems and Project Management	3
ISEE-751	Decision Risk/Benefit Analysis	3
ISEE-771	Engineering Systems I	3
ISEE-772	Engineering Systems II	3

Sustainability		
Choose three of the following:		
MECE-629	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		
MECE-731	Computational Fluid Dynamics	3
MECE-738	Ideal Flows	3
MECE-751	Convective Phenomena	3

Vibrations engineering		
MECE-658	Introduction to Engineering Vibrations	3
MECE-758	Intermediate Engineering Vibrations	3
Choose one of the following:		
MECE-606	System Modeling	3
EEEE-602	Random Signals and Noise	3
EEEE-678	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).

Microelectronics Manufacturing Engineering, ME

http://www.rit.edu/kgcoe/program/microelectronic-engineering-1
Robert Pearson, Program Director
(585) 475-2923, repemc@rit.edu

Program overview

The master of engineering in microelectronics manufacturing engineering provides a broad-based education for students with a bachelor's degree in traditional engineering or other science disciplines who are interested in a career in the semiconductor industry. This 30 credit hour program is awarded upon the successful completion of six core courses, two elective courses, a research methods course, and an internship. Under certain circumstances, a student may be required to complete more than the minimum number of credits.

Microelectronics

The microelectronics courses cover 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 a 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. The program is also offered online for engineers employed in the semiconductor industry.

Internship

The program requires students to complete an internship. This requirement 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 submit a request for credit by experience with the department head. Supported by a letter from the appropriate authority substantiating the student's job responsibility, duration, and performance quality, a student may be able to waive the internship if a previous work experience fulfills this requirement.

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 semester, and may be designed in a number of ways. At the conclusion of the internship, submission of a final internship report to the faculty adviser and program director is required.

Program outcomes

After completing the program, students 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 an 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

Microelectronics manufacturing engineering, ME degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MCEE-601	Microelectronic Fabrication	3
MCEE-605	Lithography Materials and Processes	3
MCEE-603	Thin Films	3
	Graduate Electives	6
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-795	Microelectronics Research Methods	1
MCEE-777	Microelectronic Engineering Internship	4
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the ME program in microelectronic manufacturing 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 an 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 from the International English Language Testing System (IELTS).

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 complete additional bridge courses to ensure they are adequately prepared for graduate study.

Sustainable Engineering, ME

http://www.rit.edu/kgcoe/program/sustainable-engineering-0
Brian Thorn, 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 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 equips 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 36 credit hours through course work, participate in two semesters of graduate seminar, and a capstone project. This major is designed to be completed in two years.

Sustainable engineering, ME degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISEE-785	Fundamentals of Sustainable Engineering	3
ISEE-771	Engineering of Systems I	3
MECE-629	Renewable Energy Systems	3
ISEE-795	Graduate Seminar I	0
ISEE-786	Lifecycle Assessment	3
	Engineering Electives	6
ISEE-795	Graduate Seminar II	0
Second Year		
ISEE-787	Design for the Environment	3
	Engineering Electives	6
	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 major.

Applied Statistics, Adv. Cert.

http://www.rit.edu/kgcoe/cqas/academics/advancedcertificate.htm#productprocess

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Rebecca Ziebarth, Graduate Coordinator
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Program overview

The advanced certificate in applied statistics is designed for engineers, scientists, analysts, and other professionals who want a solid education in the statistical methods that are most closely related to their work. Courses are available both on-campus and online.

Curriculum

Applied statistics, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CQAS-741	Regression Analysis	3
CQAS-701	Foundations of Experimental Design	3
	Electives	6
Total Semester Credit Hours		**12**

Admission requirements

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

- Hold a baccalaureate degree from an accredited institution (3.0 GPA strongly recommended),
- Have a satisfactory background in mathematics and statistics (preferably two courses in probability and statistics),
- 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.
- International students whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Scores from the Graduate Record Exam (GRE) are not required, however they may be beneficial for some students.

Additional information

Prerequisites

Students should have basic familiarity with MINITAB, SAS, or R statistical software. This may be obtained through self-study; short courses; or by completing Statistical Software (CQAS-611), which covers both SAS and R software.

Grades

Students must attain an overall program GPA of 3.0 (B), with no more than one grade of C, for graduation.

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.

Lean Six Sigma, Adv. Cert.

http://www.rit.edu/kgcoe/cqas/academics/advancedcertificate.htm#quality

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Program overview

The advanced certificate in Lean Six Sigma is aimed primarily at quality engineers, other engineers, process-improvement facilitators, or those who aspire to such positions.

Curriculum

Lean Six Sigma, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
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**

* This course requires an approved Lean Six-Sigma project at the student's organization or, alternatively, at an organization that will sponsor the student.

Admission requirements

To be considered for admission to the advanced certificate in Lean Six Sigma, candidates must fulfill the following requirements:

- Hold a baccalaureate degree from an accredited institution (3.0 GPA strongly recommended)
- Have a satisfactory background in mathematics and statistics (at least one course in probability and statistics)
- 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.
- International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL).

Additional information

Six Sigma Black Belt

Students may earn a Six-Sigma Black Belt (during or after obtaining the advanced certificate) by successfully completing the approved Lean Six-Sigma project from the CQAS-683 course.

Prerequisites

Students should have basic familiarity with MINITAB statistical software. This may be obtained by self-study or through short courses.

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.

Grades

Students must maintain an overall program GPA of 3.0 (B), with no more than one grade of C, to qualify for graduation.

Gainful employment
Information regarding costs and the U.S. Department of Labor's Standard Occupational Classification (SOC) code and occupational profiles for this program can be viewed at rit.edu/programs/gedt/leansixsigma.

Vibrations, Adv. Cert.

http://www.rit.edu/kgcoe/mechanical/
Edward C. Hensel, Department Head
(585) 475-2162, echeme@rit.edu

Program overview

The advanced certificate in vibrations 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 certificate takes students beyond the normal preparation in vibration 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 curriculum answers a need for graduate level instruction for practicing engineers in a field of importance for the 21st century.

Curriculum

The advanced certificate requires students to successfully complete six required courses. Students may be able to apply the courses toward a master's degree at a later date.

Vibrations, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
MECE-601	Math I For Engineers	3
MECE-602	Math II For Engineers	3
MECE-658	Introduction to Engineering Vibrations	3
MECE-758	Intermediate Engineering Vibrations	3
Choose one of the following:		
MECE-606	Systems Modeling	3
EEEE-602	Random Signals and Noise	3
EEEE-678	Digital Signal Processing	3
Total Semester Credit Hours		**15**

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Daniel R. Lawrence, BA, BS, University of Akron; MA, Ball State University; MS, Rochester Institute of Technology; Ph.D., University of Toronto (Canada)—Professor, Multivariate Analysis (categorical data), Qualitative Measurement, Psychometrics, Survey Design and Analysis

Robert J. Parody, BS, Clarkson University; MS, Rochester Institute of Technology; Ph.D., University of South Carolina—Associate Professor, Experimental Design, Response Surface Methods, Quality Control and Improvement

Joseph G. Voelkel, BS, Rensselaer Polytechnic Institute; MS, Northwestern University; Ph.D., University of Wisconsin-Madison—Professor; Experimental Design, Process Modeling and Improvement, Multivariate Analysis, Reliability, Nonparametrics

Microsystems Engineering

Bruce W. Smith, BS, MS, Ph.D., Rochester Institute of Technology—Director; Professor, Microlithography, Nanopatterning and Nanomaterials, Thin Films Materials and Processes

Mustafa A. G. Abushagur, BS, Tripoli University (Libya); MS, Ph.D., California Institute of Technology—Professor, Micro-optical Systems, Micro- and Nano-photonic Devices

David Borkholder, BS, Rochester Institute of Technology; MS, Ph.D., Stanford University—Bausch and Lomb Professor, Associate Professor, Electrical Engineering; Biosensors (electromagnetic and chemical), Biomedical Instrumentation MEMS Fabrication, Systems Engineering

Robert J. Bowman, BS, Pennsylvania State University; MS, San Jose State University; Ph.D., University of Utah—Professor, Electrical Engineering; Analog Integrated Circuit Design, Semiconductor Physics, Biomedical Instrumentation

Christopher Collison, BS, Ph.D., Imperial College of London (United Kingdom)—Associate Professor, Chemistry; Physical Chemistry: polymer chemistry

Denis R. Cormier, BS, University of Pennsylvania; MS, State University of New York at Buffalo; Ph.D., North Carolina State University— Earl W. Brinkman Professor of Screw Machine Technology; Associate Professor, Industrial Engineering

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

Thomas R. Gaborski, BS, Cornell University; MS, Ph.D., University of Rochester—Assistant Professor, Nanomaterials, Separations, Cellular Mechanics

Behnaz Ghoraani, B.Sc., Sharif University of Technology (Iran); M.Sc., Amirkabir University of Technology (Iran); Ph.D., Ryerson University (Canada)—Assistant Professor, Biomedical Signal

Analysis, Pattern Recognition in Cardiac Electrophysiology, Biomedical Instrumentation

Karl D. Hirschman, BS, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Director, Semiconductor and Microsystems Fabrication Laboratory; Associate Professor, Microelectronic Engineering; Semiconductor Process Integration, Photonic Devices

Seth M. Hubbard, BS, Drexel University; MS, Case Western Reserve University; Ph.D., University of Michigan—Associate Professor, Physics, Epitaxial Crystal Growth, Growth and Characterization of Nanomaterials, High-efficiency Photovoltaic Devices, Semiconductor Device Design and Fabrication, Thin Films

Satish G. Kandlikar, BE, Marathwada University (India); M.Tech., Ph.D., Indian Institute of Technology (India)—James E. Gleason Professor; Professor, Mechanical Engineering; Thermal Systems and Energy

Dhireesha Kudithipudi, BS, Nagarjuna University (India); MS, Wright State University; Ph.D., University of Texas at San Antonio—Associate Professor, Nanoscale Circuits and Systems, Low-power Systems, Nontraditional CMOS Technologies

Santosh Kurinec, BS, MS, Ph.D., University of Delhi (India)—Professor, Microelectronic Engineering; Electronic Materials and Devices, IC Processing, Quantum and Nanoscale Devices

Kathleen Lamkin-Kennard, BS, Worcester Polytechnic Institute; MS, Ph.D., Drexel University—Associate Professor, Biomedical Engineering, Multi-physics Systems Modeling

Brian J. Landi, BS, MS, Ph.D., Rochester Institute of Technology—Associate Professor, Chemical Engineering, Carbon Nanotubes, Batteries, Wires

Blanca Lapizco-Encinas, B.S., M.S., Instituto Tecnologico de Sonora (Mexico), Ph.D., University of Cincinnati—Associate Professor, Microfluidics, Microscale Electrokinetics and Bioseparations

Zhaolin Lu, BS, Chongqing University (China); MS, Michigan Technological University; Ph.D., University of Delaware—Associate Professor, Photonics and Metamaterials, Electromagnetics, and Nanoelectronics

Stefan Preble, BS, Rochester Institute of Technology; Ph.D., Cornell University—Associate Professor, Nanophotonics, Silicon Photonics, and Optics

Ryne Raffaelle, BS, MS, Southern Illinois University; Ph.D., University of Missouri-Rolla—Vice President for Research and Associate Provost, Professor

Christiaan Richter, BA, BSc, University of Pretoria (South Africa); MS, University of Nebraska at Lincoln; Ph.D., Northeastern University—Assistant Professor, Solar Energy, Nanomaterials, Terahertz Spectroscopy

Sean L. Rommel, BS, Ph.D., University of Delaware—Associate Professor, Microelectronic Engineering; Emerging Semiconductor Devices, Photonic Devices, Integration

Ferat E. Sahin, BS, Istanbul Technical University (Turkey); MS, Ph.D., Virginia Polytechnic Institute—Associate Professor, Electrical Engineering; Artificial Intelligence, Control Systems, Robotics

Michael Schrlau, BS, University of Pittsburgh; Ph.D., University of Pennsylvania—Assistant Professor, Bioengineering and Microsystems

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan—Professor, Chemistry; Organic/Polymer Chemistry: synthesis and device applications of block copolymer systems and nano composites

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

Computer Engineering

CMPE-610 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-251, or graduate standing) **Class 3, Credit 3 (F, S)**

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, EEEE-381) **Class 3, Lab 2, Credit 3 (F, S)**

CMPE-640 Control Systems
This course introduces students to the study of linear control systems, their behavior and design and use in augmenting engineering system performance. This is accomplished through classical control methods that employ the use of Laplace transforms, block diagrams, root locus, and frequency domain diagrams. Topics include: Laplace transform review, system modeling for control, fundamentals of time response behavior, stability analysis, steady-state error and design, feedback control properties, PID control, root locus analysis and design, and frequency response design. **Class 3, Credit 3 (S)**

CMPE-655 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-550) **Class 3, 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) **Class 3, Lab 2, Credit 3 (F)**

CMPE-661 Hardware and Software Design for Cryptographic Applications
The objective of this course is to build knowledge and skills necessary for efficient implementations of cryptographic primitives on reconfigurable hardware. The implementation platform will be a field programmable gate array (FPGA) containing a general purpose processor and additional reconfigurable fabric for implementations of custom hardware accelerators. In the studio format, team projects require design of selected cryptographic primitives followed by comparison and contrast of various implementation alternatives, such as software, custom FPGA hardware, and hybrid hardware-software co-design. Project teams are ideally composed of one computer engineering student and one software engineering or computer science student. Computer engineering students lead the hardware design portions of each project and doftware engineering and computer science students lead the software development portions. Topics may include binary finite field arithmetic, block ciphers, hash functions, counter mode of operation for block ciphers, public key cryptosystems, hardware/software co-design methodologies with FPGAs, software development and profiling, high level synthesis, on-chip buses, hardware/software interfaces, custom hardware accelerators and side channel attacks. (CMPE-260, CMPE-240) **Class 3, Credit 3 (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-220 or CSCI-251) **Class 3, Credit 3 (F)**

CMPE-664 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 system models 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. (SWEN-220 or CSCI-251 or CMPE-380) **Class 3, Credit 3 (S)**

CMPE-665 Performance Engineering of Real-time and Embedded Systems
This course discusses issues of performance in real-time and embedded systems. Techniques for profiling the resource usage of a system and for measuring the effect of increasing system requirements will be covered. The control of physical systems will motivate the need for performance tuning of a real-time system. Students will write programs running under a real-time operating system that can maintain control of a physical system. The course will discuss and experiment with performance trade-offs that can be made using hardware-software co-design. (SWEN-220 or CSCI-251 or CMPE-380) **Class 3, 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 or graduate standing) **Class 3, Credit 3 (F. S)**

CMPE-675 Robotics: Embedded and Autonomous Systems
This course covers an overview of robotics topics with an AI influence. Includes hands-on laboratory with low level microcontroller programming driving a Lynxmotion 4WD chassis. Course has a strong emphasis on robotics related input and output device inter-facing. Course topics include microcontrollers, control systems, vision, path planning localization, and machine learning. Term project of student choosing emphasizes a specific robotic topic. (CMPE-380, CMPE-460, CMPE-480) **Class 3, Lab 2, Credit 3**

CMPE-680 Digital Image Processing Algorithms
Emphasizes both theory and implementation of image processing algorithms. Two-dimensional filtering, sampling, and transforms 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. (CMPE-480 or graduate standing) **Class 3, Credit 3 (F)**

CMPE-685 Computer Vision
This course covers both fundamental concepts and the more advanced topics in computer cision. 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. (CMPE-480 or graduate standing) **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 semester 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 (S)**

CMPE-731 Design and Test of Multi-core Chips
Massive levels of integration following Moore's Law is making modern multi-core chips all-pervasive in several domains ranging from scientific applications like weather forecasting, astronomical data analysis, bioinformatics applications to even consumer electronics. This course introduces students to current and future trends in IC Design. Students learn to identify bottlenecks in designing state-of-the-art multicore System-on-Chips (SoCs) and propose solutions to such design challenges from a cross-layer perspective spanning multiple levels of abstraction in the design process. Low-power and high-speed testing of multicore chips is an important design issue in Design for Testability (DFT) of such massive multicore systems. In this course students learn various issues and solutions to ongoing challenges in SoC testing. The instruction will rely on lectures, textbooks, seminal and cutting edge publication articles and term projects. Students will be evaluated based on homework assignments, class presentations, examinations and projects. (CMPE-530 or 630) **Class 3, Credit 3 (F)**

CMPE-750 Advanced Computer Architecture
The goal of this course is to acquire a good understanding of important current and emerging design techniques, machine structures, technology factors, and evaluation methods that will determine the form of high-performance advanced programmable processor architectures in the 21st Century. The topics covered include Simultaneous Multithreading (SMT), Vector Processing, Digital Signal Processing (DSP), Media Architectures and Processors, Re-Configurable Computing and Processors, Advanced Branch Prediction Techniques, and Redundant Arrays of Disks (RAID). The course also provides an introduction to the main concepts of parallelism including single-chip multiprocessors. (CMPE-550) **Class 3, Credit 3 (S)**

CMPE-755 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 information. (CMPE-380, CMPE-550) **Class 3, Credit 3 (F)**

CMPE-770 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 670) **Class 3, Credit 3 (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 standing) **Class 3, Credit 3**

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-791 Continuation of Thesis

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 4th year status for BS/MS students) **Class 1, Credit 0 (F, S)**

CMPE-796 **Thesis Proposal Seminar**
The objective of this seminar is to engage the students in the preparation and completion of their thesis proposal. The students will learn about the resources available at RIT to support their work as well as general guidelines and practices that should lead to a good thesis proposal. (CMPE-795 Graduate Seminar. In addition, student must have a thesis adviser and a thesis topic.) **Class 1, Lab 0, Credit 0**

CMPE-799 **Independent Study**
Allows graduate students an opportunity to independently investigate, under faculty supervision, aspects of the field of computer engineering that are not sufficiently covered in existing courses. Proposals for independent study activities are subject to approval by both the faculty member supervising the independent study and the department head. (Permission of the supervising faculty member and the department head required.) **Credit variable 1-3**

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 in EE) **Class 3, 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 in EE) **Class 3, Credit 3 (F, S)**

EEEE-605 **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 optical fiber communications, image processing, super-resolution imaging, optical properties of materials, and novel optical materials. Topics covered: geometrical optics, propagation of light, diffraction, interferometry, Fourier optics, optical properties of materials, polarization and liquid crystals, and fiber optics. In all topics, light will be viewed as signals that carry information (data) in the time or spatial domain. After taking this course, the students should have a firm foundation in classical optics. (EEEE-473) Class 3, Credit 3 (S) **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 and 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, and (10) matching. (EEEE-482 or graduate standing in EE) **Class 3, 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 or graduate standing in EE) **Class 3, Credit 3 (F)**

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 or graduate standing in EE) **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 or graduate standing in EE) **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 or graduate standing in EE) **Class 3, Credit 3 (F)**

EEEE-636 **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 2, Credit 3 (S)**

EEEE-647 **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 in EE) **Class 3, 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-414 or equivalent; co-req: EEEE-603) **Class 3, Credit 3 (S)**

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 & 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. (Graduate standing in EE) **Class 3, 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-602, EEEE-603) **Class 3, 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 or graduate standing in EE) **Class 3, Credit 3 (F)**

EEEE-685 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 in EE) **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 in EE) **Class 3, 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. (Graduate standing in EE) **Class 3, 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, synchronization 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-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, EEEE-629) **Class 3, 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 in EE) **Class 3, Credit 3 (F)**

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 in EE) **Class 3, 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 in EE) **Class 3, Credit 3 (F)**

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 (S)**

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 in EE) **Class 3, Credit 3 (F)**

EEEE-721 Advanced Topics in Computer System 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 in EE) **Class 3, 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, and (9) advanced topics in data conversion. (Graduate standing in EE) **Class 3, 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, and (8) phase locked loops. (EEEE-726) **Class 3, 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, H2 and H(spaces, modeling and paradigms for robust control; internal stability; nominal performance (asymptotic tracking); balanced model reduction; uncertainty and robustness; H2 optimal control; H(control; H(loop shaping; controller reduction; and design for robust stability and performance. (EEEE-661) **Class 3, 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, 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) **Class 3, 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 descent, LMS and LMS/Newton algorithm. Noise and misadjustments. Applications will include system identification, deconvolution and equalization, adaptive arrays and multipath communication channels. (EEEE-602, EEEE-603) **Class 3, Credit 3 (S)**

EEEE-777 **Graduate Internship**
Graduate internship is designed to enhance the educational experience of graduate students through full-time paid employment during the summer semester. Students are encouraged to seek full time positions in the electrical and microelectronic engineering field. Registration is optional and is recommended for summer semesters only. Before enrolling, students are required to complete all bridge courses as well as a minimum of 18 graduate credits and receive approval from the graduate program coordinator. (Completion of all required bridge courses as well as a minimum of 18 graduate credit) **Class 0, Lab 0, Credit 0 (Su)**

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, 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, Credit 3 (S)**

EEEE-781 **Image and Video Compression**
This course studies the fundamental technologies used in image and video compression techniques and international standards such as JPEG and MPEG. At the highest level, all visual data compression techniques can be reduced to three fundamental building blocks: transformation or decomposition (examples are discrete cosine transform or DCT, wavelets, differential pulse code modulation or DPCM and motion compensation), quantization (strategies include scalar vs. vector quantization, uniform vs. nonuniform, Lloyd-Max and entropy-constrained quantization) and symbol modeling and encoding (the concept of Markov source and its entropy, context modeling, variable length coding techniques such as Huffman and arithmetic coding and Golomb-Rice coding). This course studies all of these fundamental concepts in great detail in addition to their practical applications in leading image and video coding standards. The study cases include a comprehensive review of the JPEG lossless compression standard (based on pixel prediction and Huffman coding), the JPEG lossy compression standard (based on DCT and Huffman coding), a detailed study of wavelet decomposition and a brief overview of the MPEG family of standards (employing motion compensation in addition to aforementioned techniques). (EEEE-779) **Class 3, Credit 3**

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 pre-requisite 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 in EE) **Class 3, Credit 3 (S)**

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 in EE) **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**
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 required) **Class 0, Credit 1-6 (F, S, Su)**

EEEE-791 **Continuation of Thesis**

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 1-3 (F, S, Su)**

EEEE-793 **Error Detection and Error Correction**
This course covers linear algebraic block codes, convolutional codes, turbo codes, and low-density parity-check codes. The fundamental structure of linear block code will be developed and applied to performance calculations. The structure of cyclic codes will be developed and applied to encoders and decoders. The major error correction methods, including error trapping, majority logic decoding and the BCH encoder and decoder algorithms will be developed. The Viterbi and sequential decoding algorithms will be studied. Questions of system performance, speed and complexity will be examined. **Class 3, Credit 3 (F)**

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 andShannon'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, 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/Ph.D. 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 semesters of this seminar. (Graduate standing in EE) **Class 1, Credit 0 (F, S)**

EEEE-796 **Continuation of Graduate Paper**

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-593 or EEEE-602) **Class 3, 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. (Department approval required) **Class 0, 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. (Graduate student in ISE department) **Class 3, Credit 3 (F)**

ISEE-610 **Systems Simulation**
Computer-based simulation of dynamic and stochastic systems. Simulation modeling and analysis methods are the focus of this course. A high-level simulation language such as Simio, ARENA, etc., will be used to model systems and examine system performance. Model validation, design of simulation experiments, and random number generation will be introduced.

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, Credit 3 (F)**

ISEE-661 **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. (Graduate student in ISE department) **Class 3, 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 two 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**
Computational techniques for solving constrained optimization problems. Linear programming, the Simplex method and variations, duality and sensitivity testing. (ISEE-601 or ISEE-301 or equivalent) **Class 3, 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, 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 3, 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, Credit 3 (F)**

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-510 or ISEE 610 or equivalent) **Class 3, 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-601 or [ISEE-301 and CQAS-251]) **Class 3, 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, 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, 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 bio-instrumentation. (MECE-200 or MECE-103 or graduate student in ISE or ME departments) **Class 3, Credit 3 (S)**

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 graduate student in ISE department or permission of instructor) **Class 3, Credit 3**

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. (4th year standing or greater) **Class 3, Credit 3**

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-140 or MECE-104 or graduate student in ISE or ME departments) **Class 3, 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 MECE-104 or MECE-304 or MECE-305 or graduate student in ISE or ME departments) **Class 3, Credit 3 (F)**

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 semester, 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, Credit 3 (S)**

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. (Fourth-year standing or greater) **Class 3, 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. (Knowledge of probability and statistics) **Class 3, 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-252 or graduate student in ISE department) **Class 3, Credit 3**

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 graduate student in ISE department) **Class 3, Credit 3 (S)**

ISEE-770 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. (ISEE-350) **Class 3, 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. (5th Year and Graduate Students) **Class 3, Credit 3 (F, S)**

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. (ISEE-200 or graduate student in ISE department) **Class 3, Credit 3**

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, Credit 3 (offered on demand)**

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, 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, 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, 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-785) **Class 3, 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 and MECE-304, or graduate student in ISE department) **Class 3, Credit 3 (F)**

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. **Class 3, Credit 3 (offered on demand)**

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) **Credit 1-6 (F, S, Su)**

ISEE-791 Continuation of Thesis

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. (5th year or graduate standing) **Class 3, Credit 3 (F, S)**

ISEE-793 Manufacturing Leadership Capstone
For the MS in manufacturing leadership 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 percent of course work in the manufacturing leadership program) **Class 3, Credit 3 (S)**

ISEE-794 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. **Class 0, Credit 0 (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. **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 percent of course work in the product development program) **Class 3, Credit 3 (F)**

ISEE-798 Product 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, Credit 3 (S)**

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 1-3 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. (Graduate standing) **Class 3, Credit 3 (F, S)**

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) **Class 3, Credit 3 (F, 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 status) **Class 3, Credit 3 (S)**

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) **Class 3, Credit 3 (S)**

MECE-620 **Introduction to Optimal Design**
This course is an introduction to basic optimization techniques for engineering design synthesis. Topics covered include: techmiques, 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 (S)**

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 analyse 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 (F)**

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 (S)**

MECE-629 **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 (F)**

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 (SU)**

MECE-643 **Classical Controls**
This course introduces students 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. Prerequisites: MECE-320 or equivalent course or graduate standing in the MECE-ME or MECE-MS program. **Class 3, Credit 3 (F)**

MECE-644 **Introduction to Composite Materials**
This course is an applied course in the fundamentals and applications of composite materials. Topics covered include constituents of composites of composite materials, fabrication techniques, micromechanical analysis, macromechanical analysis, and the use of composites in design. Some laboratory work will be done, and a major design project is required. Enrollment restrictions: MECE-305, MECE-204 or equivalent

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 (F)**

MECE-689 **Graduate Lower Level Special Topic**
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. **Class 3, 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. (Graduate standing) (F, S, Su)

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, Su)**

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. (Graduate standing) **Class 3, Credit 3 (F, 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 (S)**

MECE-733 **Sustainable Energy Management**
This course 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. (MECE-352, MECE-310) **Class 3, Credit 3 (F)**

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; co-requisites: MECE-601) **Class 3, Credit 3 (F)**

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 (F)**

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 (S)**

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, Nonlinear 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 (S)**

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 (F)**

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 (S)**

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-317, MECE-350) **Class 3, Credit 3 (S)**

MECE-754 **Fundamentals of Fatigue and Fracture**
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 finite element method will be discussed. (MECE-658) **Class 3, Credit 3 (S)**

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 0permission) **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-305) **Class 3, Credit 3 (S)**

MECE-789 **Graduate 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. **Class 3, Credit 3**

MECE-790 **Thesis**
In 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 0-6 (F, S, Su)**

MECE-791 **Continuation of Thesis**

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) **Credit 3 (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 required to attend each semester they are on campus. (Graduate standing) **Class 1, Credit 0 (F, S)**

MECE-796 **Continuation of Graduate Paper**

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. (Graduate standing) **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. 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
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 (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 & 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. (MCEE-601 Microelectronic Fabrication) **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)**

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 (S)**

MCEE-620 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 (F)**

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
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 (S)**

MCEE-706 SiGe and SOI Devices and Technologies
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 (S)**

MCEE-713 Quantum and Solid-state Physics for Nanostructures
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, 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 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). (Graduate standing or permission of instructor) **Class 3, Lab 0, Credit 3 (F)**

MCEE-730 Metrology for Failure Analysis and Yield of Ics
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 or permission of instructor) **Class 3, Lab, Credit 3 (S)**

MCEE-732 Evaluation of Microelectronics 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. (Permission of the department) **Credit 1-4 (F, S, Su)**

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, Credit 1-3 (F, S, Su)**

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; prepare a written paper in a short format suitable for submission for publication in a journal. (Graduate standing in MS in microelectronic engineering, adviser approval) **Credit 1-6 (F, S)**

MCEE-791 Continuation of Thesis
Continuation of Thesis

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 three credits. **Class 1, 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, Su)**

Microsystems Engineering

MCSE-610 Applied Biofluid Mechanics and Microcirculation
Circulation of blood in the body is a complex process. From the engineering point of view, the pressure generated by the heart and the flow dynamics of blood in the blood vessel control the circulation. From the perspective of biology, however, biochemical responses of the heart, blood cells, and blood vessels regulate the blood circulation. Applied Biofluid Mechanics and Microcirculation is a one-semester introductory graduate course that introduces and develops the fundamental understanding of the flow dynamics of blood and flow control from both the engineering and biological perspectives. The course includes a discussion of basic fluid mechanics, blood rheology, and biological regulation of blood flow. Emphasis will be placed on developing a physical understanding of each of the fundamental ideas introduced and how it is applied to in microcirculation. Applications of micro/nanotechnology such as microfluidics in the study of microcirculation, tissue engineering, and blood diagnostic will be also discussed in the class. (Familiarity with basic solution procedures for ordinary and partial differential equations and introductory cell biology) **Class 4, Credit 3 (F)**

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 coursework and research in materials engineering and applications. (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 EM Fields and Transmission Lines 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 EM Fields and Transmission Lines 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, or equivalent) **Class 3, Credit 3 (S)**

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-799 **Independent Study**
This course allows graduate students an opportunity to independently investigate, under faculty supervision, topics related to microsystems engineering. Proposals for independent study activities and assessment are subject to approval by both the supervising faculty member and the department head. (Adviser and department approval required) **Credit variable 1-3**

MCSE-877 **Internship**
Internship is designed to enhance the educational experience of Ph.D. students through full-time employment. (Department approval) **Credit 0 (F, S, Su)**

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 (Ph.D.) status) **Class 3, Credit 3 (F, S, Su)**

MCSE-890 **MCSE-dissertation**
MCSE-Dissertation Research in an appropriate topic as arranged by doctoral candidate and dissertation adviser in fulfillment of the dissertation requirement. **Credit variable 1-27 (F, S, SU)**

MCSE-891 **Continuation of Dissertation**
Continuation of Dissertation

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 of the following: STAT-205 or MATH-252, or CQAS-252, graduate standing in the APPSTAT-MS or SMPPI-ACT or permission of instructor) **Class 3, Credit 3 (F)**

CQAS-614 **Principles of Applied Statistics**
Review of fundamental probability theory; review of key distributions in statistics; probability plotting; linear combinations of random variables; hypothesis testing; confidence intervals and other statistical intervals; use of simulations; importance of assumptions; multiple-comparisons; goodness-of-fit tests. This course does not count as credit toward either the CQAS advanced certificates or MS degree. (MATH-173 or MATH-182 or equivalent course.) **Class 2, Lab 0, Credit 2 (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 of the following: STAT-145, STAT-205, MATH-252, CQAS-252, graduate standing, or permission of instructor) **Class 3, 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. This course does not count as credit toward the CQAS MS degree. (One of the following: STAT-145, STAT-205, MATH-252, CQAS-252, or permission of instructor) **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 of the following: STAT-145, STAT-205, MATH-252, CQAS-252, or permission of instructor) **Class 3, Credit 3 (S)**

CQAS-682 **Lean Six Sigma Fundamentals**
This course presents the philosophy and methods that 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. (Graduate standing or permission of instructor) **Class 3, Credit 3 (F, S, Su)**

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. This course does not count as credit toward the CQAS MS degree. (CQAS-682; co-requisites: CQAS-621, CQAS-670) **Class 3, Credit 3 (F, S)**

CQAS-699 **Graduate Co-op**
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, Latin square designs, incomplete block designs, nested designs, general factorial designs, split-plot designs, two-level fractional factorial designs, and response-surface methodology (One of the following: STAT-205, MATH-252, CQAS-252, or permission of the instructor and CQAS-741 or STAT-305 or permission of instructor; co-requisite: CQAS-511 or 611 or permission of instructor) **Class 3, Credit 3 (F, S)**

CQAS-720 **Mathematics for Statistics**
This is a survey of the mathematical tools of some of the more mathematically 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. Prerequisite(s): MATH-173 or MATH-182A or equivalent course. **Class 2, Lab O, Credit 2 (Su)**

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. (MATH-173 or MATH-282, or permission of instructor and STAT-205, MATH-252, CQAS-252, graduate standing or permission of instructor) **Class 3, Credit 3 (F)**

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) **Class 3, Credit 3 (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. (One of the following: STAT-205, MATH-252, CQAS-252, graduate standing, or permission of instructor; co-requisite: CQAS-511 or CQAS-611 or permission of instructor) **Class 3, Credit 3 (F, S)**

CQAS-747 Principles of Statistical Data Mining
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, na•ve Bayes classifiers, variance reduction methods (bagging) and ensemble methods for predictive optimality. (CQAS-511 or 611, CQAS-722, CQAS-741 or permission of instructor) **Class 3, Credit 3 (F, S)**

CQAS-753 Nonparametric Statistics and Bootstrapping
The emphasis of this course is how to make valid statistical inference in situations when the typical parametric assumptions no longer hold, with an emphasis on applications. This includes certain analyses based on rank and/or ordinal data and resampling (bootstrapping) techniques. The course provides a review of hypothesis testing and confidence-interval construction. Topics based on ranks or ordinal data include: sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, runs tests, chi-square tests, rank correlation, rank order tests, Kolmogorov-Smirnov statistics. Topics based on bootstrapping include: estimating bias and variability, confidence interval methods and tests of hypothesis. (One of the following: STAT-205, MATH-252, CQAS-252, graduate standing, or permission of instructor) Class 3, Lab 0, Credit 3 (Summer-distance)

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 principal components, factor analysis, clustering, and discriminant analysis. (MATH-241, CQAS-721, CQAS-511 or 611, or permission of instructor) **Class 3, Credit 3 (F, S)**

CQAS-758 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 experimental design and analysis, 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. This course is not intended for CQAS students unless they have particular interest in imaging science. CQAS students should be taking the course CQAS-756-Multivariate Analysis. Prerequisites: IMGS-211 or graduate standing in the APPSTAT-MS or STATQL-ACT or SMPPI-ACT program, or graduate standing in IMGS-MS or IMGS-PhD or CLRS-MS or CLRS-PhD **Class 3, Lab 0, Credit 3 (Su)**

CQAS-762 Sas Database Programming
This course focuses on the SAS programming language to read data, create and manipulate SAS data sets, using Structured Query Language (SQL), creating SAS macros, and SAS programming efficiency. This course covers the material required for SAS Base Programming and SAS Advanced Programming " certification exams. (CQAS-511 or 611) **Class 3, Credit 3 (F, S)**

CQAS-773 Time Series Analysis and Forecasting
This 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 nonseasonal models. (CQAS-741) **Class 3, Credit 3 (F)**

CQAS-775 Design and Analysis of Clinical Trials
This is a graduate level survey course that stresses the concepts of statistical design and analysis for clinical trials. Topics include the design, implementation, and analysis of trials, including treatment allocation and randomization, factorial designs, cross-over designs, sample size and power, reporting and publishing, etc. SAS for Windows statistical software will be used throughout the course for data analysis. (One of the following: STAT-205, MATH-252, CQAS-252, graduate standing, or permission of instructor) **Class 3, Credit 3 (F)**

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, Credit 3 (F, S)**

CQAS-786 Advanced Programming in R
This course is a continuation of the R programming language that was begun in CQAS-611. Topics include: more on function writing; ggplot2 graphics; changing text to commands or functions; handling larger data sets, efficiency considerations; simulations; select statistical applications. (CQAS-611 and one of the following: MATH-252, CQAS-252, CQAS-722) **Class 1, Lab 0, Credit 1 (Su)**

CQAS-789 Special Topics
This course provides for the presentation of subject matter of specialized value in the field of applied statistics not offered as a regular part of the program. (Department approval) **Class 3, Credit variable 1- 3 (F, S)**

CQAS-790 Thesis
For students working toward the MS degree who are writing a research thesis. (Department approval) **Credit variable 1-6 (F, S, Su)**

CQAS-791 Continuation of Thesis

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-511 or 611, CQAS-701, CQAS-722, and CQAS-741, or STAT-305) **Class 3, Credit 3 (F, S)**

CQAS-795 Graduate Seminar
This course provides for one or more semesters of study and research activity. This course is required for all first-year full-time funded students in the MS program. (Department approval) **Credit 0 (F, S)**

CQAS-799 Independent Study
Credit will be assigned at the discretion of the department. A written proposal of the work involved will be required of the candidate, and may be modified at the discretion of the faculty involved before approval is given to proceed. (Department approval) **Credit variable 1-3 (F, S)**

College of Health Sciences and Technology

Daniel Ornt, Dean
rit.edu/healthsciences

Programs of Study

Master of Science degrees in:	Page
Health Systems Administration *Concentrations available in: leadership in health care, healing hospitality, and health care operations.*	121

Master of Fine Arts degree in:	
Medical Illustration	122

Advanced Certificates in:	
Finance in Health Care	123

Online learning option available

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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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 of 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.

Health Systems Administration, MS

rit.edu/healthsciences/graduate-programs/health-systems-administration
William W. Walence, Graduate Program Director
(585) 475-4761, wwwihst@rit.edu

Program overview

The MS in health systems administration provides strategic skills for today's health care leaders. Health care is rapidly transforming. The pace of technology, innovation, and government involvement are changing how, when, and where health care is provided, and who is providing it. Concurrently, health care consumers have high expectations for quality and responsiveness to their needs—delivered in a cost-effective manner.

To provide the skills needed for effective health care leadership, the health systems administration program builds on a foundation of courses in health care delivery innovation, systems thinking, quantitative skills, and leadership. The program is focused on, and meets the needs of, health care leaders as defined by professional health care organizations and government agencies.

The program is offered online, allowing students to pursue their degree while maintaining full-time employment in locations around the world. A distinct advantage of the program is the diversity of its student population, allowing for creative discussion and comprehension of global health care issues and how they relate to the standards and practices of the American health care system. The ability to share information and ideas, and to compare and contrast strategies, allows students a level of creativity and scope of practice not found in the traditional classroom.

A new accelerated format reduces the length of the program's courses to eight-week sessions, permitting students to complete their program in half the time of traditional semester-based programs.

Curriculum

The program requires 39 credit hours at the graduate level and can be completed in two years or less. Students may complete the program on a part-time basis. Students must maintain a 3.0 grade point average. Toward the end of their program of study, students complete a capstone project consisting of a community research experience. Upon matriculation, each student works with the program chair to develop a plan of study for their research experience.

Health systems administration, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
HLTH-700	Research Methods	3
HLTH-715	Reinventing Health Care	3
HLTH-710	Health Governance and Economics	3
HLTH-740	Health Care Leadership	3
HLTH-717	Bioethics	3
HLTH-723	Human Resources in Health Care	3
HLTH-730	Finance for Health Care Professionals	3
HLTH-732	Health Insurance and Reimbursement	3
HLTH-737	Lean Sigma Application in Health Care	3
HLTH-760	Health Care Informatics	3
	Free Elective	3
HLTH-720	Health Care Planning	3
HLTH-797	Capstone	3
Total Semester Credit Hours		**39**

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 from 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 credit hours of graduate work in the program.

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.

Medical Illustration, MFA

rit.edu/healthsciences/graduate-programs/medical-illustration/
James Perkins, Graduate Program Director
(585) 475-2443, japfaa@rit.edu

Program overview

A medical illustrator is a professional artist with advanced education in the life sciences and visual communication. Collaborating with scientists and physicians, medical illustrators transform complex information into visual images that are used in education, research, patient care, public relations, legal cases, and marketing efforts.

The MFA program provides training in the biomedical sciences, the principles of visual communication, and a variety of digital media including 2D illustration, 3D computer modeling, animation, and interactive media. Students produce a thesis, which involves independent research and visual problem-solving to communicate a complex scientific subject.

Curriculum

Medical illustration, MFA degree, typical course sequence

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:		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 vertebrate 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, 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 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.

Finance in Health Care, Adv. Cert.

rit.edu/ritonline/programs/5/finance-in-health-care.html
William W. Walence, Graduate Program Director
(585) 475-4761, wwwihst@rit.edu

Program overview

The advanced certificate in finance in health care assists professionals in updating a set of skills or pursuing a career change. The advanced certificate may serve as a stand-alone credential, or, at a later date if a student decides to pursue the MS program in health systems administration, courses may be applied toward the requirements of the MS program. To meet the needs of working professionals, courses are available online.

Curriculum

Finance in health care, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
HLTH-735	Management of Risk in Health Care	3
HLTH-737	Lean Six Sigma in Health Care	3
HLTH-730	Finance for Health Care Professionals	3
HLTH-732	Health Insurance and Reimbursement	3
Total Semester Credit Hours		**12**

Daniel Ornt, BA, Colgate University; MD, University of Rochester—Dean

Health Systems Administration

William W. Walence, BA, MA, Kent State University; Ph.D, Ohio University—Graduate Program Director; Visiting 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—Professor

Health Systems Administration

HLTH-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. (RIT Online) **Class 3, Credit 3 (F, S, Su)**

HLTH-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, critique professional journal articles and prepare 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. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-710 Health Governance 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. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-715 Reinventing Health Care
This course discusses reinventing health care in our country. Specifically the course will review the current status of American health care including research into population demographics and health and the concept of wellness and prevention. Following this a review of international health care models will occur to consider best practice as alternative care models for consideration for the US. Third the students will develop, for their area of interest and expertise a strategy for incremental or radical innovation in how we provide health care to our constituents. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-717 Bioethics
This course will provide students with an ethical framework consisting of knowledge of the principle theories and moral philosophers and their methods to approach decision making. Ethics will be further explored giving consideration of cultural norms and how this influences societal ethical decision making; a review of the ethics of the professions of health care; information about gaining access to the organizations ethical principles and an understanding of personal ethics. Using these as a foundation personal and professional ethics will be explored, developed and a decision making rationale developed through a sequence of exercises requiring ethical decision making related to finance, human resources, clinical issues and personal morality. (RIT Online) **Class 3, Credit 3 (F, S, Su)**

HLTH-720 Health Systems Planning
The goal of the health systems administration department is to prepare students for leadership positions within health care. One area student's may chose to gain strategic skills in is the area of health systems planning. This course will assist in this endeavor, providing students the opportunity to develop and actualize a plan, in measurable terms, and integrate the leadership of the governing board in actualizing the plan. (HLTH-710, HLTH-715, HLTH-730, and RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-723 Human Resources in Health Care
This course focuses on the changing competitive health care environment that has made human capital an organization's key asset, with HR largely responsible for cultivating it. Specifically, students will learn the impact that human capital has on the HR division and function of health care organizations. The focus will be on how the "New HR" has become more strategic and fundamental to a health care organization's success and the need to meet the demands of highly skilled, educated and credentialed health care professionals. (RIT Online) **Class 3, Credit 3 (F, S)**

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 including the mandated data reporting requirements. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-730 Finance for Health Care Professionals
This is an overview course that will provide and in-depth investigation of the financial workings in the health care industry. The course will be presented through the investigation of the operations of various health care settings—hospitals, physicians practices, long term care facilities and home health care providers. The course covers all the essential functions in health care internal financial operations that would be experienced throughout the industry, except for the insurance companies. There are several examples involving physicians practices, inpatient hospitals, clinics, nursing homes, etc. During the course the participants will carefully evaluate what the finance department is expected to accomplish. They will better understand the role of the clinical operations managers in the financial health of an organization. The course is designed to provide an approach that includes some terminology used in accounting, but more so those terms associated with finance. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-732 Health Insurance and Reimbursement
This course provides an in-depth review of the characteristics of successful health insurance plans with emphasis on cost containment and premium control techniques. Emphasis will be placed on learning various cost containment and quality improvement tools of an effective delivery system and how to apply those tolls to different delivery structures. The relationship between shared risk and behavior change is explored as well as basic concepts of health insurance underwriting and the essentials of a successful provider payer partnership. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-735 Management of Risk in Health Care
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. This is a required course in the health systems administration program and assignments/applications are focused on health care issues. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-737 Lean Sigma 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 how the application of Lean-Sigma techniques can improve overall performance. A specific focus of the course is to learn the methodology used to obtain desired results of streamlining operations and enhancing administrative effectiveness in the clinical, administrative and service segments of health care. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-740 Health Care Leadership
Highly trained clinical and administrative professionals drive the nature of work in health care. The purpose of this course is to provide students the opportunity to study leadership theory as it is applied in health care organizations. Leadership theories and applications geared toward professionals working in health service organizations will be emphasized. Students will learn to apply leadership theories via case studies and issue analysis of their active work environments. (RIT Online) **Class 3, Credit 3 (F, S)**

HLTH-745 Healing Cultures Within Health Organizations
This course centers on the leadership's responsibilities and behaviors necessary to redesign 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. (RIT Online) **Class 3, Credit 3 (F, Su)**

HLTH-747 Healing Environments
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. (RIT Online) **Class 3, Credit 3 (F, S, Su)**

HLTH-750 Ethics in Human Subjects Research
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. (RIT Online) **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 for pharmaceutical, medical device, or biologic interventions. (RIT Online) **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. (RIT Online) **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. (RIT Online) **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. (RIT Online) **Class 3, Credit 3 (S)**

HLTH-780 Internship
This course provides the student with the opportunity to apply their graduate course work 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. (RIT Online and dept. permission) **Class 3, Credit 3 (F, S, Su)**

HLTH-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. (RIT Online and dept. permission) **Class 3, Credit 3 (F, S)**

HLTH-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. (RIT Online) **Class 3, Credit 3 (F, S, Su)**

HLTH-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 course work. The candidate must obtain the approval of their graduate adviser who will guide the thesis before registering for this course. (RIT Online and dept. permission) **Class 2-6, Credit 2-6 (F, S, Su)**

HLTH-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. (RIT Online) **Class 3, Credit 3 (F, Su)**

HLTH-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 percent to be successful. Students will have one additional opportunity to pass this examination if their initial attempt results in a failing grade. (RIT Online and dept. permission) **Class 3, Credit 0 (F, Su)**

HLTH-797 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. (RIT Online and HLTH-720) **Class 3, Credit 3 (F, S, Su)**

Medical Illustration

ILLM-601 Human Gross Anatomy
This course provides 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. Students will use contemporary research to accurately define structure and suggest function. Instruction will also focus on lighting and "shader" systems that emphasize form and are consistent with tissue characteristics. **Class 1, Lab 4, Credit 3 (F)**

ILLM-606 3D Animation of Biomedical Forms
This course explores animating biomedical subjects and processes. 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 most effective method for creating motion and transformation. (ILLM-603 3D Modeling of Biomedical Forms) **Class 1, Lab 4, Credit 3 (S)**

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 student web sites designed for allied health instruction. 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 0, Studio 6, 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-618 **Eye Ear and Nose Prosthetics**
This course provides an introduction to the field of anaplastology, a branch of medicine dealing with the prosthetic replacement or correction of an absent, disfigured, or malformed anatomic structure, usually on the face or limbs. Focusing on maxillofacial prosthetics and ocular prosthetics (artificial eyes), students learn the basic technical skills needed for an internship or apprenticeship in this field. (ILLM-601-Human Gross Anatomy) **Class 2, Studio 3, Credit 3 (S)**

ILLM-799 **Independent Study**
Medical Illustration 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. Medical Illustration Independent Study students must obtain permission of an instructor and complete the Independent Study Permission Form to enroll. (Instructor permission) **Class 0, Studio 0, Credit 1-6 (F, S, Su)**

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. **Credit 1-6 (F, S)**

Physician Assistant

PHYA-710 **Graduate Project I**
This is the first of a two-course sequence which will provide the physician assistant student with opportunities to prepare a formal graduate capstone project/paper. Projects may be in the form of a 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 life-long 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 a 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 life-long 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 non-infectious 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 4th 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 fourth year of the PA program) **Class 2, Credit 2 (S)**

PHYA-750 **Pediatrics**
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 course work. (Matriculation into the fourth year of the PA program.) **Credit 4 (F, S, Su)**

PHYA-751 **General Medicine**
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. (Matriculation into the fourth year of the PA program.) **Credit 4 (F, S, Su)**

PHYA-752 **OB/GYN**
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. (Matriculation into the fourth year of the PA program.) **Credit 4 (F, S, Su)**

PHYA-753 **Emergency Medicine**
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. (Matriculation into the fifth year of the PA program.) **Credit 4 (F, S, Su)**

PHYA-754 **Surgery**
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. (Matriculation into the fifth year of the PA program.) **Credit 4 (F, S, Su)**

PHYA-755 **Orthopedics**
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. (Matriculation into the fifth year of the PA program) **Credit 4 (F, S, Su)**

PHYA-756 **Geriatrics**
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. (Matriculation into the fifth year of the PA program) **Credit 4 (F, S, Su)**

PHYA-757 **Psychiatry**
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. (Matriculation into the fifth year of the PA program) **Credit 4 (F, S, Su)**

PHYA-758 **Family Practice**
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. (Matriculation into the fifth year of the PA program) **Credit 4 (F, S, Su)**

PHYA-759 **Elective Rotation**
This mandatory rotation in an elective field of medicine provides additional hands-on clinical exposure and experiences. This builds on solid basic medical knowledge and competencies acquired in the didactic, pre-clinical course work. (Matriculation into the fifth year of the PA program) **Credit 4 (F, S, Su)**

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-761Professional Practice I) **Class 3, Credit 2 (F)**

PHYA-763 **Professional Practice III**
This is the last in a sequence of courses designed for the physician assistant student in the clinical setting. The course will cover areas including professional development, resume 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
cias.rit.edu

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: American Crafts, Art, Design, Film and Animation, Media Sciences, and Photographic Arts and Sciences. 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 Adobe Design Achievement Awards.
- Computer graphics design alumni won an Emmy at the 31st Annual Sports Emmy awards.
- Graphics design alumni have received awards of excellence from the Society of Technical Communications, both locally and internationally.
- 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 Media Sciences 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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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, Film and Animation, and the MFA program in imaging arts (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 schools for American Crafts, Art, and 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 semesters 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, two 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 to 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 and other state-of-the-art 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.
- The Vignelli Center for Design Studies houses the extensive professional archive of Massimo and Lella Vignelli, and offers exhibition space and archival study classrooms for the examination of Modernist design history, theory, and criticism.
- Fully equipped studios for designing, forming, and finishing utilitarian and sculptural objects in clay, glass, metals and wood, including CNC routers and metal cutters. The Sands Family Studios wing houses state-of-the-art hot glass, large-scale metal fabricating, and specialized ceramic kiln areas.
- 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.

School for American Crafts

The programs in the School for American Crafts provide an in-depth artistic approach to crafts with a comprehensive technical education. Our international community of students creates a full spectrum of work including one-of-a-kind pieces, commissions, limited edition work, sculptural work, and work and designs produced for industry. Students are engaged in an intensive studio environment where personal expression and professionalism flourish.

Ceramics, MFA

cias.rit.edu/schools/american-crafts/graduate-ceramics-graduate
Richard Hirsch, Professor
Jane Shellenbarger, Assistant Professor
(585) 475-6114, sac@rit.edu

Program overview

The MFA in ceramics focuses on intellectual and artistic development through an intensive teaching of the aesthetics and techniques of ceramic design. Graduate studio courses, seminar courses, and in-depth critiques, in conjunction with thesis planning and implementation, provide students with a deep understanding of not only their own work, but the work of other students and their peers. Students will examine the creativity, perceptions, aesthetics, and criticism of the work of contemporary artists and craftspeople in courses and discussions. Thesis reviews will track students progress towards the final thesis presentation, which is completed when a formal critique and evaluation is performed by the thesis committee. The MFA program in ceramics strengthens and deepens the understanding of the aesthetics, techniques, and theory of this fine art.

Curriculum

Ceramics, MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CCER-701	Ceramics Graduate Studio I	6
CCER-702	Ceramics Graduate Studio II	6
ARTH-601	Forms of Inquiry	3
ARTH-605	Thinking About Making: The Practice of Art in a Global Society	3
	Open Graduate Elective	9
CGEN-702	Crafts Graduate Seminar	3
Second Year		
CCER-790	Ceramics Thesis Initiation	6
CGEN-703	Thesis Implementation	3
CGEN-704	Thesis Review	3
CCER-890	Ceramics Thesis Resolution	9
	Open Graduate Elective	3
	CIAS Studio Elective	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in ceramics, 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 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 (IELTS) 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 residency program

The School for American Crafts offers a Studio Residency program for students in ceramics, furniture design, glass, and metals and jewelry design. Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted residents are required to register for one independent study credit during each semester of residence.

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 are coordinated and overseen by the faculty in the resident's discipline. 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 faculty in each discipline will make decisions concerning appropriate candidates.

Inquiries should be made to the Studio Residency Program, School for American Crafts, College of Imaging Arts and Sciences, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Furniture Design, MFA

cias.rit.edu/schools/american-crafts/graduate-woodworking-graduate
Richard Tannen, Professor
Andy Buck, Professor
(585) 475-6114, sac@rit.edu

Program overview

The MFA program in furniture design is structured around the individual student's needs, interests, and background. As such, the program seeks to strengthen students' techniques, advance their aesthetic and design sensibilities, and hone their personal expression. The first year of the program exposes students to a broad range of critical issues related to the conception and production of art, serves to inspire and provoke their critical reflection, and facilitate the development of a preliminary thesis topic. In the second year students propose and fully engage in a thesis project, which culminates in a major exhibition in the spring.

Curriculum

Furniture design, MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CWFD-701	Furniture Design Graduate Studio I	6
CWFD-702	Furniture Design 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 Graduate Electives	9
Second Year		
CWFD-790	Furniture Design Thesis Initiation	6
CWFD-890	Furniture Design Thesis Resolution	9
CGEN-703	Thesis Implementation	3
CGEN-704	Thesis Review	3
	Open Graduate Elective	3
	CIAS Studio Electives	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in furniture design, 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 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 Residency program

The School for American Crafts offers a Studio Residency program for students in ceramics, furniture design, glass, and metals and jewelry design. Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted residents are required to register for one independent study credit during each semester of residence.

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 are coordinated and overseen by the faculty in the resident's discipline. 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 faculty in each discipline will make decisions concerning appropriate candidates.

Inquiries should be made to the Studio Residency Program, School for American Crafts, College of Imaging Arts and Sciences, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Glass, MFA

cias.rit.edu/schools/american-crafts/graduate-glass
Michael Rogers, Professor
David Schnuckel, Visiting Professor
Robin Cass, Professor
(585) 475-6114, sac@rit.edu

Program overview

The MFA in glass is a two-year program of study that helps students develop their personal creative voice through intensive research, discussion, critique, and experimentation. Students are provided full access to a complete glass facility and individual studio space to strengthen their technique and to practice designing pieces that flourish their personal expression of the medium. Graduate studio courses, seminar courses, and in-depth critiques are offered in conjunction with thesis planning and implementation to provide students with a deep understanding of this personal craft. Students are exposed 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 thesis exhibition and supporting documentation.

Curriculum

Glass, MFA degree, typical course sequence

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 Graduate Electives	9
Second Year		
CGLS-790	Glass Studio Thesis Initiation	6
CGLS-890	Glass Studio Thesis Resolution	9
CGEN-703	Thesis Implementation	3
CGEN-704	Thesis Review	3
	CIAS Studio Electives	6
	Open Graduate Electives	3
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 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 (IELTS) will be 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 Residency program

The School for American Crafts offers a Studio Residency program for students in ceramics, furniture design, glass, and metals and jewelry design. Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted residents are required to register for one independent study credit during each semester of residence.

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 are coordinated and overseen by the faculty in the resident's discipline. 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 faculty in each discipline will make decisions concerning appropriate candidates.

Inquiries should be made to the Studio Residency Program, School for American Crafts, College of Imaging Arts and Sciences, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

Metals and Jewelry Design, MFA

cias.rit.edu/schools/american-crafts/graduate-metalcrafts-graduate
Leonard Urso, Professor
Carlos Caballero-Perez, Professor
(585) 475-6114, sac@rit.edu

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 MFA in metals and jewelry design provides students a broad exposure to metal working techniques, expands 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. The program is structured on the basis of individual needs, interests, and background preparation, as may be determined through faculty counseling.

Metals and jewelry design, MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CMTJ-701	Metals and Jewelry Design Graduate Studio I	6
CMTJ-702	Metals and Jewelry Design 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 Graduate Elective	9
Second Year		
CMTJ-790	Metals and Jewelry Design Thesis Initiation	6
CMTJ-890	Metals and Jewelry Design Thesis Resolution	9
CGEN-703	Thesis Implementation	3
CGEN-704	Thesis Review	3
	Open Graduate Elective	3
	CIAS Studio Electives	6
Total Semester Credit Hours		**60**

Admission requirements

To be considered for the MFA program in metals and jewelry design, 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 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 Residency program

The School for American Crafts offers a Studio Residency program for students in ceramics, furniture design, glass and metals and jewelry design. Residence positions are limited and are awarded after the review of all applicants' portfolios, transcripts, and references. An interview is required. Accepted residents are required to register for one independent study credit during each semester of residence.

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 are coordinated and overseen by the faculty in the resident's discipline. 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 faculty in each discipline will make decisions concerning appropriate candidates.

Inquiries should be made to the Studio Residency Program, School for American Crafts, College of Imaging Arts and Sciences, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

School of Art

School of Art educates students to be fine artists and illustrators, who contribute to their professions, communicate effectively within their disciplines, have a lifelong attitude of inquiry, and make a positive impact on society. The school's nationally recognized programs balance expression, imaginative problem solving, aesthetic understanding, critical thinking, and creativity within a studio environment.

The school also seeks to encourage imagination, creative ability, and artistic discrimination; to develop the skills essential for professional competence; to relate to the various arts and help students find the means to enjoy them; and to incorporate studies in the College of Liberal Arts for social and cultural growth, inspiring students to make maximum contributions as creative artists and citizens.

Art Education (Visual Art–All Grades), MST

cias.rit.edu/schools/art/graduate-teaching-visual-arts
Thomas R. Lightfoot, Program Director
(585) 475-7562, facpgd@rit.edu

Program overview

The MST in art education (visual art–all grades) leads to initial/professional New York state certification in visual arts for grades K through 12. This certification allows applicants to teach in New York state public schools. The program features pedagogical studies, studio inquiry, and student teaching. The program prepares students to meet the national, state, and regional need for teachers of the visual arts and is 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

Art education (visual art-all grades), MST degree, typical course sequence

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
ARED-711	Professional Practices	3
ARED-790	Student Teaching	9
ARED-890	Graduate Seminar in Art Education	6
	Graduate Studio Elective	3
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 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.
- Complete a graduate application.

Fine Arts Studio, MFA

cias.rit.edu/art/
Elizabeth Kronfield, Associate Professor
(585) 475-7562, facpgd@rit.edu

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 on a professional level. Students 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

Fine arts studio, MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
	Fine Art Studio Major Courses	15
ARTH-601	Forms of Inquiry	3
ARTH-605	Thinking About Making	3
FNAS-702	Fine Art Research	3
	Art History Course	3
	Open Elective	3
	Studio Elective	3
Second Year		
	Fine Art Studio Major Courses	9
FNAS-606	Business Practices	3
FNAS-890	Research and Thesis	10
	Studio Elective	3
	Open Elective	3
Total Semester Credit Hours		**61**

Non-toxic Printmaking, Adv. Cert.

Glen Hintz, Administrative Chair
(585) 475-2161, grhfad@rit.edu

Program overview

The advanced certificate in non-toxic printmaking offers technical training and retraining for artists and printmaking professionals seeking a comprehensive working knowledge of non-toxic printmaking techniques, including a study of methodology and aesthetic applications.

Curriculum

Non-toxic printmaking, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
FNAS-607	Non-Toxic Printmaking I	6
FNAS-608	Non-Toxic Printmaking II	6
Total Semester Credit Hours		**12**

Admission requirements

To be considered for admission to the advanced certificate in non-toxic printmaking, candidates must fulfill the following requirements:

- Hold a BFA, MFA, or be recognized as a master printer or professional print maker,
- 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.

Additional information

Gainful employment

Information regarding costs and the U.S. Department of Labor's Standard Occupational Classification (SOC) code and occupational profiles for this program can be viewed at rit.edu/programs/gedt/nontoxicprintmaking.

School of Design

The School of Design provides quality design education and preparation for professional practice. Our internationally recognized programs educate students to be designers who make valuable contributions to their professions, communicate effectively, maintain a lifelong attitude of inquiry, and make a positive impact on society. Within the school programs, faculty, and students form an inquisitive and dynamic educational community in which creativity, critical thinking, innovative problem solving, aesthetic understanding, cross-disciplinary study, professionalism, and social responsibility are explored, cultivated, and promoted.

Industrial Design, MFA

cias.rit.edu/schools/design/graduate-industrial-design
Stan Rickel, Graduate Director
(585) 475-4745, srrfaa@rit.edu

Program overview

The master of fine arts degree in industrial 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

Industrial design, MFA degree, typical course sequence

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 Graduate 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 Graduate Elective	9
Total Semester Credit Hours		**60**

Visual Communication Design, MFA

cias.rit.edu/schools/design/graduate-visual-communication-design
Chris Jackson, Graduate Program Director
(585) 475-5823, cbjpgd@rit.edu

Program overview

The changing landscape of people's everyday interactions has blurred the lines between respected design fields giving designers new responsibilities to shape experiences. Designers must increase their knowledge in all areas of design, including print media, human-computer interaction design, motion graphics, and 3D digital graphics.

The MFA in visual communication design provides a learning environment for advancement in innovative research, user-centered design, and professional practice focusing on the creative potentials of visual communication through a full spectrum of media. Students may advance their design knowledge and technical skills by choosing one of three options: communication design, interaction design, or motion and 3D digital design.

The cross-disciplinary nature of the program offers a greater potential to foster innovation and creativity in visual communication design. The program reflects the current views and changes occurring in the professional design field. The skill sets required of graphic, interactive, and digital design have now crossed over and are interrelated.

Curriculum

Visual communication design (communication design option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-701	Design History Seminar	3
VCDE-706	3D Modeling and Motion	3
VCDE-707	Web and UI Design	3
VCDE-708	Typography	3
VCDE-709	Digital Design in Motion	3
VCDE-711	Design Theory and Methods Seminar	3
VCDE-717	Design Systems	3
VCDE-718	Project Design and Implementation	3
VCDE-723	Interaction Design	3
	Open Elective	3
Second Year		
VCDE-732	Branding and Identity Design	3
VCDE-741	Environmental Graphic Design	3
VCDE-742	Information Design	3
VCDE-746	Professional Practices	3
VCDE-790	Thesis Research and Planning	3
VCDE-890	Thesis Implementation and Evaluation	6
	Open Elective	9
Total Semester Credit Hours		**60**

Visual communication design (interaction design option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-701	Design History Seminar	3
VCDE-706	3D Modeling and Motion	3
VCDE-707	Web and UI Design	3
VCDE-708	Typography	3
VCDE-709	Digital Design in Motion	3
VCDE-711	Design Theory and Methods Seminar	3
VCDE-718	Project Design and Implementation	3
VCDE-723	Interaction Design	3
IGME-601	Programming for Designers	3
	Open Elective	3
Second Year		
VCDE-733	Digital Media Integration	3
VCDE-741	Environmental Graphic Design	3
VCDE-742	Information Design	3
VCDE-746	Professional Practices	3
VCDE-790	Thesis Research and Planning	3
VCDE-890	Thesis Implementation and Evaluation	6
	Open Elective	9
Total Semester Credit Hours		**60**

Visual communication design (motion and 3D digital design option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
VCDE-701	Design History Seminar	3
VCDE-706	3D Modeling and Motion	3
VCDE-707	Web and UI Design	3
VCDE-708	Typography	3
VCDE-709	Digital Design in Motion	3
VCDE-711	Design Theory and Methods Seminar	3
VCDE-716	3D Particles and Dynamics	3
VCDE-718	Project Design and Implementation	3
VCDE-728	Motion Graphics	3
	Open Elective	3
Second Year		
VCDE-731	3D Visual Design	3
VCDE-733	Digital Media Integration	3
VCDE-741	Environmental Graphic Design	3
VCDE-746	Professional Practices	3
VCDE-790	Thesis Research and Planning	3
VCDE-890	Thesis Implementation and Evaluation	6
	Open Elective	9
Total Semester Credit Hours		**60**

Admission requirements

To be considered for admission to the MFA program in visual communication design, 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 strong design skills, 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,
- Complete a graduate application.

Portfolio

A 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 of a candidate's design skills, aesthetic development, and maturity.

The portfolio must demonstrate a strong understanding of design principles and visual computer skills using Adobe products, including Photoshop, Illustrator, and InDesign. A portfolio of 10-15 examples representing a cohesive body or bodies of recent work should be uploaded to rit.slideroom.com, the college's portfolio website, or via a personal website.

Examples must demonstrate a good sense of design, typography, and digital illustration in addition to the applicant's interests in and aptitudes for advanced study and, specifically, potential for success at RIT. Applicants are encouraged to submit only their best original work. Applicants

should not submit work copies from film, television, photographs, magazine/book illustrations, or other sources.

Application deadline
The application deadline is February 15th. Admission selection for the fall semester is made in the spring from among all portfolios and completed applications submitted. Acceptance after February 15th is based upon available space and accepted applicants may be placed on a waiting list.

School of Media Sciences

The rapid innovation of digital technology has blurred the roles that traditionally differentiated printers, publishers, advertising agencies, graphic designers, website developers, and mail and fulfillment houses. The School of Media Science's MS program in print media develops and enhances the individual talents and skills of our students as they learn on more than $40 million in state-of-the-art equipment in 17 laboratories.

Print Media, MS

cias.rit.edu/schools/media-sciences/graduate-graduate-print-media

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 36 semester credit hours of study and includes six core courses, four electives, and a thesis.

Electives
Electives 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.

Print media, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
PPRT-601	Materials and Processes in Printing	3
PPRT-602	Tone and Color Analysis	3
PPRT-603	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**

School of Film and Animation

Because majors offer more production experience than any other school in the country, the School of Film and Animation draws students from all over the world. The school recognizes the increasingly interdependent relationships among film technology, video, animation, and the computer. As a result, hands-on experience in all areas of study is essential while students specialize in their medium of choice.

Film and Animation, MFA

cias.rit.edu/schools/film-animation/graduate-film-and-animation
Malcolm Spaull, Chair of Film and Animation
(585) 475-2779, mgscdm@rit.edu

Program overview

The MFA program in film and animation enjoys state-of-the-art facilities. Students can create 2D and 3D 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, information technology, and printing.

Goals

The program provides 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

The MFA in film and animation offers four options:

(1) 2D animation concentrates on traditional forms drawn by hand, a mixture of both traditional and digital, or all digital origination. Students may concentrate their studies on stop motion puppet animation.

(2) 3D animation courses focus on advanced 3D modeling, lighting, texturing, and animating in a 3D space.

(3) Production allows students to develop and refine their creative approach to fictional narrative, documentary, and experimental work.

(4) Scriptwriting is an opportunity for students to complete short films with a concentration in creating feature length screenplays.

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 in the third year.

A minimum of 65 semester credit hours of graduate work is outlined below. The curriculum does not include bridge work, which refers to any undergraduate work required by action of the admission committee in accepting a particular applicant who may be deficient in a particular area, nor does it include undergraduate prerequisites for graduate courses.

Film and animation (2D animation option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-605	Basic Sound Recording	3
SOFA-610	Graduate Seminar	2
SOFA-611	History and Aesthetics of Animation	3
Choose one of the following:		3
SOFA-603	2D Animation I: Fundamentals	
SOFA-617	Stop Motion Puppet Fundamentals	
SOFA-622	30-Second Film	3
SOFA-625	Animated Acting Principles	3
SOFA-627	Pre-production for Animators	3
Choose one of the following:		3
SOFA-604	2D Animation II: Mechanics	
SOFA-623	Stop Motion Master Class	
SOFA-628	Animation Writing and Visual Storytelling	3
SOFA-630	Animation Film Language	2
Second Year		
SOFA-717	Animation Workshop	4
SOFA-725	Business Careers and Animation	3
SOFA-748	Concept and Character Design	3
SOFA-780	Thesis Preparation Seminar	1
	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

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-605	Basic Sound Recording	3
SOFA-610	Graduate Seminar	2
SOFA-611	History and Aesthetics of Animation	3
SOFA-615	3D Animation Fundamentals	3
SOFA-622	30-Second Film	3
SOFA-625	Animated Acting Principles	3
SOFA-627	Pre-production for Animators	3
SOFA-628	Animation Writing and Visual Storytelling	3
SOFA-630	Animation Film Language	2
SOFA-695	Advanced 3D Animation	3
Second Year		
SOFA-675	3D Lighting and Texturing	3
SOFA-717	Animation Workshop	4
SOFA-725	Business Careers and Animation	3
SOFA-780	Thesis Preparation Seminar	1
	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 (production option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-602	Production Processes	4
SOFA-605	Basic Sound Recording	3
SOFA-606	Directing the Actor for F & V	3
SOFA-610	Graduate Seminar	2
SOFA-613	Graduate Screenwriting I	3
SOFA-621	Spring Film	3
	History and Aesthetics Elective	3
SOFA-626	Writing the Short Film	3
Second Year		
SOFA-721	Fall Film	3
SOFA-735	Business and Careers in Film	3
SOFA-763	Cinematography and Lighting	3
SOFA-780	Thesis Preparation Seminar	1
	History & Aesthetics Elective	3
	SOFA Electives	9
	Free Electives	6

COURSE		SEMESTER CREDIT HOURS
Third Year		
SOFA-790	Research and Thesis I	4
SOFA-890	Research and Thesis II	4
Total Semester Credit Hours		**63**

Film and animation (scriptwriting option), MFA degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
SOFA-601	Graduate Production	3
SOFA-602	Production Processes	4
SOFA-605	Basic Sound Recording	3
SOFA-606	Directing the Actor for Film and Video	3
SOFA-610	Graduate Seminar	2
SOFA-613	Graduate Screenwriting I	3
SOFA-621	Spring Film	3
SOFA-626	Writing the Short Film	3
	History and Aesthetics Elective	3
Second Year		
SOFA-663	Writing the Feature I	3
SOFA-664	Writing the Feature II	3
SOFA-721	Fall 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		**63**

Electives

SOFA 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.

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, drawings, paintings, sculpture, stop motion puppets, scripts, storyboards, and original music.

Applicants must present what they consider to be the best of their work, not all of their work. Films or videos should total 12-minutes or less. A complete work is preferable to a demo reel. If there are no short works then a 12-minute excerpt of a longer piece is acceptable.

Applicants must place their portfolios on a Web or FTP site, such as Vimeo or YouTube, which can be easily accessed by RIT faculty for review. Your application should include a URL Web or FTP address to your online portfolio. If your portfolio is placed on a shared Web or FTP site that contains other files, be sure the file name contains your full name (which must match the name used on your application materials). When applicable, please include any usernames and/or passwords necessary for access to your portfolio. Please provide an inventory sheet or table of contents with your portfolio, and if it is not obvious, clearly indicate what your combination was to group and collaborative pieces. This can be a separate description or can be included in the portfolio presentation.

Applicants are also required to produce a 2 to 3 minute video self-portrait to accompany the online portfolio. This should include information about the applicant such as why you want to attend the School of Film and Animation, which concentration you wish to pursue, and why. Please include information about one significant accomplishment you have made. Sound and picture quality should be clear.

For more information about portfolio guidleines as well as assistance in uploading an online portflio, contact Graduate Enrollment Services.

Transfer credit

Graduate-level course work taken prior to admission should be submitted for approval upon entrance into the program. Up to 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

Students must maintain a B (3.0) average GPA to meet graduation requirements for the MFA. Thesis hours are usually completed over several semesters. Acceptance or rejection of the thesis is made by the candidate's thesis board and the graduate faculty.

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.

Screenings

Screenings are required for all student-produced films and are coordinated through the professor or the thesis chair.

School of Photographic Arts and Sciences

The School of Photographic Arts and Sciences prepares students for a wide range of careers in photographic and related imaging fields. The principles of imaging are taught through courses investigating the tools and processes used to make pictorial-, data-, and information-based images. Students are encouraged to take advantage of Rochester's historic connection with photography. A comprehensive schedule of activities and events—including exhibitions, lectures, seminars, and visiting artists—is offered by the city's array of cultural institutions.

Imaging Arts, MFA

photography.rit.edu
Christine Shank, MFA Director,
School of Photographic Arts and Sciences
(585) 475-2884, crspph@rit.edu

Program overview

The MFA 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 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 students to seek careers in education, museum or gallery work, or as self-employed visual artists.

Program goals

The program provides 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, and
- encourage a sense of community, creativity, scholarship, and purpose.

Accreditation

The MFA program in imaging arts and the BFA program in photographic and imaging arts are accredited by the National Association of Schools of Art and Design (NASAD).

Curriculum

Imaging arts, MFA degree, typical course sequence

COURSES		SEMESTER CREDIT HOURS
First Year		
PHGR-701	Histories and Aesthetics of Photography I	3
PHGR-702	Histories and Aesthetics of Photography II	3
PHGR-703	Imaging Core I	3
PHGR-704	Imaging Core II	3
PHGR-711	Graduate Seminar	3
PHGR-722	Contemporary Issues	3
ARTH-605	Thinking about Making: The Practice of Art in a Global Society	3
	Professional Electives	9
Second Year		
PHGR-721	Research Core I	3
PHGR-723	Research Core II	3
PHGR-724	Professional Development for the Emerging Artist	3
PHGR-890	Thesis	12
	Professional Electives	9
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.

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. Thesis publication will be prepared for inclusion in the 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, 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,
- Submit an artist statement,
- Participate 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 submit a portfolio of 20 images representing a cohesive body or bodies of recent work. Images can be uploaded to rit.slideroom.com, the college's portfolio website, or via a personal website. An artist's statement accompanies the portfolio, addressing the work being presented and its creative process.

Admission selection for the fall semester 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:

- Submit a portfolio of no more than 20 images to the College's portfolio website rit.slideroom.com or via a personal website. (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 viewed.
- Include a numbered page detailing portfolio 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.

Additional information

Faculty

Thirteen 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 supported by a staff of 30 full-time faculty members from the schools of Art and Photographic Arts and Sciences, faculty from the art history department, 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. To learn about the MFA faculty, facilities, equipment cage, MFA events and curriculum, please visit the school's website at https://photography.rit.edu.

Scholarships and graduate assistantships

All accepted applicants are awarded a university scholarship. Level of scholarship support is based on merit of application materials. Concurrently, the MFA program faculty grants graduate assistantships to all accepted applicants. Assistantships include a variety of postions, including team teaching, faculty assistant, gallery management and staff, among others. Upon acceptance into the MFA program, applicants are notified by the MFA director as to level of support for both the university scholarship and the graduate assistantship. Both scholarship and assistantship are renewable in the second year of graduate study.

Transfer credit

Graduate-level course work completed prior to admission should be submitted for approval upon entrance into the program. Up to 8 semester hours of graduate work with a minimum grade of a B (3.0) 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 degree. Thesis hours are usually taken over several semesters. 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.

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.

William Harris Gallery

William Harris Gallery (cias.rit.edu/spas-gallery/) supports the exhibition of graduate thesis work, student work, and the works of contemporary imagemakers. It maintains a 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 as a gallery manager or staff member.

Lorraine Justice, BFA, Edinboro University; MFA, Ph.D., The Ohio State University—Dean

School of Art

Michael Amy, BA, Vrige Universiteit Brussel (Belgium); MA, Ph.D., New York University—Professor

Donald Arday, BFA, Cleveland Institute of Art; MFA, Syracuse University—Professor

Robert Dorsey, BFA, Rochester Institute of Technology; MFA, Syracuse University—Professor

William Finewood, BA, State University College at Geneseo; MFA, Syracuse University—Associate Professor

Glen R. Hintz, BA, Lafayette College; MS, The Medical College of Georgia—Administrative Chair, School of Art, 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—Graduate Director, Art Education (Visual Arts-All Grades); Associate Professor

Heidi Nickisher, BA, University of California at Santa Barbara; MA, California State University, Fullerton—Senior Lecturer

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

Sarah Thompson, BA, University of California at San Diego; MA, Ph.D., University of California at Santa Barbara—Assistant Professor

School of Design

Deborah Beardslee, BFA, Syracuse University; MFA, Virginia Commonwealth University—Associate Professor

Peter Byrne, MFA, York University (Canada)—Administrative Chair, School of Design; Associate Professor

Nancy A. Ciolek, BFA, MFA, Indiana State University—Program Chair, Graphic Design; Associate Professor

Daniel DeLuna, BFA, Ball State University; MFA, Pratt Institute—Associate Professor

Carol Fillip, BS, State University of New York at Buffalo; MFA, Rochester Institute of Technology—Assistant Professor

Shaun Foster, BBA, University of Wisconsin; MFA, Rochester Institute—Assistant Professor

Lorrie Frear, BFA, MFA, Rochester Institute of Technology—Assistant Professor

Mitch Goldstein, BFA, Rhode Island School of Design; MFA, Virginia Commonwealth University—Assistant Professor

Joyce Hertzson, BFA, Rhode Island School of Design; MFA, Indiana University—Professor

Chris B. Jackson, BFA, Alfred University; MFA, Rochester Institute of Technology—Graduate Director, Visual Communication Design; Associate Professor

Alex Lobos, BA, Universidad Rafael Landivar (Guatemala); MFA, University of Notre Dame—Assistant Professor

Bruce I. Meader, BFA, MFA, Carnegie Mellon University—Associate Professor

Josh Owen, BA, BFA, Cornell University; MFA, Rhode Island School of Design—Program Chair, Industrial Design; Associate Professor

R. Roger Remington, BFA, Rochester Institute of Technology; MS, University of Wisconsin—Professor

Stan Rickel, BID, Pratt Institute; MID, Syracuse University—Graduate Director, Industrial Design; Associate Professor

Marla Schweppe, BA, University of Kansas; MA, The Ohio State University—Professor; Director of Visualization

Kim Sherman, BS, State University College at Cortland; MFA, Rochester Institute of Technology—Senior Lecturer

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—Administrative Chair, School for American Crafts, Professor, Metals

Robin Cass, BFA, Rhode Island School of Design; MFA, State University of New York College of Ceramics at Alfred University—Professor

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

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

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, 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

Roberley Bell, BFA, University of Massachusetts at Amherst; MFA, State University of New York College of Ceramics at Alfred University—Professor

Eileen Bushnell, BFA, University of Massachusetts at Amherst; MFA, Indiana State University—Associate Professor

Frank Cost, BS, Eisenhower College; MS, Rochester Institute of Technology—Program Chair, Visual Media; Professor

Gregory Halpern, 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—Program Chair, Advertising Photography; Associate Professor

Dan Larkin, BFA, Rochester Institute of Technology; MFA, Bard College—Associate Professor

Therese Mulligan, BA, University of Missouri-Kansas City; MA, Michigan State University; Ph.D., University of New Mexico—Administrative Chair, Photographic Arts and Sciences; Professor

Oscar Palacio, MFA, Massachusetts College of Art and Design; MA, University of Miami—Assistant Professor

Ahndraya Parlato, BA, Bard College; MFA, California College of the Arts—Lecturer

Laurie O'Brien, MFA, California Institute of the Arts—Assistant Professor

Willie Osterman, MFA, University of Oregon—Program Chair, Fine Art Photograhy; Professor

Patricia Russotti, BS, Empire College; MS, Ed.S., Indiana University—Associate Professor

Christine Shank, MFA, Miami University; MFA, Texas Woman's University—Graduate Director, Imaging Arts MFA; Assistant Professor

Ken White, BA, Princeton University; MA, MFA, University of New Mexico—Associate Professor

Carla Williams, BA, Princeton University; MFA, University of New Mexico—Assistant Professor

School of Media Sciences

Barbara Birkett, BA, Aquinas College; MBA, Rochester Institute of Technology; CPA, Maryland—Associate Processor

Christopher Bondi, BS, New York Institute of Technology; MS, Rochester Institute of Technology—Gannet Distinquished Professor; Professor

Shu Chong, BS, Bevea College; Ph.D., University of Minnesota—Melbert B. Cary Distinguished Professor

Robert Y. Chung, BS, Eastern Washington State University; MS, Rochester Institute of Technology—Gravure Research Professor

Elena Fedorovskaya, MSc., Ph.D., Lomonosov Moscow State University—Paul and Louise Miller Distinguished Professor

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

Patricia Sorce, BA, Kent State University; MS, Ph.D., University of Massachusetts—Graduate Coordinator Print Media; Associate Professor, Roger K. Fawcett Professor

Interdisciplinary Imaging Arts

ITDI-776 **College Teaching and Learning**
This course will provide students with an introduction to the scholarship of teaching and learning in the university environment. Students will explore a range of perspectives on pedagogical practice, curriculum development and the assessment of learning in a studio, lab and seminar based classroom. Additionally, students will focus on ways that students learn, how learning can be improved, and different methods of conducting research into teaching and learning. 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)**

School for American Crafts

Ceramics

CCER-620 **Ceramics Elective II**
This class is specifically designed for non-majors covering the fundamental techniques and aesthetics of working with clay. Topics covered include the forming techniques, clay mixing, basic properties of clay, glazing and firing techniques and fundamental understanding of historical and contemporary practices and applications. The course includes prescribed projects. Lab fee is required. **Studio 4, Credit 3 (F, S)**

CCER-630 **Ceramics Elective III**
This is a class specifically designed for non-majors covering the fundamental techniques and aesthetics of working with clay. Topics covered include the forming techniques, clay mixing, basic properties of clay, glazing and firing techniques and fundamental understanding of historical and contemporary practices and applications. The course includes prescribed projects. Lab fee is required. **Studio 5, Credit 3 (F, S)**

CCER-698 **Ceramics Internship**
The Ceramics Internship will provide students with the option to work in the ceramics 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. **Credit 3 (F, S)**

CCER-699 **Ceramics Co-op**
The Ceramics Co-op will provide students with the option to work in the ceramics field or ceramics industry. Students may apply for co-op employment to businesses based on the availability of positions and business job needs. Ceramics co-ops must be approved and sponsored by a faculty adviser. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All Co-ops must fall within an RIT term. **Credit 0 (F, S)**

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 arts 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-799 **Ceramics Independent Study**
Ceramics 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. Ceramics Independent Study students must obtain permission of an instructor and complete the Independent Study Permission Form to enroll. **Credit 1-6 (F, S)**

CCER-890 **Ceramics Thesis Resolution**
Ceramics Thesis Resolution is the 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 Crafts 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 Metalcrafts and Jewelry Graduate Studio I, CWFD-701 Furniture Design Graduate Studio I) **Class 3, Credit 3 (S)**

CGEN-703 **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 Il, CGLS-701 Glass Graduate Studio Il, CMTJ-701 Metalcrafts and Jewelry Graduate Studio I, CWFD-701 Furniture Design Graduate Studio I) **Class 3, Credit 3 (F)**

CGEN-704 **Thesis Review**
This course is a continuation of the process begun in CGEN-703 Thesis Implementation, coordinated and overseen by the SAC graduate director and chief thesis adviser, will monitor the progress of a graduate student in the development of their written thesis as defined in the SAC Graduate Handbook. 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 their written thesis based on the Timeline for the written thesis defined in the Handbook. A final and formal thesis critique by the student's thesis committee will take place at the end of the semester. Students will submit their finished and thesis committee-approved written thesis as the culminating experience in this course. **Class 3, Credit 3 (S)**

CGEN-892 **Continuation of Thesis: School for American Crafts**
The School for American Crafts Continuation of Thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. **Credit 0 (F, S)**

Glass

CGLS-620 Graduate Crafts Glass Elective II
This course, designed for non-majors, will introduce the beginner to the glass studio and to glass as a creative material. Students will learn the basic skills of forming glass in the molten state. Both functional and sculptural approaches will be practiced. This course is project based.Lab fee is required. **Studio 4, Credit 2 (F, S)**

CGLS-630 Graduate Crafts Glass Elective III
This is a class specifically designed for non-majors covering the fundamental techniques and aesthetics of working with glass. Topics covered include glass forming techniques, basic properties of glass, cold-working and hot-working techniques and fundamental understanding of historical and contemporary practices and applications. The course includes prescribed projects.Lab fee is required. **Studio 6, Credit 3 (F, S)**

CGLS-698 Glass Graduate Internship
Glass graduate internship is a course that offers students the chance to take advantage of professional opportunities as they arise during their graduate studies. This course is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. This course leads to the master's thesis, proposed by the student and approved by the faculty. **Credit 1-6 (F, S, Su)**

CGLS-699 Glass Graduate Co-op
This course will examine professional opportunities present outside the major studio at RIT or other studios or educational institutions. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term (F, S, Su) **Credit 0 (F, S, Su)**

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-799 Glass Graduate Independent Study
Glass 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 will propose a course of study. Students will produce projects specific to their proposal. (Permission of instructor) **Credit 1-6 (F, S)**

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) **Studio 18, Credit 9 (S)**

Metals and Jewelry Design

CMTJ-620 Metals and Jewelry Design Elective II
An elective course providing an opportunity for introductory study in metals: either hollowware or jewelry. Development of metals techniques, design fundamentals and encouragement of personal expression will be encouraged. The student will learn to evaluate new techniques, materials and concepts. Slide lectures, technical demonstrations, field trips, hands-on experience and critiques will be used. Lab fee is required. **Studio 4, Credit 2 (F, S)**

CMTJ-630 Metals and Jewelry Design Elective III
An elective course providing graduate-level students an opportunity for introductory study in metals: either hollowware or jewelry. Students will gain an understanding of the history of metals. Development of metals techniques, design fundamentals and encouragement of personal expression are encouraged. The student will learn to evaluate new techniques, materials and concepts. Slide lectures, technical demonstrations, field trips, hands-on experience and critiques will be used. Lab fee is required. **Studio 6, Credit 3 (F, S, Su)**

CMTJ-698 Metals and Jewelry Design Graduate Internship
This internship is open to all metals graduate students with a minimum of a 3.0 GPA. Metals 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 metals and jewelry design 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 job site supervisor. 90 hours of work earns one semester credit. (Permission of Department) **Credit 1-6 (F, S, Su)**

CMTJ-699 Metals and Jewelry Design Graduate Co-op
The Metal and Jewelry Design Graduate Co-op will provide students with the option to work in the metals and jewelry design industry. Students may apply for co-op employment to businesses based on the availability of positions and business job needs. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term. (Permission of department) **Credit 0 (F, S, Su)**

CMTJ-701 Metals and Jewelry Design Graduate Studio I
This is the first of a two-semester sequential series 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. Lab fee is required. **Studio 18, Credit 6 (F)**

CMTJ-702 Metals and Jewelry Design Graduate Studio II
This is the second of a two-semester sequential series 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) Lab fee is required. **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) Lab fee is required. **Studio 18, Credit 6 (S)**

Textiles

CWTD-630 **Quilting Graduate Elective**
This course will introduce the beginner to the textile studio and to textiles as a creative material. Particularly the art of quilting. The students will acquire the ability to sew by hand and by machine. Lectures will include topics such as quilt design, fabric surface design, the history of quilting and techniques of quilting. Lab fee is required. **Lab/Studio 6, Credit 3 (F, S)**

CWTD-799 **Graduate Textiles Independent Study**
Textiles 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. **Credit 1-6 (F, S)**

Furniture Design

CWFD-620 **Furniture Design Elective II**
This is a class designed for non-majors, covering a fundamental introduction to techniques and aesthetics of woodworking. Topics covered include the use of select hand tools and woodworking power tools, wood as a material, its basic properties and fundamental processes of wood fabrication. The course includes a prescribed project based on number of in-class studio hours (4). Lab fee is required. **Studio 4, Credit 2 (F, S)**

CWFD-630 **Furniture Design Elective III**
This is a class designed for non-majors, covering a fundamental introduction to techniques and aesthetics of woodworking. Topics covered include the use of select hand tools and woodworking power tools, wood as a material, its basic properties and fundamental processes of wood fabrication. The course includes a prescribed project based on five in-class contact hours. Lab fee is required. **Class 1, Lab 4 (F, S)**

CWFD-698 **Furniture Design Internship**
The Furniture Design Internship will provide students with the option to work in the furniture design or furniture manufacturing 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. Registration with co-op and placement office also required. (Permission of department) **Credit 1-6 (F, S)**

CWFD-699 **Furniture Design Co-op**
The Furniture Design Co-op will provide students with the option to work in the furniture design or furniture manufacturing field. Students may apply for co-op employment to businesses based on the availability of positions and business job needs. Furniture Design co-ops must be approved and sponsored by a faculty adviser. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term. (Permission of department) **Credit 0 (F, S, Su)**

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**
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) Lab fee is required. **Studio 18, Credit 6 (F)**

CWFD-799 **Furniture Design Independent Study**
Furniture Design 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. Furniture design students must obtain permission of an instructor and complete the Independent Study Form to enroll. (Permission of instructor) **Credit 1-6 (F, S)**

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, design fundamentals and encouragement of personal expression. (CWFD-780 Furniture Design Thesis Initiation) Lab fee is 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**
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 collobrate 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 and 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)**

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 six to seven 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; co-requisite: ARED-890 Graduate Seminar In Art Education) **Class 28, Credit 6 (F)**

ARED-890 Graduate Seminar in Art 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; co-requisite: ARED-790 Student Teaching) **Class 6, Credit 6 (F)**

Art History

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. Students 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)**

ARTH-611 Extreme Abstraction
Although we can trace the roots of abstraction to non modern times and find its beginning as a concept in the visual arts in the late 18th and through-out the 19th century, it is a predominantly 20th century phenomena. During the beginning of the 20th century there were many artists that turned to nonfigurative practices for reasons that were mostly cultural and political. The world was changing and the artists wanted art to change as well. Although these reasons were about creating new ways of seeing and representing the world the sources for these visions varied from artist to artist. Scientific discoveries dealing with concepts of evolution, germs, atomic theory and astronomy contributed to the artists theorizing and producing abstract works of art. And although the work took on a look that may have been associated with decoration, most artists denied this connection for fearing that their work would not be taken seriously. Merely decorative! Abstraction since then has gone through many manifestations. The artists of today are no longer just going through the process of abstracting but are now producing abstract work that has its own history, rules and grammar. Issues of science, spirituality, primitivism and the decorative still resonate in the work of late 20th and early 21st century artists. But what is different? **Class 3, Credit 3 (S)**

ARTH-621 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 CIAS (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, semiotics and the image, as well as criteria by which to assess their success or failure (their intelligibility) and their alleged redemptive and poetic power. **Class 3, Credit 3 (F, S)**

ARTH-624 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 post-war epoch; it is equated with such leading brands as Volvo, Saab, Ericsson, Nokia, H&M, Electrolux Orrefors, Georg Jensen, ARTEK, Iitala, 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. **Class 3, Credit 3 (F or S)**

ARTH-638 Symbols and Symbol Making: Psychoanalytic Perspectives on Art
This course explores the links between psychoanalytic theory and art history with special focus on the work of Sigmund Freud, Carl Jung, and their followers. 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 and 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 studied include: Albrecht Dürer, Leonardo da Vinci, Michelangelo, Edvard Munch, Max Ernst, Jackson Pollock, Louise Bourgeois, Mary Kelly and Victor Burgin; in addition to examples from film (Maya Deren, Luis Buñuel and Salvador Dali, as well as Stan Brakhage). **Class 3, Credit 3 (F or S)**

ARTH-644 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. **Class 3, Credit 3 (F, S)**

ARTH-666 Modernism Realism Expressionism
This course is an inquiry into one of the major debates of modern art. This debate had a seemingly clear victor. The idea that the artist expresses his or her individuality and then communicates that "self" to the rest of "humanity" through a higher, transcendental, language has dominated the discourse and practice of modernist art. In retrospect, the art that dominated most of the first half of the 20th century was of an expressive nature. On the other hand art that addressed the social and in anyway addressed direct and specific social issues was banished by art's major institutions. Realism was dead. In this course we will look at the circumstances of how Realism became subordinated to Expressionism. We will also address the question of what exactly constituted the practice of realist art. We will look at the roots of both movements that will take us at times into 18th and 19th centuries. But mostly we will concentrate on how institutions like the Museum of Modern Art helped define how we see the history of 20th century art as being determined. We will also explore how Modernism's "other", Realism, survived and gained new currency in practices of late 20th and early 21st century art. **Class 3, Credit 3 (F)**

ARTH-668 Art and Technology: From the Machine Aesthetic to the Cyborg Age
This course explores the link between art and technology in the 20th 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 posthuman. Key theorists to be discussed include: Karl Marx, Norbert Weiner, Reyner Banham, Siegfried Gideon, Michel Foucault, Deleuze and Guattari, Donna Haraway, and Martin Heidegger, as well as examples from film (Modern Times, Metropolis, Man with the Movie Camera and Blade Runner) and literature (Shelley's Frankenstein, Zamyatin's We). Artists covered include: Tatlin, Rodchenko, Malevich, Moholy-Nagy, Legér, Sheeler, Picabia, Duchamp, Calder, Ernst, Le Corbusier, Klee, Tinguely, Oldenburg, Rauschenberg, Warhol, Beuys, Kiefer, Lewitt, Fischli and Weiss, Acconci, Nam June Paik, Survival Research Laboratories, Bureau of Inverse Technology, Stelarc, Orlan, Dara Birnbaum, Roxy Paine, Marina Abramovic, Eduardo Kac and Bill Viola. **Class 3, Credit 3 (F or S)**

ARTH-671 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, and power; 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. **Class 3, Credit 3 (F or S)**

ARTH-672 Art of the Americas
This is a survey course of Native North and South American visual arts within an historical and anthropological framework. Included will be an examination of the development of principal styles of Ancient American architecture, sculpture, painting, and ceramics up to the sixteenth century when the Spanish conquistadores defeated the Aztec and Inca empires and imposed colonial rule. Consideration is also given to materials used, techniques of construction, individual and tribal styles, as well as to the meaning and function of various art forms within Native American societies. **Class 3, Credit 3 (F)**

ARTH-673 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. **Class 3, Credit 3 (F or S)**

ARTH-674 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, as well as broader literary and ideological contexts (e.g. Freud, Breton, Lautréamont, Leiris and Bataille). A wide 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, Dalí, Ernst, Giacometti, Man Ray, Bellmer, Cahun, Cornell, Magritte, Miro, Oppenheim, Toyen and Picasso) will be analyzed in depth. **Class 3, Credit 3 (F or S)**

ARTH-676 Early Medieval Art
This class will examine medieval European artistic production — including architecture, architectural and free standing sculpture, metalwork, painting, and manuscript illumination — from the sixth to the 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 medieval art and the past. **Class 3, Credit 3 (F, S)**

ARTH-677 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. **Class 3, Credit 3 (S)**

ARTH-678 Edvard Munch
The Norwegian artist Edvard Munch (1863-1944) continues to generate a great deal of popular interest, critical scholarship, and reflection. The four-volume catalogue raisonné of his paintings was published in 2009, and the graphic work appeared in 2001. 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-Siècle. 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 beginning with the famous 1913 Armory Show. 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. **Class 3, Credit 3 (F or S)**

ARTH-681 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; the conflicts and tensions involved in the search for a cultural identity. **Class 3, Credit 3 (S)**

ARTH-682 **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. **Class 3, Credit 3 (F, S)**

ARTH-683 **Installation Art**
This course will introduce students to historic, contemporary, and critical issues surrounding installation art. There will be an introduction to the development of installation art as a genre. We will examine the changes, which have developed over the past three decades, of object sculpture to non-object. There will be an emphasis on the development of the concept of an installation project and its relationship to site and/or audience. Both public and gallery spaces will be discussed. **Class 3, Credit 3 (F)**

ARTH-684 **Late Medieval 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 concept of Gothic, architectural design and construction, 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. **Class 3, Credit 3 (F, S)**

ARTH-686 **History of Things: Studies in Material Culture**
This course is an examination of techniques and materials together with a historical overview of the artistic achievements of craftsmen and women in the past, with particular emphasis on ceramics and metalsmithing. It includes study of Renaissance and early modern earthenware and stoneware as a prelude to the consideration of the history of porcelain and explores creative thinking and designing in other traditional craft areas such as fiber, glass, and wood. **Class 3, Credit 3 (F)**

ARTH-687 **The Gothic Cathedral**
This class will examine the Gothic cathedral and related art production (stained glass, sculpture, and metalwork within the cathedral context) 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 cathedrals 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; the urban context of Gothic cathedrals; and the holistic view of the Gothic cathedral. **Class 3, Credit 3 (F or S)**

ARTH-688 **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. **Class 3, Credit 3 (F or S)**

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: (painting, nontoxic printmaking, sculpture, or new forms) classes 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: Nontoxic Printmaking**
Graduate students in the fine arts studio program may choose any combination of fine arts studio (painting, nontoxic 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 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 (painting, non-toxic printmaking, sculpture, or new forms) classes to meet the 24 credit course requirements in their major. Any course may be repeated four times (up to 12 credit hours). 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 (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). In Fine Arts Studio: Sculpture students 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 course 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-607 **Nontoxic Printmaking I**
This is part one of a two-part graduate certificate in nontoxic printmaking for highly motivated students who are able to sustain their work independently. This course is designed to introduce basic non-toxic printmaking technical concepts that may also include techniques such as Intaglio-Type, A.R.E., screen, relief, monoprint, digital transfer, halftone, photo and the art of the master printer. The focus will be on nontoxic intaglio printmaking research and how to creatively apply techniques that will result in works of art. **Class 2, Studio 6, Credit 6 (F)**

FNAS-608 **Nontoxic Printmaking II**
This is part two of a graduate certificate in nontoxic printmaking program for highly motivated students who are able to sustain their work independently. This course is designed to introduce advanced level nontoxic printmaking technical concepts that may also include one or more of the following techniques; Intaglio-Type, A.R.E., screen, relief, monoprint, digital transfer, halftone, polyester plate litho, 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 more sophisticated works of art. **Class 2, Studio 6, Credit 6 (S)**

FNAS-614 **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. **Class 2, Lab 3, Credit 3 (F)**

FNAS-633 **Painting for Non-majors**
Students will be encouraged to experience and explore the properties of oil painting and establish strategies toward solving problems of composition related to successful form content. **Class 1, Studio 4, Credit 3 (S)**

FNAS-635 **Art Gallery Management**
The complex social and cultural roles 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 larger Rochester community arts audiences. Metro site visitations and gallery research will be combined with arranged studio hours in a gallery laboratory setting. **Class 2, Lab 3, Credit 3 (F, S)**

FNAS-638 New Forms for Non-majors
New Forms for Non-Majors is designed to introduce students who are not in the fine arts studio program to some of the new possibilities for personal expression outside of or beyond traditional drawing, painting, printmaking and sculpture. The students' expertise from other fields can be channeled into forms of personal, fine art expression. **Studio 6, Credit 3 (S)**

FNAS-643 Foundary 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. **Class 1, Lab 4, Credit 3 (S)**

FNAS-660 Watercolor
An exploration of watercolor concepts and techniques to enhance skill development and personal expression of the individual student. **Class 1, Lab 4, Credit 3 (F, S, Su)**

FNAS-661 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. **Class 1, Lab 1, Studio 3, Credit 3 (F)**

FNAS-663 Contemporary Drawing
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. **Class 1, Studio 4, Credit 3 (S)**

FNAS-668 Monoprint Figure
Life drawing exercises focus on dynamic and expressive line quality. Half of the class time will be dedicated to life drawing and the other half to monoprinting. The focus will be on creative techniques that result in works of art. **Class 1, Lab 4, Credit 3 (S)**

FNAS-671 Painting the Figure
The course explores materials and techniques in painting the human form. We build on the theory and practice of color and drawing as well as other resources to develop an understanding of how to portray the figure. Traditional and contemporary approaches to figurative painting are examined. Students are instructed to complete a set of paintings and drawings that demonstrate their understanding of form, color and composition. **Class 1, Lab 4, Credit 3 (F)**

FNAS-673 Figure Sculpture
Through the use of live models the student will develop an understanding of the human form through the creation of multiple armatures and oil clay maquettes. The student will then create a series of castings pulled from the accumulated experience with the model. **Class 2, Studio 4, Credit 3 (S)**

FNAS-683 Welding and Fabrication
This course is designed to introduce or develop students' skills in metal fabrication. Several different types of equipment will be introduced and explained along with the welding and cutting processes. Emphasis will be placed on students completing a body of work consisting of finished steel fabricated sculptures. There is a $200 lab fee to cover some personal equipment and supplies. The course will be taught off-campus at Mahany Welding, 115 Fedex Way, Rochester, NY. **Class 1, Lab 4, Credit 3 (S)**

FNAS-698 Fine Arts Studio Internship
The Fine Arts Studio Internship will provide students with the option to work with established artists or in fine art related businesses. 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. **Credit 1-6 (F, S, Su)**

FNAS-699 Fine Arts Studio Co-op
The Fine Arts Studio Co-op will provide students with the option to work with established artists or in fine art related businesses. Students may apply for co-ops to businesses based on the availability of positions and business job needs. Students must obtain permission of an instructor and complete the Co-op Permission Form to enroll. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term. Permission of instructor. **Credit 0 (F, S, Su)**

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-731 Non-toxic Printmaking for Non-majors
This course is designed to introduce non-toxic printmaking concepts and techniques. **Studio 6, Credit 3 (F, S)**

FNAS-799 Fine Arts Studio Independent Study
Fine Arts Studio 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. Fine Arts Studio Independent Study students must obtain permission of an instructor and complete the Independent Study Permission Form to enroll. **Credit 1-6 (F, S)**

FNAS-890 Research and Thesis
After creating a body of artwork derived from the student's thesis proposal, 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)**

FNAS-892 Continuation of Thesis Fine Arts Studio
The Fine Arts Studio Continuation of Thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. (FNAS-890 Research and Thesis and Fine Arts Studio MFA student) **Credit 0 (F, S)**

ILLS-662 Journalistic Illustration Graduate
This course will familiarize students with the requirements of researching and visually reporting a specific happening or event. Assignments will be longer in duration and will consist of several major works, many drawings, sketches, notes, and photo references. This journalistic approach to illustration demands that students attend an event and selectively record important aspects that will best communicate the atmosphere and action of the scene. Extensive research, both informational and visual is expected. A personal, editorial viewpoint is desired. This course will familiarize students with methods and issues involving creating a series of images for the single purpose of representing a story or illustrated sequence. Emphasis will be placed on choosing important content and planning effective image sequences. Students will learn to share their observations to clarify and embellish what might be commonplace for the non-visual observer. **Class 2, Studio 3, Credit 3 (S)**

ILLS-668 Pop-up Books
This course will deal with constructing, illustrating, and developing stories for pop-up and mechanical books. Students will study planning, preparation, engineering and illustration for production of pop-ups. The course will be divided into a preliminary section of learning basic mechanisms of pop-up books and a second section, which allows students to apply knowledge learned in the first section to the illustration and production of their own book. **Class 2, Studio 3, Credit 3 (F)**

ILLS-669 Advertising Illustration Graduate
This course will deal with creating illustrations used to advertise products, services and events. Assigned projects will give students a better understanding of the wide range of assignments that advertising illustrators produce for advertising agencies and corporate accounts. Students will experience the fast-paced working conditions inherent in the advertising industry. **Class 2, Studio 3, Credit 3 (F, S)**

ILLS-679 Digital Editorial Graduate
Digital Editorial will introduce students to editorial illustration. Importance will be placed on interpretation of editorial subject matter for illustration series, and preparation of digital imagery for print reproduction. Students will apply approaches to creative illustration while creatively interpreting editorial text and visual narratives. Students may use vector and raster-based software applications and a variety of input and output devices. Stylistic issues, conceptual strategies, production restrictions, and color systems will also be covered. **Class 2, Studio 3, Credit 3 (S)**

ILLS-799 Illustration Graduate Independent Study
Illustration 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 will propose a course of study. Students must obtain permission of an instructor and complete the Independent Study Form to enroll. **Credit Variable 1-6 (F, S)**

School of Design

Industrial Design

IDDE-620 **The Studio 2.0**
The course focuses on implementing developing ideas in art, design and crafts. The specific subtopics for this course will vary each time it is taught. As a result this course may be repeated. The subtopic is determined by the instructor. Potential topics may include the creation of public spaces, products, Analog and digital fabrication, furniture, interdisciplinary collaborations, etc. Graduate students are also required to document and present a critical analysis of their work. **Class 1, Studio 4, Credit 3, (F, S)**

IDDE-665 **Experimental Studio**
The course focuses on implementing advanced, newly developing ideas in industrial design. The specific sub-topic for this course will vary. As a result this course may be repeated. The subtopic is determined by the instructor. Potential topics may include the creation of exhibits, consumer products, sustainable design, analog and digital fabrication, furniture, interior landscapes, vehicle design, medical and health care design, interdisciplinary design, etc. **Class 2, Studio 3, Credit 3 (F, S)**

IDDE-669 **Master's Seminar**
The master's seminar is a forum for cross-disciplinary presentations and discussions of methods, techniques, processes and interpretations. Luminaries discuss conceptual and practical studio activities, their current and past endeavors and the contextualization of their work. Assignments may range from, ideation exercises, charrettes, studio visits, research papers and presentations. **Class 3, Studio 0, Credit 3, (F, S)**

IDDE-673 **ID Sketching Studio**
A studio styled course in freehand sketching and visualization techniques using a combination of orthogonal, perspective and empathic and any other two-dimensional methods of developing and communicating design concepts. **Class 2, Studio 2, Credit 3 (F, S)**

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. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All Co-ops must fall within an RIT term (F, S, Su) (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, this course 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. **Lab/Studio 6, Credit 3 (F)**

IDDE-704 **Form of Function**
The second of a two-semester sequence, this course 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) **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. **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) **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) **Class 3, Lab/Studio 6, Credit 6 (S)**

IDDE-892 **Continuation of Thesis Industrial Design**
The Industrial Design Continuation of Thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. (IDDE-890-Thesis Implementation and Evaluation and IDDE-MFA student) **Credit 0 (F, S, Su)**

Visual Communication Design

VCDE-617 **Experimental Workshop**
The course focuses on implementing advanced, newly developing ideas in visual communication design. The specific subtopic for this course varies each time it is taught. As a result it may be repeated with a different subtopic. The subtopic is determined by the instructor. Potential topics include the creation of interactive installations, adaptive/responsive interface design, tangible media design, digital performances, cyber fashion, network art, locative media, scientific visualization, information visualization, event design, projection design, or any new area in digital design. (VCDE-706 3D Modeling and Motion,VCDE-707 Web and UI Design, VCDE-709 Digital Design in Motion) **Class 2, Studio 3, Credit 3 (F, S)**

VCDE-621 **Character Design and Rigging**
This course covers first the design of characters and then the creation of them using three-dimensional software, inverse kinematics, parent and rigid binding, bones, and deformers. Students design characters using techniques like interpretant matrices, model sheets, sketches, and maquettes followed by development of the actual character in software. Characters are designed for incorporation into motion graphics, games, real time applications, performance, or visualization. (VCDE 706 3D Modeling and Motion) **Class 2, Studio 2, Credit 3 (S)**

VCDE-626 **Physical Interface Design**
This course covers the use of basic electronics so that students can develop embedded systems or controllers for games, design environments with ambient intelligence, design interactive museum exhibits and point of purchase installations, or embed electronics in clothing. Students use micro controllers, sensors, switches, lights, and motors to implement their designs. **Class 2, Studio 2, Credit 3 (S)**

VCDE-627 **Real Time Design**
In this course, students design levels for games or virtual worlds for a variety of applications. Once the design is complete, the design is implemented using high-end three-dimensional software. In many cases the projects will be large and will be executed by teams of students. Versioning systems will be used to keep track of the most recently developed assets. Models are imported into real time software engines for manipulation. (VCDE-706 3D Modeling and Motion) **Class 2, Studio 2, Credit 3 (S)**

VCDE-628 **3D Particles and Dynamics**
This course focuses on three-dimensional 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-633 **Hard Surface Modeling**
The course focuses on designing and constructing hard surface models including machinery, furniture, vehicles, electronics, and robots. Students explore the use of different modeling techniques in the process and are particularly interested in the flow of the topology within the geometry. Some attention is given to creating controls for moving the hard surface models. (VCDE-706 3D Modeling and Motion) **Class 2, Studio 2, Credit 3 (F)**

VCDE-666 **Design History Colloquium**
This course is about scholarly issues such as critical thinking, analysis, expression, rigorous questioning, discussion, and dialogue. The course seeks to stimulate a deeper interest in scholarly approaches for graduate students who share an intellectual curiosity about the history of design and seek to expand their knowledge in the emerging field of design studies through a dynamic interplay of design history, design theory and design criticism as these central elements are focused on design objects or artifacts. The Vignelli Center for Design Studies and the Cary Graphic Design Archive offer unique archival resources to support research and interpretive course objectives. The aspect of a colloquium is a gathering of graduate students who share an intellectual curiosity about the history of design and seek to expand their knowledge in the emerging field of design studies. The course objectives are realized through lectures, field trips, guest speakers, archive visits and required research and writing projects. Using a case study format, the course content will focus primarily on the seminal people, places and products of the Modern design movement. **Class 3, Credit 3 (F, S)**

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. **Credit 1-6 (F, S)**

VCDE-699 **Visual Communication Design Co-op**
The Visual Communication Design Co-op will provide real world, on the job experience for students wishing to gain experience at visual communication design. Students will apply and be hired by firms to enhance student's career readiness. Visual communication Design co-ops must be approved and sponsored by a faculty adviser. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term. **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. Online 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 three-dimensional 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. **Class 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. **Class 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 (two and three-deminsional), 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-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 three-dimensional 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 Media Intergration**
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. **Class 3, Credit 3 (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 1-4 (F, S)**

VCDE-890 **Thesis: Implementation and Evaluation**
This course focuses on the physical thesis project. Students work independently on their 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) **Class 3, Studio 6, Credit 6 (S)**

VCDE-892 **Continuation of Thesis Visual Communication Design**
The MFA Visual Communication Design Continuation of Thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. (VCDE 890 Thesis Implementation and Evaluation and VISCOM-MFA student) **Class 0, Lab 0, Credit 0 (F, S)**

School of Film and Animation

Film and Animation

SOFA-601 **Graduate Production**
A fundamental course in 16mm non-synchronous film and basic digital video production. Filmmaking is presented as a means of interpretation and expression. This course combines technical information, camera technique and editing with a theoretical and practical approach to motion picture continuity. Production is divided into two learning experiences: 16mm (non-sync) format and digital video format. Students furnish film, tape and processing with equipment furnished by the department. **Class 2, Lab 3, Credit 3 (F)**

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 **Graduate Directing**
An introduction to the arts of directing and acting with an emphasis on script analysis, performance, and blocking. Students direct and act in scenes from professional productions. Scenes are rehearsed outside of class, and then staged and critiqued in class. **Class 3, Credit 3 (F)**

SOFA-607 **Advanced Directing**
Students deepen skills in analyzing scripts and directing actors while adding the breakdown of scenes into shots and the choreography of the camera with actors. Students stage scenes from professional productions in class, and then shoot and edit them outside of class with a focus on creative rather than technical accomplishment. (SOFA-606 Graduate Directing) **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, Screening 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, story telling, 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, Screening 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-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 three-dimensional 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 or equivalent) **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 in their 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 two-dimensional 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 course 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-635 Acting for Film
A course in basic acting technique with an emphasis on the requirements of film production. Students are introduced to various approaches to acting through exercises and by performing in scenes from professional productions. Scenes are rehearsed outside of class, and then staged and critiqued during class time. **Class 2, Lab 3, Credit 3 (F, S)**

SOFA-638 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. (SOFA-615 3D Animation Fundamentals) **Lec 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, Screening 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-652 Alternate Frame-by-Frame
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 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 work with 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. (SOFA-603 2D Animation I or SOFA-617 Stop Motion Puppet Fundamentals or SOFA-615 3D Animation Fundamentals) **Class 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, Screening 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-to-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, Screening 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. **Class 2, Screening 3, Credit 3 (F, S)**

SOFA-663 Writing the Feature
This is course is an exploration of the feature film form. Students propose ideas for a feature length film and in consultation with the instructor and other students, write a detailed step outline and a substantial portion of the first draft. (SOFA-626 Writing the Short Film) **Class 3, Credit 3 (F)**

SOFA-664 Writing the Series
This course is an introduction to all forms of series writing for television and the Internet. Students will choose to write either a one-hour pilot for a dramatic series, or a half-hour pilot and an additional episode for a single-camera comedy series. All students will develop and write a series bible, a thorough description of all the characters and the world in which the series takes place as well as how the series may develop with future plotlines. (SOFA-626 Writing the Short Film) **Class 3, Credit 3 (S)**

SOFA-665 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. **Class 3-6, Credit 3-6 (F, S)**

SOFA-668 Alternate Traditional Animation Techniques
This course 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-678 Cinematography and Lighting) **Class 3, Credit 3 (S)**

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-678 **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-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, Credits 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 three-dimensional 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, Screening 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-695 **Advanced 3D Animation**
This course pushes character animation to a new level with drama, emotion, and speech. Topics will include facial expressions 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 character animation with dialogue and emotion. (SOFA-615 3D Animation Fundamentals) **Class 2, Lab 3, Credit 3 (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 Video Graduate Internship**
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 (F, S, Su)**

SOFA-699 **Film and Animation 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, Su)**

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 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-717 **Animation Workshop**
This course is the students 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 course 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-748 **Concept and Character Design**
This course will introduce students to the basics of design as applied to characters and environments for animated productions. Students will create and develop a 'cast' of characters for an imagined 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. 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-628 Animation Writing and Visual Storytelling) **Class 2, Lab 3, Credit 3 (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) **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 percent or more of the project the student should register for SOFA-890 Research and Thesis. **Class 0, Credit 4 (F)**

SOFA-799 **Film and Animation Graduate Independent Study**
SOFA 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 deliverables. Students must obtain permission of an instructor and complete the Independent Study Permission Form to enroll. Student must have a minimum of a 3.0 GPA to apply. **Class 0, Studio 0, Credit 1-4 (F, S, Su))**

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 percent 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. **Credit 1-4 (S)**

SOFA-892 **Continuation of Thesis Film and Animation**
The School of Film and Animation continuation of thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. (SOFA-890 Research and Thesis II and FILMAN-MFA student) **Credit 0 (F, S)**

School of Media Sciences

Printing Management

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. Emphases are placed on CIE colorimetry, device calibration and characterization, and color management systems. **Class 2, Lab 3, Credit 3 (F)**

PPRT-603 **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-661 Dynamic Communication Processes
This course focuses on the integration of content from various media sources to create customized dynamic communications. Topics include the process of understanding and utilizing databases, digital assets, and tools to create and distribute customized documents through the web and in print. **Class 3, Credit 3 (F)**

PPRT-663 Technical Writing
This course prepares a student to engage in a variety of written and oral communications necessary in academic and technical environments. Students are expected to produce appropriate audience-centered written materials based on techniques, organization, format, and style that are helpful for generating the graduate-level proposal and thesis. **Class 2, Credit 2 (S)**

PPRT-666 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 will choose individual typographic topics to research (e.g. technology, psychology, history, aesthetics, imaging, writing systems, culture, and society). Course lectures survey these topics. 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-671 Advanced Digital Asset Management
In this course students will research the current and future trends associated with content management as well as digital asset management. Students will understand what metadata is, the standards that are frequently applied, the creation of custom metadata, and the various uses of metadata in the automation of asset creation, storage, and retrieval. **Class 3, Credit 3 (F)**

PPRT-673 Transmedia Publishing and Storytelling Transmedia
Publishing is a form of multimedia communication that tells stories from a database of media assets. It differs from conventional publishing in that the reader dynamically participates in shaping the story and the story is adapted to the channel used to distribute it. Students create stories through the application of the theoretical principles, methods and tools employed in transmedia publishing and storytelling. **Class 3, Credit 3 (S)**

PPRT-676 Media Business Transformation
This course provides the knowledge required to improve a graphic communication business. Students gain an understanding of the business assessment process, and the knowledge to apply analysis and decision-making skills to engage in growth-oriented transformation in the graphic communications industry. Students learn how to evaluate a firm's economic, operational, and market position and to apply practical solutions to improve its business practices, operations, resource allocation, and services model. **Class 3, Credit 3 (F)**

PPRT-688 Package Printing
This course introduces students to the package printing industry. Printing processes, materials, production workflows and quality control systems used in package printing will be introduced. Students will take several packages from creation to final printed product. **Class 2, Lab 3, Credit 3 (S)**

PPRT-699 Print Media Graduate Co-op
The co-op will provide students with the opportunity to work in the graphic communication field. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term (F, S, Su) **Credit 0 (F, S, Su)**

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
Industry Issues and Trends 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 (Su)**

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-, web- 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-763 Applied Data Analytics
This course prepares a student to apply data analytics to understand the unmet and undefined content needs of a target audience. Students will learn secure and repeatable data analysis practices in a closed-loop cross media communications value chain. (Consent of instructor) **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) **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. **Credit 1-6 (F, S, Su)**

PPRT-892 Continuation of Thesis Print Media
This course allows the student to continue thesis research on a topic relevant to the graphic arts industry. Topic must be approved by a committee compromising graduate faculty and an adviser. (PPRT-704 Research Methods and Trends in Graphic Media) **Credit 0 (F, S, Su)**

School of Photographic Arts and Sciences

Graduate Photography

PHGR-656 **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-657 **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 Cafe. (PHGR-756 Moving Media I) **Class 2, Lab 3, Credit 3 (S)**

PHGR-698 **Photography Internship**
The photography internship will provide students with the option to work in the photographic 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. **Credit 1-3 (F, S, Su)**

PHGR-699 **Cooperative Education Experience**
Co-ops are an opportunity for students to gain experience in their field. Co-ops are typically paid work experiences and can be either part-time (10-15 hrs/wk) or full-time (min 35 hrs/wk). All co-ops must fall within an RIT term (F, S, Su). The RIT Office of Cooperative Education and Career Services assist students in identifying co-op placements and opportunities. **Class 0, Credit 0 (F, S, Su)**

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. **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 the MFA program at RIT. 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 (e.g.: George Eastman House, Visual Studies Workshop, etc.) **Class 3, Credit 3 (F)**

PHGR-721 **Research Core I**
This course will outline the policies and procedures required for the MFA thesis (thesis exhibition, thesis defense and thesis publication) and provide students with research tools and resources to begin the development of the thesis publication and thesis defense. Class presentations will include methods of scholarly writing, research as well as editing and sequencing procedures for the creation of the capstone thesis defense and publication work. **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. This course can be repeated for credit. **Class 3, Credit 3 (F, S)**

PHGR-723 **Research Core II**
Research Core II is the second term of a year-long required course which supports the SPAS MFA student in the completion of the thesis publication and thesis defense. Supported by the research tools and resources outlined in Research Core, students will conduct practice defenses and write, edit, and fabricate a thesis publication to complete their graduate experience. (PHGR-721 Research Core I) **Class 3, Credit 3 (S)**

PHGR-724 **Professional Development for the Emerging Artist**
This course 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, Credits 3 (S)**

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-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. **Credit 1-4 (F, S)**

PHGR-890 **Thesis**
The thesis work produced within this course represents the capstone project of the MFA degree in Imaging Arts. The completion of the thesis exhibition in its entirety; artwork, artist's statements, extended statements for thesis publication and installation of exhibition, are the main focus of this course. (PHGR-721 Research Core I and PHGR-723 Research Core II) **Class 6, Credit 6 (F, S)**

PHGR-892 **Continuation of Thesis Imaging Arts**
The imaging arts continuation of thesis course provides student additional semester(s) to complete their thesis research, project, and thesis document. (PHGR-890 Thesis) **Credit 0 (F, S, Su)**

College of Liberal Arts

James J. Winebrake, Dean
rit.edu/cla

Programs of Study

The College of Liberal Arts offers master of science degrees in the following areas: communication and media technologies; criminal justice; experimental psychology; science, technology, and public policy; and school psychology. The college also offers two advanced certificates in engineering psychology 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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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.

Communication and Media Technologies, MS

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 commerce, industry, education, entertainment, and government, as well as for graduate work toward a doctoral degree.

Curriculum

The degree requires the completion of 36 credit hours of graduate course work.

Communication and media technologies, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
COMM-701	History of Media Technologies	3
COMM-702	Communication Theories	3
	Communication Electives	9
	Professional Core	9
COMM-703	Research Methods in Communication	3
COMM-704	Media Law and Ethics	3
COMM-799	Communication Thesis/Project	6
Total Semester Credit Hours		**36**

Communication electives

Students are required to select three communication electives from the choices below.

COURSE		SEMESTER CREDIT HOURS
COMM-705	Technology-Mediated Communication	3
COMM-706	Crafting the Message	3
COMM-707	International Media	3

COURSE		SEMESTER CREDIT HOURS
COMM-708	Communication Education	3
COMM-709	Online Advertising	3
COMM-710	Visual Communication	3
COMM-711	Persuasion in a Digital Age	3
COMM-713	Classic Media	3
COMM-725	Special Topics in Communication	3

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		SEMESTER CREDIT HOURS
Print Media (College of Imaging Arts and Sciences)		
PPRT-703	Cross Media Workflow I	3
PPRT-741	Digital Printing and Publishing	3
PPRT-742	Printing Industry Trends and Issues	3
PPRT-743	Perspectives on Contemporary Publishing	3
Marketing (Saunders College of Business)		
MGMT-740	Organizational Behavior and Leadership	3
MGMT-741	Managing Organizational Change	3
MGMT-742	Introduction to Technology Management	3
MKTG-761	Marketing Concepts	3
MKTG-766	Marketing in Global Business	3
MKTG-767	Advertising and Marketing Communications	3
MKTG-772	Marketing on the Internet	3
MKTG-778	Commercializing and Marketing of New Products	3
Health Systems (College of Applied Science and Technology)		
HLTH-700	Research Methods and Data Analysis	3
HLTH-710	Health Governance and Economics	3
HLTH-717	Bioethics	3
HLTH-720	Health Systems Planning	3
HLTH-725	Stakeholder Communications and Reporting in Health Care	3
SERQ-712	Breakthrough Thinking, Creativity, and Innovation	3
Public Policy (College of Liberal Arts)		
PUBL-700	Readings in Public Policy	3
PUBL-708	Technological Innovation and Public Policy	3
PUBL-709	Public Administration and Management	3
PUBL-710	Information and Communication Policy	3

Graduate committee

Full-time students create a graduate advisement committee by the end of their 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 project appropriate to their course of study and their career goals.

Master's thesis/project

A thesis or project is required of all students in the program. The topic should complement the student's academic graduate interests and scholarly training. Topic selection and methods 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 from 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 applicants whose native language is not English must submit scores from either the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). Minimum scores of 570 (paper-based) or 88-89 (Internet-based) are required on the TOEFL. A minimum score of 6.5 is required on the IELTS. This requirement may be waived for students who submit undergraduate transcripts from American colleges and universities.

Criminal Justice, MS

rit.edu/cla/criminaljustice
John McCluskey, Graduate Program Director
(585) 475-2666, jdmgcj@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 will 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 30 semester credit hours is required for completion of the MS in criminal justice.

Students applying to the program 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.

Criminal justice, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
CRIM-700	Professional Seminar In Criminal Justice Theory	3
CRIM-701	Statistics	3
CRIM-702	Professional Seminar in Research Methods	3
CRIM-703	Advanced Criminology	3
CRIM-704	Crime, Justice and Community	3
CRIM-705	Interventions and Change in Criminal Justice	3
	Electives	6
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 course work,
- 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 English as a Foreign Language (TOEFL). Minimum scores of 570 (paper-based) or 88 (Internet-based) are required.

Experimental Psychology, MS

rit.edu/cla/psychology/engg.htm
Andrew Herbert, Department Chair
(585) 475-4554, amhgss@rit.edu

Program overview

The master of science degree in experimental psychology builds on the strengths of faculty research and student interests in experimental psychology broadly defined. The program has two tracks: experimental psychology and engineering psychology.

The experimental psychology track embraces the application of the scientific method to the study of behavior. Faculty are experts in a variety of fields including addiction, attention, cognition, development, evolutionary psychology, forensic psychology, perception, psychopathology, and social psychology, among others.

The engineering psychology track 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. Courses emphasize the role of human behavior and performance in both simple and complex human-machine systems. Students are trained in both research methods of experimental psychology and application of the results to contemporary problems in industry. This track prepares students to function as effective engineering psychologists in industrial, governmental, or consulting organizations.

The program as a whole provides a foundation for further advanced academic study in human factors and/or experimental psychology.

Curriculum

The program includes 30 credit hours of core courses, elective courses, and a thesis.

Experimental psychology, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
PSYC-640	Graduate Statistics	3
Choose one of the following:		3
PSYC-714	Graduate Engineering Psychology	
	PSYC Elective	
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

Any graduate course at RIT can be taken as an elective, assuming prerequisites are met. Students in the engineering psychology track must select two electives from the following (students should check for course prerequisites or if permission of the instructor is required):

HCIN-610	Foundations of Human-Computer Interaction
HCIN-620	Information and Interaction Design
HCIN-630	Usability Testing
HCIN-700	Current Topics in HCI
HCIN-705	Topics in HCI for Biomedical Informatics
HCIN-715	Agent-based and Cognitive Modeling
HCIN-720	Designing User Experiences for Internet-enabled Devices
HCIN-722	Human Computer Interaction with Mobile Devices

HCIN-730	User-Centered Design Methods
HCIN-735	Collaboration, Technology, and the Human Experience
ISEE-730	Biomechanics
ISEE-731	Advanced Topics Human Factors
ISEE-732	Systems Safety Engineering

Thesis

Students select a thesis adviser during the first year. Selection of an adviser, thesis topic, and research proposal must be completed in the second semester of the first year of the program. Ongoing research activity is expected through the summer term 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 experimental psychology, candidates must fulfill the following requirements:

- Have a minimum of 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 one course in statistics,
- Submit official transcripts (in English) for all previously completed undergraduate and graduate course 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 personal statement describing the applicant's goals for the program focusing on their research interests and possible thesis research (including possible thesis mentors), 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 after the first year of the program. The co-op experience provides 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

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.

Curriculum

School psychology, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
SPSY-640	Statistics	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-631	Cognitive Assessment	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-722	Advanced Counseling	3
SPSY-720	Advanced Consultation	3
SPSY-710	Developmental Psychopathology	3
SPSY-701	Advanced Practicum I: Issues in Diversity	3
SPSY-641	Research Methods	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	6
Total Semester Credit Hours		**66**

Degree requirements

A minimum of 66 semester 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 psychology, 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 in behavioral sciences with a grade of B (3.0) 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 9 semester credit hours of graduate work in the program. Applications are due by February 1. Later applications will be reviewed on a space-available basis.

Engineering Psychology, Adv. Cert.

rit.edu/cla/psychology/advanced-certificates/engineering-psychology
Esa Rantanen, Associate Professor
(585) 475-4412, esa.rantanen@rit.edu

Program overview

The advanced certificate in engineering psychology provides students with core knowledge in the key areas of engineering psychology, as well as an opportunity to study particular topics in greater depth through electives. The advanced certificate provides students with a formal acknowledgment of their knowledge in engineering psychology and credentials for seeking a career in the human factors/ergonomics field. The program consists of five courses. Students must earn at least a B in each course to earn the certificate. Students enrolled in the MS degree in experimental psychology can be awarded the advanced certificate by taking the required courses as part of their master's program.

Curriculum

Engineering psychology, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
PSYC-712	Graduate Cognition	3
PSYC-714	Graduate Engineering Psychology	3
PSYC-715	Graduate Perception	3
	Electives	6
Total Semester Credit Hours		**15**

Electives

Students choose two of the following electives:

HCIN-610	Foundations of Human-Computer Interaction
HCIN-620	Information and Interaction Design
HCIN-630	Usability Testing
HCIN-700	Current Topics in Human-Computer Interaction
HCIN-705	Topics in Human-Computer Interaction for Biomedical Informatics
HCIN-715	Agent-based and Cognitive Modeling
HCIN-720	Designing User Experiences for Internet-enabled Devices
HCIN-722	Human Computer Interaction with Mobile Devices
HCIN-730	User-Centered Design Methods
HCIN-735	Collaboration, Technology, and the Human Experience
ISEE-730	Biomechanics
ISEE-731	Advanced Topics Human Factors
ISEE-732	Systems Safety Engineering
PSYC-716	Graduate Social Psychology

With approval of the advanced certificate coordinator, other relevant graduate courses may also be chosen as electives.

Admission requirements

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

- Hold a baccalaureate degree from an accredited institution
- Have a minimum of 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 one course in statistics,
- Have a minimum undergraduate GPA of 3.0,
- Submit a personal statement describing the applicant's experience and goals regarding the certificate,
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work, 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).

Scores from the Graduate Record Exam (GRE) are not required, however they may be beneficial for some students.

Additional information

Prerequisite courses

Students may meet the prerequisite requirements either by taking the designated prerequisite courses at RIT, by having sufficient background from their undergraduate education, or if prerequisite requirements are explicitly waived by the course instructor.

School Psychology, Adv. Cert.

rit.edu/cla/schoolpsychology/
Suzanne Bamonto, Graduate Program Director
(585) 475-2765, sbggsp@rit.edu

Program overview

The advanced certificate in school psychology is designed for students who are interested in learning aspects of school psychology, but may not want to pursue an advanced degree. The advanced certificate may be completed as a stand-alone program, or courses may be applied later for students who wish to complete a master's degree. Students who complete the MS program in school psychology automatically earn this certificate.

Curriculum

School psychology, advanced certificate, typical course sequence

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**

Science, Technology and Public Policy, MS

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 enables students to work at the intersection of engineering, science, and public 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 Applied Science and Technology, Business, Engineering, Liberal Arts, and Science. The program is geared toward producing 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, climate change policy, healthcare policy, STEM education policy, telecommunications policy, or energy policy. Typical students include those with science or engineering backgrounds seeking 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 30 semester credit hours are required for completion of the program. The program consists of five required core courses, three elective courses, and a thesis, which allows students to work with a faculty adviser on an independent research project in their area of interest.

Electives

Students choose three elective courses based on their interests and career goals. Courses may be offered in various colleges throughout the university, including the colleges of Applied Science and Technology, Business, Engineering, and Science. Course selection is completed jointly with a faculty adviser and typically aims at developing a specialized area of interest for the student (e.g., biotechnology policy, environmental policy, energy policy, communications policy, etc.).

Science, technology and public policy, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
PUBL-700	Readings	3
PUBL-701	Graduate Policy Analysis	3
STSO-710	Science and Technology Policy Seminar	3
PUBL-702	Graduate Decision Analysis	3
PUBL-703	Program Evaluation and Research Design	3
	Graduate Electives	9
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 from 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.

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—Senior 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

Patrick M. Scanlon, BA, State University of New York at Albany; MA, Ph.D., University of Rochester—Department Chair; Professor

Bruce A. Austin, BA, Rider College; MS, Illinois State University; Ph.D., Temple University—Professor

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

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

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—Associate Professor

Criminal Justice

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

Irshad Altheimer, BA, Alabama State University; MA, Ph.D., Washington State University—Associate Professor

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—Graduate Program Director; 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—Associate Professor

Economics

M. Jeffrey Wagner, BA, University of Missouri; MA, Ph.D., University of Illinois—Department Chair; Professor

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—Associate Professor

Humanities

Rebecca O. Edwards, BA, College of the Holy Cross; Ph.D., University of Rochester—Professor, History

Timothy H. Engström, BA, MA, Ph.D., University of Edinburgh (United Kingdom)—Professor, Philosophy

Jessica Lieberman, BA, University of Pennsylvania; Ph.D., University of Michigan—Associate Professor, Visual Culture

Cecillia Ovesdotter Alm, BA, Universitat Wien (Austria); MA, Ph.D., University of Illinois—Assistant Professor, English

David B. Suits, BA, Purdue University; MA, Ph.D., University of Waterloo (Canada)—Professor, Philosophy

Psychology

Andrew M. Herbert, B.Sc., McGill University (Canada); MA, Ph.D., University of Western Ontario (Canada)—Department Chair; Professor

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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

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—Associate Professor

Audrey Smerbek, BA, University of Rochester; Ph.D., State University of New York at Buffalo—Assistant Professor

Tina Sutton, BS, Union College; MA; Ph.D., State University of New York at Albany—Assistant Professor

Public Policy

Sandra Rothenberg, BS, Syracuse University; MS, Ph.D., Massachusetts Institute of Technology—Department Chair, Professor

Eric Hittinger, BS, MS, Case Western Reserve University; Ph.D., Carnegie Mellon University—Assistant Professor

Ronil Hira, BS, Carnegie Mellon University; MS, Ph.D., George Mason University—Associate Professor

James J. Winebrake, BS, Lafayette College; MS, Massachusetts Institute of Technology; Ph.D., University of Pennsylvania—Dean; Professor

Science, Technology and Society

Deborah Blizzard, BA, Smith College; MS, Ph.D., Rensselaer Polytechnic Institute—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

M. Ann Howard, BS, Cornell University; JD, Rutgers University—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

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. **Class 3, Credit 3 (S)**

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. **Class 3, Credit 3 (S)**

COMM-705 **Technology-mediated Communication**
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. Applying 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. **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 specific medium including print, broadcast, interactive, digital and online technologies. Case studies of both effective and unsuccessful messages from, for example, advertising, public service, education, and entertainment will be examined. Students will create and execute a variety of messages using different writing styles with images that are directed toward specific target audiences. **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 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, focusing on global implications of the Internet and digital technologies on international cooperation, trade, and culture. **Class 3, Credit 3 (S)**

COMM-708 **Communication Education**
An analysis of and practicum in teaching communication in higher education. Students explore teaching and learning styles, the role of technology in higher education, and teaching assessment methods. Students create teaching resources and gain teaching experience in a college classroom. **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. **Class 3, Credit 3 (S)**

COMM-710 **Visual Communication**
Cross-listed with undergraduate course offering. 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 analyze visual messages from the following media: print photography, video, film and the Internet. **Class 3, Credit 3 (F)**

COMM-711 **Persuasion in a Digital Age**
Digital communication technologies blur the lines of distinction between mass persuaders, various publics, personal networks, and individuals. This course combines traditional theories and research in media, rhetoric, and persuasion within the context of new and dynamic channels of communication. This course will investigate the prevalence of persuasive communication in various facets of our society with particular attention to the impact of digital communication channels on the persuasion process. **Class 3, Credit 3 (S, biennial)**

COMM-713 **Classic Media**
Required of students without an undergraduate degree in communication. To introduce students to a broad range of important texts. Students will gain an understanding of how theory and research developed in the study of mass media and communication. The course is historical but focuses on the literature and media of the twentieth century. Key research studies and media productions are analyzed. Students learn to write in American Psychological Association style and conduct secondary research. **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)**

COMM-890 **Continuation of Thesis/project**
A guided research study culminating in an original, systematic, and scholarly study of a significant communication problem. Focuses on designing, conducting and completing an independent research project. The progress of each project is publicly defended. **Class 0, Credit 0 (F, S, Su)**

COMM-999 **Co-op**
One semester of work experience in a professional setting related to the communication major. (Department approval required.) **Class 0, Credit 0 (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. **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 CJ 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. The prerequisite for this course will be a strong undergraduate foundation in theories of crime and criminality. (CRIM-350 Theories Crime and 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. The course will emphasize how these critical community dimensions are related to both crime and criminal justice. 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 (e.g., poverty, residential mobility, etc.) and social processes (e.g., social capital, collective efficacy, etc.) 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. Central to this will be a discussion of co-production (i.e., the intersection between formal and informal social control). **Class 3, Credit 3 (S)**

CRIM-705 **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 on its effectiveness. Detailed attention will be given to prevention/control strategies aimed at both juvenile and adult offenders. Programs will also be examined in the broader context of the ideology and philosophy of justice. Students will become familiar with the state of the art in crime and justice related interventions by studying the theory, practice and evaluation of contemporary crime and justice interventions. **Class 3, Credit 3 (S)**

CRIM-706 **Current Issues in CJ**
This course provides an examination of current issues in criminal justice with an emphasis on the application of evaluation, management, theory and ethics to analysis of criminal justice policy, The goal is to engage students in discussion of current issues with their peers and with experts in the field. Elective course for criminal justice graduate students. **Class 3, Credit 3 (F)**

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. Elective course for criminal justice graduate students. **Class 3, Credit 3 (S)**

CRIM-711 **Directed Readings in Criminal Justice**
This course will be tailored to individual students' research interests as they explore areas of inquiry that may become topics for their thesis research. An emphasis will be placed on building a theoretically informed research question via existing literature and research in criminal justice and other disciplines (economics, psychology, sociology, and so on). Parallel to that effort, students will work to identify locally relevant research questions, potential research designs, and possible projects and/or agencies with whom which to conduct this research. Elective course for criminal justice graduate students. **Class 3, Credit 3 (F)**

CRIM-712 **Crime and Media**
This course is designed to analyze and critique the mainstream media's coverage of criminal justice issues, and to study how that coverage impacts society at large. The course will scrutinize, compare and contrast crime coverage of different eras, and will also discuss how that coverage is changing today with around-the-clock media outlets and ubiquitous social media. Among the issues studied will be the impact of crime coverage on public policy; the impact of televised trials; the editorial decisions made daily in newsrooms across America about the placement and priority of crime news; the trademarks that can catapult a crime story into local, regional or even national prominence; and the occasional alliances between law enforcement and media. **Class 3, Credit 3 (S, biannual)**

CRIM-775 **Criminal Justice Capstone**
The criminal justice capstone involves guided research on a topic approved by the instructor. The capstone requires students to develop, design and complete an original research project. Satisfactory completion involves the execution of a substantial research paper and includes a public oral presentation. Permission of instructor required. **Class 3, Credit 3 (F, S)**

CRIM-799 **Independent Study**
A program of study executed by an individual student with assistance and guidance by an instructor, outside a regular classroom setting. Guidelines for designing and gaining approval for an independent study are provided in College of Liberal Arts Policy I.D. **Class variable, Credit 1-6 (F, S, Su)**

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)**

CRIM-890 **Continuation of Thesis**
The Continuation of Thesis offers the opportunity to fulfill the work plan agreed by the student and the thesis adviser in commencing the thesis project in criminal justice. The goal of the course is to complete the thesis research proposed in a thesis proposal. (Permission from thesis instructor) **Class NA, Lab NA, Credit 0 (F, S, Su)**

English

ENGL-781 **Introduction to Natural Language Processing**
ENGL 781 is a graduate-level counterpart to ENGL 481. Students enrolled under the graduate-level number will be required to read the additional graduate-level reading; meet with the professor and other graduate students enrolled outside of class for an additional weekly discussion session; produce an annotated bibliography linking the thematic focus topic to their thesis work; and produce an individual final project that connects with their thesis work. This course provides theoretical foundation as well as hands-on (lab-style) practice in computational approaches for processing natural language text. The course will have relevance to various disciplines in the humanities, sciences, computational, and technical fields. We will discuss problems that involve different components of the language system (such as meaning in context and linguistic structures). Students will additionally work on modeling and implementing natural language processing and digital text solutions. **Class 3, Credit 3 (varies, biannually)**

ENGL-782 **Advanced Topics in Computational Linguistics**
Study of a focus topic of increased complexity in computational linguistics. The focus topic varies each semester. Students will develop skills in computational linguistics analysis in a laboratory setting, according to professional standards. A research project plays a central role in the course. Students will engage with relevant research literature, research design and methodology, project development, and reporting in various formats. ENGL 782 is a graduate-level counterpart to ENGL 582. Students enrolled under the graduate-level number will be required to read the additional graduate-level reading; meet with the professor and other graduate students enrolled outside of class for an additional weekly discussion session; produce an annotated bibliography linking the thematic focus topic to their thesis or capstone project; and produce an individual final project that connects with their thesis or capstone work. Prerequisite: Introduction to Natural Language Processing or instructor's consent. **Class 3, Credit 3 (varies, biannually)**

Experimental Psychology

PSYC-640 **Graduate 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. (Admitted to MS in 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 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 psychology or permission of instructor) **Class 3, Credit 3 (S)**

PSYC-699 **Psychology Co-op**
Co-op in psychology. Optional for students in the MS in 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 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. This course is an elective for students in the experimental psychology MS program. (Admitted to MS in 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 MS program. (Admitted to MS in 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 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 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 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 (varies)**

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 adviser, 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) **Class 3, Credit 3 (F)**

PSYC-790 **Continuation of Thesis**
Restricted to GPSA graduate program only. Must have permission of department to register for this course. **Credit 0 (F, S)**

PSYC-799 **Independent Study**
A program of study executed by an individual student with assistance and guidance by an instructor, outside a regular classroom setting. Guidelines for designing and gaining approval for an independent study are provided in College of Liberal Arts Policy I.D. **Class variable, Credit 1-6 (F, S, Su)**

Philosophy

PHIL-703 **Seminar in Art and Aesthetics**
What is the relationship between art and knowledge, art and truth, art and politics, art and philosophical theory? What role is played in criticism by art theory, by considerations of the artists' intentions, by ethics and other forms of cultural criticism? What makes an interpretation of an artwork valid or invalid? How is aesthetic value related to other values? The questions discussed are philosophical questions about art and aesthetic experience. The meetings in this course are not lectures but discussions, and participation is required of all students. Since the theories and examples discussed are mostly from the Western canon, familiarity with the history of Western art is recommended. Graduate level elective. (Prerequisite: Enrollment in MFA program or permission of instructor) **Class 3, Credit 3 (F)**

PHIL-799 **Independent Study**
A program of study executed by an individual graduate student with assistance and guidance by an instructor, outside a regular classroom setting. Guidelines for designing and gaining approval for an independent study are provided in College of Liberal Arts Policy I.D. **Class variable, Credit 1-3 (F, S, Su)**

Public Policy

PUBL-610 **Technological Innovation and Public Policy**
Technological innovation, the incremental and revolutionary improvements in technology, has been a major driver 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, such as patents, to spur and shape innovation and its impacts on the economy and society. Students will be introduced to a global perspective on innovation policy including economic competitiveness, 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 in, and regulation of, information, computer and telecommunications technologies. In particular the course will examine such topics as privacy, freedom of speech, cybersecurity, intellectual property rights, access to information technology, and regulation of the Internet. (Graduate standing) **Class 3, Credit 3 (varies)**

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 (varies)**

PUBL-699 **Public Policy Graduate Co-op**
One semester of paid work experience in a professional setting related to the communication major. (Graduate level standing required.) **Class 0, Credit 0 (F, S, Su)**

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. Students will apply these tools to contemporary public policy decision making at the local, state, federal, and international levels. (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, including forecasting, 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. (Graduate standing) **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 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 (varies)**

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)**

PUBL-788 **Graduate Research Experience**
Gives the student first-hand experience in designing and performing research. Students are closely supervised by a faculty member, developing their pre-professional skills while learning how to do research first hand. Allows examination of a special problem or topical area in the field of Public Policy at the graduate level. Topics and specific content and methods vary from year to year or term to term. **Credit 0-6 (F, S, Su) Permission of Instructor**

PUBL-789 **Public Policy Graduate Special Topics**
Allows examination of a special problem or topical area in the field of Public Policy at the graduate level. Topics and specific content and methods vary from year to year or term to term. **Class 3, Credit 3 (varies)**

PUBL-790 **Public Policy Thesis**
The master's thesis in science, technology, and public policy requires the student to select a thesis topic, adviser 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. (Matriculation in the science, technology and public policy master's program, acceptance of a thesis proposal and satisfactory completion of a minimum of 15 graduate credits are required.) **Class variable, Credit 1-6 (F, S, Su)**

PUBL-799 **Public Policy Graduate Independent Study**
A program of study executed by an individual student with assistance and guidance by an instructor, outside a classroom setting. Guidelines for designing and gaining approval for an independent study are provided in College of Liberal Arts Policy I.D. **Class variable, Credit 1-12 (F, S, Su)**

PUBL-810 **Technology, Policy and 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 restricted to students in the Ph.D. or MS in sustainability or permission by instructor) **Class 3, Credit 3 (varies)**

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, micro-skills in counseling, classroom management, and relevant professional and legal issues. (Matriculated 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 (S)**

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. (SPSY-631 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 (F)**

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 (S)**

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 neuro-anatomy 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 (F)**

SPSY-723 Systems and Organizational Interventions
This course will assist students in building their consultation skills, with an explicit focus on systems-level issues and interventions. Students will learn principles of population-based prevention and intervention services and family-school collaboration. An array of evidence-based schoolwide interventions will be explored in depth with a focus on the role of the school psychologist within the larger system. (SPSY 620, 630, 650, 720, and 721) **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. (SPSY-631 Cognitive Assessment, SPSY-632 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 course work 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)**

SPSY-757 Special Topics in School Psychology
This course is designed to allow the student to focus on a given special topic or area of research relative 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 1 to 3 credit hours depending on the specific topic covered. **Class 1-3, Credit 1-3 (varies)**

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 science, technology and 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 science, technology, and public policy, or permission of instructor.) **Class 3, Credit 3 (S)**

STSO-750 Sustainable Communities
The concept of sustainability has driven many national and international policies. More recently, we have become aware that unless we physically build and rebuild our communities in ways that contribute to sustainability, making progress toward that goal is unlikely. It is equally important to recognize the social/cultural context of sustainability. In addition, it is at the local level that the goals of equity (a key consideration in community sustainability), most often achieved through citizen participation and collaborative processes are most easily realized. This course will broaden students understanding of the concept of sustainability, particularly the concept of social sustainability. This course focuses on sustainability as a way to bring light to the connections between natural and human communities, between nature and culture, and among environmental, economic, and social systems. Working closely with local organizations, students will explore the applicability of theoretical concepts. **Class 3, Credit 3 (F)**

STSO-789 STSO Graduate Special Topics
Allows examination of a special problem or topical area in the field of STS or Environmental Studies at the graduate level. Topics and specific content and methods vary from year to year or semester-to-semester. **Class 3, Credit 3 (varies)**

STSO-799 Science, Technoogy, and Society Graduate Independent Study
A program of study executed by an individual student with assistance and guidance by an instructor, outside a classroom setting. Guidelines for designing and gaining approval for an independent study are provided in College of Liberal Arts Policy I.D. **Class variable, Credit 1-12 (F, S, Su)**

Center for Multidisciplinary Studies

Mary Boyd, Interim Director
rit.edu/cms

Programs of Study

Master of Science degree in:	Page
Professional Studies	174

Advanced Certificate in:	
Project Management	176

Online learning option available

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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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

rit.edu/academicaffairs/cms/degrees-programs
Mary C. Boyd, Director
(585) 475-2296, mcbcms@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 an individualized 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.

For example, students interested in integrating sustainability into their career as a facilities manager might combine courses from the sustainability and facility manangement programs. Educators may be interested in combining courses from the school psychology and secondary education of students who are deaf or hard of hearing programs to improve their knowledge of special learning populations and the social issues students face in today's educational environments. Communication professionals interested in employment in government offices might choose concentrations in communication and media technologies and public policy to enhance their knowledge of media relations, public relations, government operations, and policy formation. There are a wide range of concentrations that can be created based on each student's professional career aspirations.

The degree also includes a capstone project. This applied, hands-on project is directly related to the student's individualized plan of study.

Concentration areas

Students create two or three concentrations with courses selected from a wide range of graduate programs at RIT. Some common concentration areas include:

Applied and Computational Mathematics
Applied Statistics/Quality
Bioinformatics
Business (Marketing, Management, etc.)
Chemistry
Color Science
Communication and Media Technology
Computer Engineering
Computer Science
Criminal Justice
Electrical Engineering
Environmental, Health and Safety Management
Facilities Management
Health Systems Administration
Human Resource Development
Imaging Science
Industrial and Systems Engineering Industrial Design
Information Sciences and Technologies
Microelectronics Manufacturing Engineering

Packaging Science
Product Development and Design
Project Management
Public Policy
School Psychology
Secondary Education of Students Who Are Deaf or Hard of Hearing
Service Management
Software Development
Software Engineering
Sustainability
Training, Design and Assessment
Visual Communication Design

Curriculum

The program requires the completion of 33 credit hours and can be completed through full or part-time study. Students begin their studies with Contexts and Trends (PROF-705), the program's foundation course. Throughout this course students explore their personal career objectives and research RIT's many graduate programs to identify courses that best match their professional and personal goals.

Students create two or three concentrations that make up their required course work for the degree program. Each concentration is a selection of courses drawn from existing RIT graduate programs and can range from 9 to 15 credit hours. Graduate credits earned in other programs may be used in completing a concentration, upon approval.

Credit hours not required to fulfill a concentration area may be used for electives. All elective and transferred graduate courses need to be integrated into the proposed plan of study. With certain concentrations, the degree may be completed entirely through online learning.

Required courses

Context and Trends (PROF-705)
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.

The Capstone Project (PROF-775)
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.

Professional studies, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
PROF-705	Context and Trends	3
	Concentration A courses	9
	Concentration B courses	6
Second Year		
	Concentration A or elective courses	6
	Concentration B course	3
	Concentration B or elective course	3
PROF-775	Capstone Project	3
Total Semester Credit Hours		**33**

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 a 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 for those submitting educational transcripts and diplomas from American colleges and universities.

All applicants are urged to discuss their course ideas with a professional studies graduate adviser before submitting a formal application.

Project Management, Adv. Cert.

rit.edu/academicaffairs/cms/graduate-certificates
Center for Multidisciplinary Studies
(585) 475-2234, cms1@rit.edu

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.

Project management, advanced certificate, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
BUSI-710	Project Management	3
	Approved Graduate Electives	6
BUSI-711	Advanced Project Management	3
BUSI-712	International Project Management	3
Total Semester Credit Hours		**15**

Approved electives

Center for Multidisciplinary Studies	
TCOM-621	Creating Technical Proposals
College of Applied Science and Technology	
HRDE-720	Theory of Organizational Development
HRDE-722	Talent Development
HRDE-731	Team Process and Facilitation Skills
HRDE-750	Theories of Career Development
SERQ-710	Evolving Contexts in Service
SERQ-712	Breakthrough Thinking, Creativity and Innovation
SERQ-722	Customer Centricity
Saunders College of Business	
BLEG-745	Legal and Ethical Issues in Technology-intensive Environments
MGIS-715	Information Technology and Globalization
MGMT-740	Organizational Behavior and Leadership
MGMT-741	Managing Organizational Change
MGMT-745	Social and Political Environment of Business
MGMT-755	Negotiations
MGMT-756	Power and Influence
MGMT-762	Managing New Process and Product Development
MGMT-775	Business Ethics

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 certificate can be completed entirely online, on campus, or through a combination of both options.

Mary Boyd, BA, Earlham College; MS, University of Iowa—Interim Director; Associate Professor

Thomas Hanney, Certificate, Rochester Institute of Technology; BA, St. John Fisher College; MPA, State University College at Brockport—Senior Lecturer

Samuel McQuade III, BA, Western Washington University; MPA, University of Washington; Ph.D., George Mason University—Graduate Program Director; Associate Professor

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

Business Administration Management

BUSI-710 **Project Management**
This course addresses project management from a multidisciplinary perspective, covering the fundamental nature of and techniques for managing a broad range of projects—public, commercial, and non-profit. Topics cover the project management life cycle from planning to termination. It also addresses the behavioral and quantitative facets of project management, as well as the use of spreadsheet models, project management software, and simulation for risk analysis software. Also covered are PERT, CPM, Learning Curves, and EVA. Introduces the Framework and 10 Knowledge Areas of A Guide to the Project Management Body of Knowledge (PMBOK® Guide) as defined by the Project Management Institute (PMI). Project Management is available in on-campus and online formats. (MGMT-150 or MGMT-215 or equivalent experience; STAT 145 or MTSC-211; or permission of instructor. **Credit 3 (F, S, Su) Note: Students who have taken BUSI-510 may not register for or receive credit for BUSI-710.**

BUSI-711 **Advanced Project Management**
Advanced Project Management covers the topics necessary for implementation of and excellence in project management. It deals with turning the principles and theory of project management into practice. The course addresses the best practices for project management in the world; project portfolio management and ROI; the project office and Six Sigma; project risk management and integrated projects; corporate cultures, behavior, and cultural failures; informal, adaptive, and extreme project management; and critical chain project management. It integrates aspects of A Guide to the Project Management Body of Knowledge (PMBOK® Guide). Advanced Project Management is available in on-campus and online formats. (BUSI-710; or permission of the instructor.) **Credit 3 Note: BUSI-411, an undergraduate course, is sometimes co-listed with BUSI-711; however, BUSI-411 may not be substituted for BUSI-711 in a CMS graduate concentration or the CMS advanced certificate in project management. Additionally, a student may not register for and receive credit for both BUSI-411 and BUSI-711, whether taken as an undergraduate or graduate student.**

BUSI-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. It deals with cultural and social differences within firms, among countries, and within countries; language and dialect variations; varying project management practices and structures; religious practices; legal, regulatory, and reporting requirements; technology and infrastructure differences; time zone differences; and political contexts. International Project Management is available in on-campus and online formats. (BUSI-710, BUSI-711 or permission of the instructor). **Credit 3 Note: BUSI-412, an undergraduate course, is sometimes co-listed with BUSI-712; however, BUSI-412 may not be substituted for BUSI-712 in a CMS graduate concentration or the CMS advanced certificate in project management. Additionally, a student may not register for and receive credit for both BUSI-412 and BUSI-712, whether taken as an undergraduate or graduate student.**

MGNL-751 **Principles of Games and Learning**
Games are changing the way we think about learning and knowledge acquisition in a number of ways. The impact that digital media has had upon current and future generations is only now beginning to be examined in detail, and our current understanding of games and interactive media, and the ways in which these experiences can transform education, is not yet well understood. This course compares formal learning theories such as constructivism, behaviorism, constructionism, zone of proximal development, Gestalt Theory and similar topics with in-game examples and experiences that (knowingly or unknowingly) use these methodologies in a game based context. An examination of human motivation and preferred methods of learning are also addressed in this course, as are current games, apps, and media pieces that succeed (or fail) in formal and informal educational contexts. The course will include discussion of how games and media are beginning to be examined in light of the national discourse on education. Students in the course will be expected to read, play, and discuss relevant theories, games and interactive media, and participate in class activities which may include papers, exams, and projects (Graduate standing). **Class 3, Credit 3 (F, F1)**

MGNL-752 **Constructivism and Constructionism in Virtual Worlds**
This course provides advanced exploration of constructionist and constructivist principles as they apply to games and virtual environments. Two major themes that define the course are (a) building virtual or virtual/physical hybrid artifacts to advance underlying systems knowledge and to prove/disprove initial hypotheses, and (b) the role of games as third places – i.e. the removal of fear of failure from the educational process and the role of play as a motivation for experimentation. Students in the course will be expected to read and discuss relevant theories, play games, and use interactive media while participating in other class activities such as required papers, exams, and projects (MGNL-751 Principles of Games and Learning). **Class 3, Credit 3 (S, F2)**

MGNL-753 **Multi-player Games as Learning Communities**
This course explores game design principles and deep learning as defined by Gee, Squire, and used in popular games and online platforms and player communities. Emphasis is given to player identity, communication, cooperation, competition, bonding and bridging. These unique concepts are discussed with respect to their impact on individual and groups of players and the overall a learning (i.e., gaming) community. The course concludes with a discussion of bridging and the relationship to diversity and informal education, and the notion of an online community as a form of diversity that challenges a learner's reified world view: i.e. in shared play spaces as a third place the opportunities for informal social bridging is of itself an educational success. Students will play several games and media titles as a part of the course work experience, both hosted by RIT and available commercially, as well as contribute to class discussions, critique, and analysis through written and recorded presentations (Pre-requisite: MGNL-751 Principles of Games and Learning). **Class 3, Credit 3 (F, S1)**

Professional Studies

PROF-705 **Context and Trends**
The gateway course for students enrolled in the MS in professional studies degree program. Course provides students with opportunities to interact about controversial issues while discovering foundational knowledge about interdisciplinary history, theory, along with applied problem-solving, research methods and professional ethics. Students use this course as a means of designing and receiving approval for individualized plans of study. (Department permission required). Students should consult their adviser before registering. **Class 3, Credit 3 (F, S)**

PROF-770 **Capstone Proposal Seminar**
This course guides the student through preparation of the capstone proposal that is required for the applied final course of his/her MS in professional studies degree - the capstone project. Students will determine a capstone project concept, and articulate the methods for implementing the capstone project. The course concludes with a paper describing the capstone project, including background and description, methodology, anticipated outcomes, and probable capstone adviser. Student will meet regularly with the course facilitator. Upon successful completion of this course, student will be registered for the capstone project. (Pre-requisites: PROF-705 and core coursework; course restricted to MS in professional studies students) **Class 0, Lab 0, Credit 0 (F, S, Su)**

PROF-775 **Capstone Project**
The capstone course for students enrolled in the MS in professional studies degree program. With individualized advising from a faculty adviser, students participate in a real world problem solving project carried out in an organizational setting. Problems selected for project work relate to a student's professional course concentrations. Course requirements involve completing a literature review, writing a project proposal, engaging in online discussion with faculty adviser and other CMS capstone students, various kinds of field work carried, writing full draft and final academic reports and making a (Powerpoint) presentation. Registration completed on behalf of students following faculty review of acceptable capstone project proposal. (PROF 770; Department approval) **Class 3, Credit 3 (F, S, Su)**

PROF-798 **Independent Study**
Prerequisites: Graduate standing and permission of faculty. **Class 3, Credit 3**

PROF-799 **Special Topics**
Special topics are experimental courses announced each semester. Variable credit.

Quality Management

QLTM-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 asset management programs. (QLTM-340 or an equivalent statistics course; graduate standing or permission of instructor **Class 3, Credit 3 (S)**

Technical Communication

TCOM-610 Introduction to User Experience Design
This course introduces students to the design process for researching, identifying, and implementing a user experience strategy for online Web and app development. Students will learn to gather needed source material and organize, write and formulate cross-platform information architecture and wireframe solutions across various platforms based on graphical user interface requirements and trends. The user experience workflow will cover; client problem solving, audience identification and needs, content organization, information architecture processes, wireframing methods and basic UX validation. Students will complete a simulated UX solution based on personal professional experiences and content. Course is restricted to online students only. (Graduate status) **Class 2, Lab 4, Credit 3 (F, S)**

TCOM-611 Introduction to Interactive Technologies
This course provides an introduction to key Internet, Web and mobile technologies. Topics covered include computer-based communication and information systems: basic HTML 5, CSS, JavaScript, WYSIWYG editors for creating content and project workflows for delivery online content. The course will examine and integrate programmatic solutions and processes for single and responsive design solutions. Best practices and technologies for hybrid, native and Web solutions will be identified and explored. Course is restricted to online students only. (Graduate status) **Class 2, Lab 4, Credit 3 (F, S)**

TCOM-621 Proposal Writing
This course focuses on reviewing examples of the elements of proposal responses and practicing creating those elements. Students learn the process of evaluating and responding to RFIs and RRPs with concentration on making bid decisions, organizing teams, identifying strategies, establishing credibility, ensuring technical clarity, taking advantage of technology, applying creativity, and writing persuasively. Topics include the proposal process that is practiced by government, industry, and grant-funding agencies. Co-listed with TCOM-414. (Prerequisites: Basic course in college writing and ability to write concisely, including proper use of grammar and punctuation; graduate standing or permission of instructor.) **Class 3, Credit 3 (S)**

TCOM-644 Science Writing
Course introduces students to the writing process for describing scientific and technological subject matter for presentation to general audiences. Students will learn to gather needed source material and organize, write and edit articles that cover developments in the scientific and technological communities. Various article formats used in professional, in-house, trade and popular publications are presented. Students who have taken TCOM-444 may not enroll for this course. (Graduate status) **Class 3, Credit 3 (F)**

National Technical Institute for the Deaf

Gerard Buckley, President, NTID; Vice President and Dean, RIT
ntid.rit.edu

Programs of Study

The National Technical Institute for the Deaf (NTID) is the world's largest technological college for deaf students. Among RIT's more than 18,300 full- and part-time students are more than 1,200 undergraduate and graduate deaf students from the United States and 16 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.

Admission requirements

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

Secondary Education of Students Who Are Deaf or Hard of Hearing, MS

rit.edu/NTID/msse
Gerald C. Bateman, Director
(585) 475-6776 (voice),(585) 286-4282 (VP), 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.

Secondary Education of Students Who Are Deaf or Hard of Hearing, MS

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Curriculum

Secondary education for students who are deaf or hard of hearing, MS degree, typical course sequence

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	Special Education in the Social Context	3
MSSE-710	General Instructional Methods	3
MSSE-712	Practicum	2
MSSE-713	Assessment Principles and Practices	3
MSSE-715	Issues in Mainstreamed Education	3
MSSE-725	Structures of ASL and English	3
MSSE-726	Language Acquisition and Learning	3
MSSE-727	ASL in Instructional Delivery	3
MSSE-785	Foundations of Educational Research	3
Second Year		
MSSE-702	Educational and Cultural Diversity	3
MSSE-704	Teaching Deaf and Hard of Hearing Learners Special Educational Needs	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-760	Student Teaching I*	6
MSSE-761	Student Teaching II*	6
MSSE-790	Professional Portfolio	3
MSSE-794	Inquiry in Teaching (elective)	(3)
Total Semester Credit Hours		**62**

* 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 must be completed before the first student teaching placement.

Degree requirements

Course work requires a minimum of four semesters. 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 from 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 American 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,
- Submit scores from Graduate Record Exam (GRE),
- 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. Please 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

Financial Aid

NTID tuition is approximately 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 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 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. There also are numerous on-campus student employment opportunities available.

Gerald C. Bateman, BS, MS, State University College at Geneseo; Ed.D., University of Rochester—Professor; Director, Curriculum and Teaching

Carol Lee De Filippo, BA, Newark State College; MS, Purdue University; MS, Ph.D., Washington University—Professor, Communication Sciences: Audiology

Susan B. Foster, BA, Northwestern University; BS, University of Maine; M.Ed., Bridgewater State College; Ph.D., Syracuse University—Professor, Special Education and Rehabilitation

Melinda J. Hopper, BS, MS, Illinois State University; Ph.D., University of Rochester—Lecturer, Literacy and the Deaf Adolescent

Ronald R. 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 A. N. Kurz, BS, Rochester Institute of Technology; MS, Ph.D., University of Kansas—Associate Professor, Special Education: Education of Deaf Students

Ila Parasnis, BA, MS, Nagpur University (India); MA, Ph.D., University of Rochester—Professor, Psychology

Thomastine Anne Sarchet, BS, MS, Rochester Institute of Technology—Research Associate, NTID Center for Educational Research Partnerships (CERP); Adjunct Instructor, Teaching and Curriculum

Deirdre A. Schlehofer, BA, University of Alaska; M.Phil., University of Bristol (United Kingdom); Ed.D., University of Rochester—Assistant Professor, Language Acquisition and Learning

Sara Schley, BA, Reed College; MA, Northeastern University; Ed.D., Harvard University—Associate Professor, Human Development and Language Acquisition

Michael S. Stinson, BA, University of California at Berkeley; MA, Ph.D., University of Michigan—Professor, Educational Psychology

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 Special Education in the Social Context
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, Credits 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, 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 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 and 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; MLAS-202 Beginning ASL II with a grade of C or higher or equivalent skill). **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)**

Deafness Specialty Preparation Program in Speech-Language Pathology

NCOM-720 Cochlear Implants in Children
Students will learn to make and implement effective clinical decisions that result in optimal care of children with cochlear implants and hearing aids. Students will study deafness in children and the technologies, programs, and services that enhance spoken communication and learning. Students will develop an understanding of the impact of medical, socio-economic, and cultural factors on clinical interventions with children with deafness. (Co-requisite: student in Nazareth Deafness Specialty Program or permission of instructor) **Class 3, Credit 3 (F)**

College of Science

Sophia Maggelakis, Dean
rit.edu/cos

Programs of Study

Doctor of Philosophy degrees in:	Page
Astrophysical Sciences and Technology *Tracks available in: astrophysics, astro-informatics and computational astrophysics, astro-informatics and computational astrophysics (general relativity concentration), and astronomical instrumentation.*	195
Color Science	198
Imaging Science	189

Master of Science degrees in:	Page
Applied and Computational Mathematics *Options available in: discrete mathematics, dynamical systems, and scientific computing.*	193
Astrophysical Sciences and Technology	194
Bioinformatics	191
Chemistry	184
Color Science	197
Environmental Science	192
Imaging Science	188
Materials Science and Engineering (offered jointly with College of Engineering)	186

Online learning option available

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

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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.

School of Chemistry and Materials Science

rit.edu/cos/scms
Paul Craig, School Head
(585) 475-6145, paul.craig@rit.edu

The School of Chemistry and Materials Science offers MS programs in chemistry and in materials science and engineering (offering jointly with the Kate Gleason College of Engineering).

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 School of Chemistry and Materials Science 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 develop the ability to attack scientific problems with minimal supervision.

Curriculum

The program offers two options: a thesis option and a project option. Concentrations are available in organic, analytical, inorganic, physical chemistry, polymer chemistry, materials science, and biochemistry. Customized concentrations are available to accommodate specific student interests and needs relating to graduate study in chemistry.

Each student, together with an adviser, chooses courses to create a customized curriculum that best meets their interests, needs, and career aspirations. Each student's curriculum 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 30 semester credit hours beyond the bachelor's degree.

Courses in chemistry will generally be chosen from 600- and 700-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, organic chemistry, and physical chemistry. As part of the required credits, each student must have four semester credit hours in seminar (CHEM-771, 772, 773, 774).

2. Ten credit hours in research (minimum) for the thesis option

A minimum of 10 semester credit hours are required with the thesis option. For students who opt for the project option, four semester hours of project are required.

3. Passage of an oral defense of the MS thesis

Students enrolled in the thesis option are expected to complete an independent research thesis and pass an oral defense. Typically, all requirements are met within two years.

Chemistry (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CHEM-771, 772	Graduate Chemistry Seminars	2
	Graduate Chemistry Focus Courses	12
CHEM-670	Graduate Chemistry Writing	1
CHEM-790	Research and Thesis Guidance	5
Second Year		
CHEM-773, 774	Graduate Chemistry Seminars	2
	Graduate Chemistry Focus Course	3
CHEM-790	Research and Thesis Guidance	5
Total Semester Credit Hours		**30**

Chemistry (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CHEM-771, 772	Graduate Chemistry Seminars	2
	Graduate Chemistry Focus Courses	12
CHEM-670	Graduate Chemistry Writing	1
Second Year		
CHEM-773, 774	Graduate Chemistry Seminars	2
	Graduate Chemistry Focus Courses	9
CHEM-780	Chemistry Project	4
Total Semester Credit Hours		**30**

Admission requirements

To be considered for admission to the MS program in chemistry, candidates 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 language 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 submitting transcripts from American universities, or those 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 participate in 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 6 semester 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

Courses are offered in the late afternoons and evenings to encourage practicing chemists to pursue the MS degree without interrupting their employment. Part-time students may take the project option, which includes a capstone project in place of a thesis. Students employed full time normally take one course each semester. At this pace, course work can be completed within four to five years.

Equipment

The School of Chemistry and Materials Science 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 school's website for a complete list of equipment and instrumentation.

External research credit

The School of Chemistry and Materials Science 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

Students at the master's level who have, or are able to obtain, industrial employment may be able to earn cooperative education credit for their work experiences. Semesters of co-op can be interspersed with semesters of full-time academic work. Research credits may be obtained through external research credit. If industrial employment does not permit research, then research credits may be obtained within the School of Chemistry and Materials Science.

Materials Science and Engineering, MS

rit.edu/cos/cmse/

Paul Craig, Interim Program Director
(585) 475-6145, paul.craig@rit.edu

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

A minimum of 30 semester credit hours is required for the completion of the program. This includes five required core courses, graduate electives, and either a thesis or project. The core courses are 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.

Elective courses may be selected from advanced courses offered by the School of Chemistry and Materials Science 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.

Materials science and engineering (thesis option), MS degree, typical course sequence

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

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 TOEFL score of 575 (paper-based) or 88-89 (Internet-based) is required. 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/Project

Students may choose to complete a thesis or a project as a conclusion to their program. Students who pursue a thesis will take two graduate electives and complete nine semester credit hours of research and produce a thesis paper. The project option includes completing four graduate electives and a 3 semester credit hour project.

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 6 semester credit hours, each semester. A student who wishes to register for more than 6 semester credit hours must obtain the permission of his or her adviser.

Maximum limit on time

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.

Chester F. Carlson Center for Imaging Science

cis.rit.edu
Stefi A. Baum, Director
(585) 475-6220, baum@cis.rit.edu

The Chester F. Carlson Center for Imaging Science offers masters and doctoral degrees in imaging science and color science. The science of imaging encompasses a wide range of subject areas, from the physics of light sources to the psychophysics of high-level visual perception. From how light is generated to how the world is perceived, imaging science addresses questions about every aspect of systems and techniques that are used to create, perceive, analyze, and optimize images. Application areas of imaging are equally diverse. Thus, imaging science is interdisciplinary in its content and multi-disciplinary in its applications. The center conducts research and prepares students for challenging and rewarding careers in a range of imaging application areas.

Imaging Science, MS

cis.rit.edu/node/1020
John Kerekes, Graduate Program Coordinator
(585) 475-6996, kerekes@cis.rit.edu

Program overview

The master of science program in imaging science prepares students 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 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 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, vision, 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 program can be completed on a full- or a part-time basis. Some courses are available online, specifically in the areas of color science, remote sensing, medical imaging, and digital image processing.

Curriculum

All students must earn 30 credit hours as a graduate student. 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 the following core courses: Fourier Methods for Imaging (IMGS-616), Digital Image Processing (IMGS-682), Optics for Imaging (IMGS-633), and either Radiometry (IMGS-619) or The Human Visual System (IMGS-620).

Speciality track courses

Students choose two courses 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

The research thesis is based on experimental evidence obtained by the student in an appropriate field, as arranged between the student and their adviser. The minimum number of thesis credits required is four 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 or the student's place of employment, under the following conditions:

1. The results must be fully publishable.
2. The student's adviser must be approved by the graduate program coordinator.
3. The thesis must be based on 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 a master's dgeree 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 coordinator, may choose the graduate project option (3 credit hours). This option takes the form of a systems project course. The graduate paper is normally performed during the final semester of study. Both part- and full-time students may choose this option, with the approval of the graduate program coordinator.

Imaging science (thesis option), MS degree, typical course sequence

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, 607	Imaging Science Seminar I, II	2
IMGS-682	Digital Image Processing	3
IMGS-633	Optics for Imaging	3
	Specialty Track Course	3
Second Year		
	Specialty Track Course	3
	Elective	3
IMGS-790	Research and Thesis	4
Total Semester Credit Hours		**30**

Imaging science (project option), MS degree, typical course sequence

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	3
Second Year		
	Specialty Track Course	3
	Electives	6
	MS Systems Project	3
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) 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 applicants 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

Applicants who lack adequate preparation may be required to complete bridge courses in mathematics or physics before matriculating with graduate status.

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.

Imaging Science, Ph.D.

cis.rit.edu/node/1022

John Kerekes, Graduate Program Coordinator
(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. Graduates will contribute to an increase in the fundamental body of knowledge associated with imaging science. They will acquire the capabilities, skills, and experience to continue to expand the limits of the discipline, and to meet future scholarly, industrial, and government demands on the field.

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 credit hours of course work and research. The core curriculum includes courses that span and integrate a common body of knowledge essential to an understanding of imaging processes and applications. Courses are defined by the student's study plan and must include core course sequences plus a sequence in a topical area such as remote sensing, digital image processing, color imaging, digital graphics, electro-optical imaging systems, medical imaging, and microlithographic imaging technologies.

Students may take a limited number of credit hours in other departments and must complete research credits including two credits of research associated with the research seminar course, Graduate Seminar (IMGS-606, 607).

Graduate elective courses offered by the Center for Imaging Science (and other RIT academic departments in fields closely allied with imaging science) allow students to concentrate their studies in a range of imaging science research and imaging application areas, including electro-optical imaging, digital image processing, color science, perception and vision, electrophotography, lithography, remote sensing, medical diagnostic imaging, electronic printing, and machine vision.

Imaging science, Ph.D. degree, typical course sequence

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, 610	Graduate Laboratory I, II	2
IMGS-606, 607	Graduate Seminar I, II	2
IMGS-682	Digital Image Processing	3
IMGS-633	Optics for Imaging	3
	Specialty Track Course	3
Second Year		
IMGS-613	Probability, Noise and System Modeling	3
	Specialty Track Course	3
	Graduate Electives	6
IMGS-890	Research and Thesis	1
Third Year		
IMGS-890	Research and Thesis	10
Fourth Year		
IMGS-890	Research and Thesis	10
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 qualifying exam
- Study plan revision based on outcome of qualifying exam and adviser recommendation
- Research committee appointment
- Candidacy exam based on thesis proposal

Following the qualifying exam, faculty decide whether a student will continue on the doctoral program or if the pursuit of an MS degree or other program option is more acceptable. For students who continue in the doctoral program, the student's plan of study will be revised, a research committee is appointed, candidacy/proposal exams are scheduled, and, finally, a dissertation defense is presented.

Research committee

Prior to the candidacy exam, the student, in consultation with an adviser, must present a request to the graduate program coordinator for the appointment of a research committee. The committee is composed of at least four people: an 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 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 their research adviser select a research topic for the dissertation. Proposed research must be original and publishable. Although the topic may deal with any aspect of imaging, research is usually concentrated in an area of current interest within the center. The research proposal is presented to the student's research committee during the candidacy exam at least six months prior to the dissertation defense.

Final examination of the dissertation

The research adviser, on behalf of the student and the student's research committee, must notify the graduate program coordinator of the scheduling of the final examination of the dissertation by forwarding to the graduate program coordinator 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 coordinator), 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 coordinator 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) (if seeking financial assistance),
- 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. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- 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) or 100 (Internet-based) are required. Students may also submit scores from the International English Language 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.

Admission 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 credit toward the doctoral degree after successful completion of the qualifying examination and approval of their study plan. (Students should consult their academic adviser for more information.) The required research credits may not be waived by experience or examination.

Additional information

Residency

All students in the program must spend at least two consecutive semesters (summer excluded) as resident full-time students to be eligible to receive the doctoral degree. If circumstances warrant, the residency requirement may be waived via petition to the graduate program coordinator, 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

University policy requires that doctoral programs be completed within seven years of the date of the student passing the qualifying exam. Bridge courses are excluded.

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.

Thomas H. Gosnell School of Life Sciences

rit.edu/cos/lifesciences
Larry Buckley, Head
(585) 475-7507, ljbsbi@rit.edu

The School of Life Sciences offers MS degrees in bioinformatics and environmental science.

Bioinformatics, MS

bioinformatics.rit.edu/
Michael V. Osier, Director
(585) 475-4392, mvoscl@rit.edu

Program overview

The master of science degree in bioinformatics provides students with a strong foundation in biotechnology, computer programming, computational mathematics, statistics, and database management. Graduates of the program 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 graduate degree in bioinformatics, particularly when coupled with industry-sponsored research as thesis work. This research provides 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 the program 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 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.

The program is offered on a full- or part-time basis to fulfill the needs of traditional students and those currently employed in the field.

Curriculum

A minimum of 30 semester credit hours is required for completion of the program. A number of 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 relevant RIT graduate courses.

Bioinformatics, MS degree, typical course sequence

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	6
Total Semester Credit Hours		**30**

* Any graduate level course deemed related to the field of bioinformatics by the program director.

Admission requirements

To be considered for admission to 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 from an accredited institution,
- 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 must submit scores from the Test of English as a Foreign Language (TOEFL). A minimum score of 79 (Internet-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 6.0. For additional information about the IELTS, please visit www.ielts.org.

Environmental Science, MS

rit.edu/cos/environmental/
Christy Tyler, Director
(585) 475-5042, actsbi@rit.edu

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 by the Thomas H. Gosnell School of Life Sciences in the College of Science in collaboration with the department of science, technology, and society in the College of Liberal Arts. The curriculum provides 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, human well-being, and economic development. Students augment their hands-on classroom work with in-depth experiential learning through an individual thesis or project providing students with 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 34 semester credit hours beyond the bachelor's degree is required. All students must propose, conduct, and report on an original research thesis or project.

Environmental science (thesis option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ENVS-601	Environmental Science Graduate Studies	3
MATH-655	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	6
Total Semester Credit Hours		**34**

Environmental science (project option), MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ENVS-601	Environmental Science Graduate Studies	3
MATH-655	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	6
Total Semester Credit Hours		**34**

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) 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 faculty members are engaged in field-based projects and the college boasts excellent laboratory facilities that support field research, including 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, Li-Cor light meter, plankton samplers, macroinvertebrate 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, Unisense microelectrode system, Lachat autoanalyzer, incubators, infrared spectrophotometers, capillary electrophoresis, DSCs, DMA, Asher, 300 MHz NMR, drying oven, and a Wiley mill.

School of Mathematical Sciences

math.rit.edu
Mihail Barbosu, Head, School of Mathematical Sciences
(585) 475-5440

Responding to the growing demand from industry, government, and academia for mathematicians and statisticians with strong quantitative and computing skills, the School of Mathematical Sciences offers an MS degree in applied and computational mathematics. Constant feedback from various sources, including alumni, has enabled the school to update its courses, programs, and equipment in order to make sure students are well-trained in current techniques, technology, and applications. Students utilize symbolic mathematical and statistical software in many courses. Our workshop classrooms and statistics labs provide support for all of our programs. Industrial needs and trends are carefully discussed with employers in order to update our curricula, and graduates find that their RIT mathematics and statistics education is tailor-made for their professional careers.

Applied and Computational Mathematics, MS

rit.edu/cos/sms/academics.html
Nathan Cahill, Graduate Program Director
(585) 475-5144, nathan.cahill@rit.edu

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 master of science degree in applied and computational mathematics provides 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. The program offers options in discrete mathematics, dynamical systems, and scientific computing. Students will complete a thesis, which includes the presentation of 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.

Curriculum

Applied and computational mathematics (discrete mathematics option), MS degree, typical course sequence

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

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

COURSE		SEMESTER CREDIT HOURS
First Year		
MATH-611	Numerical Analysis	3
MATH-651	Combinatorics and Graph Theory I	3
	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**

Admission requirements

To be considered for 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 (applicant's should have completed course work in 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) 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

Cooperative education enables students 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 semester. Co-op is optional for this program.

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 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 course instructor. Courses taken for credit may be applied toward the master's degree if the student is formally admitted to the program at a later date. However, the number of credit hours that may be transferred in to the program from courses taken at RIT is limited for nonmatriculated students.

School of Physics and Astronomy

rit.edu/cos/physics/
Michael Kotlarchyk, Head
(585) 475-6115, mnksps@rit.edu

The School of Physics and Astronomy offers MS and doctoral degrees in astrophysical sciences and technology.

Astrophysical Sciences and Technology, MS

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 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 program's multidisciplinary emphasis sets it apart from conventional astrophysics graduate programs at traditional research universities.

Curriculum

The MS program comprises a minimum of 32 credit hours of study. The curriculum consists of four core courses, four elective courses, two semesters of graduate seminar, and a research project culminating in a thesis.

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 and consists 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.

Astrophysical sciences and technology, MS degree, typical course sequence

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, 602	Graduate Seminar I	2
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
Second Year		
ASTP-740	Galactic Astrophysics	3
ASTP-790	Research and Thesis	6
ASTP-750	Extragalactic Astrophysics	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 from 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) 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 lacking adequate academic preparation or for those who hold a bachelor's degree in an area other than those listed above, 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. Upon 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, Ph.D.

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 program's multidisciplinary emphasis sets it apart from conventional astrophysics graduate programs at traditional research universities.

Curriculum

Students must complete a minimum of 60 credit hours of study, consisting of at least 27 credit hours of course work and at least 24 credit hours of research. Students may choose to follow one of three tracks: astrophysics, astro-informatics and computational astrophysics (with the option of a concentration in general relativity), or astronomical instrumentation. All students must complete four core courses and two semesters of graduate seminar. The remaining course credits are made up from specialty track courses and electives. Students must successfully complete a master's-level research project and pass a written qualifying examination prior to embarking on the dissertation research project.

Astrophysical sciences and technology, Ph.D. degree, typical course sequence

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, 602	Graduate Seminar I, II	2
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
Second Year		
	Specialty Track Courses	6
	Elective	3
ASTP-890	Research and Thesis	4
	Elective or Specialty track course	3
ASTP-890	Research and Thesis	4
Third Year		
ASTP-890	Research and Thesis	10
Fourth Year		
ASTP-890	Research and Thesis	10
Total Semester Credit Hours		**60**

Tracks

Astrophysics

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		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		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		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

Electives include additional courses in astrophysics, detector development, digital image processing, computational techniques, optics, and entrepreneurship, among others. 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 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. Assessment is based on a combination of a written project report and an oral presentation.

Admission to candidacy

Students must pass a qualifying examination after completing the core curriculum and prior to embarking on the doctoral 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 program's 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 and including the student's research adviser and two additional faculty members, will assess the student's overall qualifications. Students must pass the qualification examination by the beginning of the third year of full-time study or its equivalent, to continue in the program. Students are permitted two attempts to pass the exams.

Dissertation research adviser

After passing the qualifying examination, each 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

The program director will conduct an annual review to ascertain the progress of the student's work. 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, each student gives 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 at least two letters of academic and/or professional recommendation. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- 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) 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.

Additional information

Residency

All students in the program must spend at least one year (summer term excluded) in residence as full-time students to be eligible to receive the doctorate degree.

Time limitations

All doctoral candidates must maintain continuous enrollment during the research phase of the program. Normally, full-time students complete the course of study 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 enrolled in the astrophysical sciences and technology MS program may be allowed to attempt the Ph.D. qualifying examination. Upon 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 Programs

Color Science, MS

rit.edu/cos/colorscience/

Mark D. Fairchild, Graduate Program Director
(585) 475-2784, mdf@mail.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 scienxsce, 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 program revolves around the activities of the Munsell Color Science Laboratory within the College of 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 30 semester credit hours as a graduate student to earn the master of science degree. For full-time students, the program requires three to four semesters of study. Part-time students generally require two to four years of study. 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 indicate to the program director if they will complete a research thesis or graduate project at the conclusion of their degree.

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. 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 9 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.

Color science, MS degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CLRS-601	Principles of Color Science	3
CLRS-720	Computational Vision Science	3
CLRS-750	Historical Research Perspectives	1
CLRS-602	Color Physics and Applications	3
CLRS-820	Modeling Visual Perception	3
CLRS-751	Research and Publication Methods	2
CLRS-820	Electives	6
Second Year		
	Research	6
	Elective	3
Total Semester Credit Hours		**30**

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) 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

Scholarships and assistantships are available for qualified color science applicants and 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.

Color Science, Ph.D.

rit.edu/cos/colorscience/

Mark D. Fairchild, Graduate Program Director
(585) 475-2784, mdf@mail.rit.edu

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 60 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 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, might be required to complete undergraduate foundation courses in mathematics, statistics, computer science, and general science before matriculating with graduate status.

Curriculum

The degree requires 60 credit hours of course work and research.

Core courses

The following core courses are completed during the first year of study: Principles of Color Science (CLRS-601), Computational Vision Science (CLRS-720), Color Physics and Applications (CLRS-602), Modeling Visual Perception (CLRS-820), Historical Research Perspectives (CLRS-750), and Research and Publication Methods (CLRS-751).

Electives

Elective courses are selected depending on the student's interests and background. The program director must approve all electives.

Color science, Ph.D. degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
CLRS-601	Principles of Color Science	3
CLRS-720	Computational Vision Science	3
CLRS-750	Historical Research Perspectives	1
CLRS-602	Color Physics and Applications	3
CLRS-820	Modeling Visual Perception	3
CLRS-751	Research and Publication Methods	2
CLRS-820	Electives	6
Second Year		
	Research	6
	Elective	3
	Research or Electives	12
Third Year		
	Research	12
Fourth Year		
	Research	6
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. 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 and 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 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 semester 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.

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 includes 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 a professional 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 semester 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 program director. For example, the dissertation research adviser or the dissertation committee might 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 at least two letters of academic and/or professional recommendation. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- 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 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. 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.

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 600 (paper-based) or 100 (Internet-based). Students who submit IELTS scores must have a minimum score of 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 semesters (summer may be excluded) as resident full-time students to be eligible to receive the Ph.D.

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. 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 might be waived. Thus, it might be possible for students with graduate degrees in a related discipline to take the qualifying examination during their first year of study. The color science graduate program director determines the specific courses and credit hours that can be applied toward the Ph.D. in Color Science.

Sophia A. Maggelakis, BS, MS, Ph.D., Old Dominion University—Dean

Bioinformatics

Gregory Babbitt, BA, Ohio Wesleyan University; MS, Ph.D., University of Florida—Assistant Professor: evolution of the biophysical properties of whole genomes and their interactions with DNA binding proteins

Feng Cui, MS, Truman State University; Ph.D., Iowa State University; MD, Hunan Medical University (China)—Assistant Professor, Bioinformatics: Next-generation sequencing, modeling genome-wide nucleosome positions, analysis of genome-wide p53 binding sites

André Hudson, BS, Virginia Union University; Ph.D., Rutgers University—Associate Professor, Biology: amino acid metabolism, bacteria-plant interactions

David A. Lawlor, BA, University of Texas; MS, Ph.D., University of Texas Health Science Center at San Antonio—Associate Professor, Biotechnology: immunology

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

Gary K. Skuse, BA, University of Rochester; Ph.D., Syracuse University—Professor, Bioinformatics: cancer genetics, RNA processing, amateur radio, computer networking and communications

Environmental Science

Larry Buckley, BA, University of Missouri; MS, Southern Illinois University at Edwardsville; Ph.D., Southern Illinois University at Carbondale—Head, Thomas H. Gosnell School of Life Sciences; Associate Professor, Biology: herpetology, evolution of iguanas, biogeography, systemics

Elizabeth Hane, BA, Rice University; MA, University of Kansas; Ph.D., Brown University—Associate Head, Thomas H. Gosnell School of Life Sciences; Associate Professor, Biology: plant community ecology, ecosystem biology, conservation biology

M. Ann Howard, BS, Cornell University; J.D. Rutgers University School of Law— Professor, College of Liberal Arts, Science, Technology and Society/Public Policy: relationship between environmental decision-making and the role of citizen involvement, sustainable community development

Christine Keiner, BA, McDaniel College (formerly Western Maryland College); Ph.D., Johns Hopkins University—Associate Professor, College of Liberal Arts, Science, Technology and Society/ Public Policy: history of ecology and biology, U.S. environmental politics, and relations between science and politics

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

Jeffrey S. Lodge, BA, University of Delaware; Ph.D., University of Mississippi—Associate Professor, Biology: bioremediation of oil-contaminated sites and industrial waste streams

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, College of Liberal Arts, Science, Technology, Society/Public Policy: practical problems associated with the conservation of biodiversity

Paul Shipman, BSE, MS, Emporia State University; Ph.D., Oklahoma State University—Associate Professor, Biology: ecological informatics, conservation of amphibians and reptiles, behavioral and evolutionary ecology

Susan Smith Pagano, BS, State University College at Oswego; MS, State University College at Brockport; Ph.D., University of Rhode Island—Assistant Professor, Environmental Science: avian nutritional ecology and migration physiology

Anna Christina Tyler, BS, Cornell University, MS, Ph.D., University of Virginia—Graduate Program Director, Environmental Science; Associate Professor, Environmental Science and Biology: aquatic ecology, biogeochemistry, invasive species, ecosystem restoration

Jan van Aardt, BSc, University of Stellenbosch (South Africa); MS, Ph.D., Virginia Polytechnic Institute and State University—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

Jeffrey Wagner, AB, University of Missouri at Columbia; MS, Ph.D., University of Illinois-Urbana—Associate Professor, College of Liberal Arts, Economics: sustainable waste management

Applied and Computational Mathematics

Anurag Agarwal, MS, Indian Institute of Technology (India); Ph.D., State University of New York at Buffalo—Associate Professor, Number Theory, Cryptography, Algebra, Graph Theory

Ephraim Agyingi, BS, MS, University of Ilorin (Nigeria); Ph.D., University of Manchester (United Kingdom)—Associate Professor, Numerical Analysis

David S. Barth-Hart, BS, Syracuse University; MA, University of Rochester—Associate Professor, Algebra, Number Theory

Maurino P. Bautista, BS, Ateneo de Manila University (Philippines); MS, Ph.D., Purdue University—Professor, Numerical Analysis, Applied Mathematics

Bernard Brooks, BS, University of Toronto (Canada); MBA, Rochester Institute of Technology; MS, Ph.D., University of Guelph (Canada)—Professor, mathematical modeling

Nathan Cahill, BS, MS, Rochester Institute of Technology; D.Phil., University of Oxford (United Kingdom)—Associate Professor, scientific computing, biomedial image analysis, computer vision

Manuela Campanelli, Laurea in Mathematics, University of Perugia (Italy); Ph.D., University of Bern (Switzerland)—Director, School of Mathematical Sciences; Professor: numerical relativity, gravitational physics, computational astrophysics

Linlin Chen, BS, Beijing University (China); MCS, Rice University; MA, Ph.D., University of Rochester—Assistant Professor, statistics, biostatistics, statistical consulting, genetics, bioinformatics and computational biology

Elizabeth Cherry, BS, Georgetown University; Ph.D., Duke University—Associate Professor, Computational Cardiac Dynamics

Patricia A. Clark, SB, SM, Massachusetts Institute of Technology; Ph.D., University of Rochester—Professor, Mathematical Biology

Matthew Coppenbarger, BS, University of Arizona; MA, Ph.D., University of Rochester—Associate Professor, Mathematical Physics, Spectral Theory

Joshua Faber, BS, State University of New York at Stony Brook; Ph.D., Massachusetts Institute of Technology—Associate Professor, Numerical Relativity, Computational Astrophysics, Dynamics

David L. Farnsworth, BS, Union College; MA, Ph.D., University of Texas at Austin—Professor, Mathematical Statistics

Raluca Felea, BS, University of Iasi; Ph.D., University of Rochester—Associate Professor, Microlocal Analysis

John F. Hamilton, BA, Cornell University; MA, Ph.D., Indiana University—Research Faculty

Anthony A. Harkin, BS, State University College at Brockport; MS, Massachusetts Institute of Technology; Ph.D., Boston University—Associate Professor, Applied and Computational Mathematics, Partial Differential Equations

Matthew J. Hoffman, BA, Williams College; MS, Ph.D., University of Maryland—Assistant Professor, Data Assimilation, Applied Mathematics, Ocean and Atmospheric Forecasting

Jay Alan Jackson, BS, MS, Ph.D., Florida State University—Associate Professor (Joint Appointment with Golisano College of Computing and Information Sciences), Mathematical modeling, innovative and interdisciplinary math and science education

Jobby Jacob, BS, Bharata Mata College (India); MS, Indian Institute of Technology (India); MS, Ph.D., Clemson University—Assistant Professor, Graph Theory

Baasansuren Jadamba, BS, National University of Mongolia (Mongolia); MS, University of Kaiserslautern (Germany); Ph.D., University of Erlangen-Nuremberg (Germany)—Assistant Professor, Partial Differential Equations, Inverse Problems, Numerical Optimization

Akhtar Khan, MS, Technical University Kaiserslautern (Germany); Ph.D., Michigan Technological University—Associate Professor, Applied Math, Optimization, Inverse Problems, Variational Inequalities, Elasticity Imaging

Seshavadhani Kumar, BS, MS, University of Madras (India); Ph.D., University of Delaware—Professor, Operations Research, Simulation

Manuel Lopez, AB, Princeton University; Ph.D., Wesleyan University—Associate Professor, Homological Algebra

Carlos Lousto, MS, Universidad Nacional De La Plata (Argentina); Ph.D., Universidad De Buenos Aires (Argentina)—Professor, Numerical Relativity

Carl V. Lutzer, BS, Michigan State University; MA, Ph.D., University of Kentucky—Professor, Mathematical Physics

Sophia A. Maggelakis, BS, MS, Ph.D., Old Dominion University—Dean, College of Science; Professor, Biomathematics

Kara L. Maki, BS, University of New Hampshire; MS, Ph.D., University of Delaware—Assistant Professor, Mathematical Modeling, Scientific Computing

Carol E. Marchetti, BS, Case Institute of Technology; MS, Weatherhead School of Management; MA, Ph.D., University of Rochester—Associate Professor, Statistics

James E. Marengo, BA, MS, California State University; Ph.D., Colorado State University—Professor, Statistics, Probability

Douglas S. Meadows, BS, Stanford University; MS, New York University; Ph.D., Stanford University—Professor, Algebraic Topology, Number Theory, Orthogonal Polynomials

Darren A. Narayan, BS, State University of New York at Binghamton; MS, Ph.D., Lehigh University—Professor, Graph Theory, Discrete Math

Michael Radin, BA, Rowan University; MS, Ph.D., University of Rhode Island—Associate Professor, Differential Equations

David Ross, BA, Columbia College; Ph.D., New York University—Professor, Differential Equations and Numerical Analysis

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Paul Wenger, BA, Boston College; MS, Ph.D., University of Illinois at Urbana-Champaign—Assistant Professor, Extremal and structural graph theory

John T. Whelan, BA, Cornell University; Ph.D., University of California at Santa Barbara—Associate Professor, Computational Relativity and Gravitation, Gravitational Wave Data Analysis

Tamas Wiandt, BS, Jozsef Attila University; Ph.D., University of Minnesota—Associate Professor, Dynamical Systems

Elmer L. Young, BA, Amherst College; MS, Ph.D., The Ohio State University—Associate Professor, Topology and Analysis

Yosef Zlochower, BS, Ph.D., University of Pittsburgh—Associate Professor, Numerical Relativity

Chemistry

Jeremy Cody, BS, Indiana University of Pennsylvania; Ph.D., University of Rochester—Assistant Professor, Organic Chemistry: synthetic organic chemistry

Christina Goudreau Collison, BA, Colby College; Ph.D., University of Rochester—Associate Professor, Organic Chemistry: synthetic organic chemistry

Christopher Collison, BS, Ph.D., Imperial College of London (United Kingdom)—Associate Professor, Physical Chemistry: polymer chemistry

Michael G. Coleman, BS, Ph.D., University of Buffalo—Visiting Assistant Professor, Medicinal chemistry: synthethic organometallic methodologies towards medicinally relevant targets

Paul A. Craig, BS, Oral Roberts University; Ph.D., University of Michigan—Professor, School Head, Analytical Biochemistry

Nathan Eddingsaas, BS, University of Wisconsin, Stevens Point; Ph.D., University of Illinois at Urbana-Champaign—Assistant Professor, Analytical Chemistry, Atmospheric Chemistry

Joseph P. Hornak, BS, Utica College of Syracuse University; MS, Purdue University; Ph.D., University of Notre Dame—Professor, Joint Appointment with Imaging Science, Physical Chemistry: magnetic resonance spectroscopies and imaging

Thomas D. Kim, BS, Loyola College; Ph.D., University of Wisconsin at Madison—Associate Professor, Biochemistry: pharmacology

Lea V. Michel, BA, Colgate University; Ph.D., University of Rochester—Assistant Professor, Biochemistry: structural biology, biophysics

Massoud J. Miri, BS, MS, Ph.D., University of Hamburg (Germany)—Associate Professor, Polymer Chemistry: polymerization mechanisms, polymer properties, catalysis

Suzanne O'Handley, BS, Rutgers University; MS, Ph.D., University of Rochester—Associate Professor, Biochemistry: cloning characteristics of nudix hydrolases, novel phosphatase families, novel antibiotic targets, enzyme-substrate specificity

John-David Rocha, BS, MS, University of North Texas; Ph.D., Rice University—Assistant Professor, Physical Chemistry

L. Paul Rosenberg, BS, Bridgewater State College; Ph.D., University of New Hampshire—Professor, Analytical Chemistry: pharmaceutical analysis, physical properties of drug compounds, chemical separations techniques

K. S. V. Santhanam, BSc, MA, Ph.D., Sri Venkateswara University (India)—Professor, Analytical Chemistry: organic conducting polymers, electrochemistry, sensors and carbon nanotubes

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan—Professor, Organic/Polymer Chemistry: synthesis and device applications of block copolymer systems and nano composites

Gerald A. Takacs, BS, University of Alberta (Canada); Ph.D., University of Wisconsin—Professor, Physical Chemistry: chemical kinetics, atmospheric chemistry, plasma chemistry, and photochemistry

Laura Ellen Tubbs, BA, Hood College; Ph.D., University of Rochester—Professor, Physical Chemistry: accelerator-based ultrasensitive mass spectroscopy, natural radioisotope dating, aqueous polymer solutions

Scott Williams, BS, Purdue University; Ph.D., Montana State University—Professor, Assistant School Head, Inorganic Chemistry: pharmaceutical quality assurance through application of point-of-care assays

Materials Science and Engineering

John Andersen, BS, State University of New York at Buffalo; MA, Ph.D., University of Rochester—Professor, Physics: theoretical solid-state physics, transport phenomena, electron-photon interactions, nonlinear phenomena, electronic properties of molecular crystals, experimental low-temperature physics, large-scale computations, parallel processing

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

David A. Borkholder, BS, Rochester Institute of Technology; MS, Ph.D., Stanford University—Associate Professor, Electrical Engineering

Robert J. Bowman, BS, Pennsylvania State University; MS, San Jose State University; Ph.D., University of Utah—Professor, Electrical Engineering

Peter Cardegna, BS, Loyola College; Ph.D., Clemson University—Professor, Physics: superconductivity, low temperature physics, photographic materials

Robert A. Clark, BS, Massachusetts Institute of Technology; Ph.D., University of Maryland—Professor Emeritus, Chemistry: plasma modification of organic polymers, polymer science, chemistry of microlithographic imaging systems, kinetics and thermodynamics of thermal and photochemical transformations of small hydrocarbon molecules

Tracy Davis, BA, BS, Wofford College; Ph.D., Clemson University—Associate Professor, Physics: experimental solid-state physics, optics, low temperature physics, computer models of chaotic systems

Alan B. Entenberg, AB, Washington University; Ph.D., University of Rochester—Professor, Physics: stress and adhesion in thin films; surface modification by glow discharge plasma and/or ion bombardment

Surendra K. Gupta, B.Tech., India Institute of Technology (India); MS, University of Notre Dame; Ph.D., University of Rochester—Professor, Mechanical Engineering: x-ray diffraction, atomic force microscopy, micromechanics modeling, digital image analysis

Richard K. Hailstone, BS, Northern Illinois University; MS, Indiana University—Associate Professor, Imaging Science: silver halide materials and processing, imaging materials

Joseph P. Hornak, BS, Utica College of Syracuse University; MS, Purdue University; Ph.D., University of Notre Dame—Professor, Chemistry: physical chemistry, magnetic resonance spectroscopy and imaging

Michael A. Jackson, BS, MS, Ph.D., State University of New York at Buffalo—Associate Professor, Microelectronic Engineering: microelectronic device design, fabrication, and test; material characterization techniques, surface analytical instrumentation; vacuum processing, including CVD, plasma, and ion beam techniques, micromachining, ferroelectric thin films, amorphous silicon and polysilicon film deposition and characterization

Michael Kotlarchyk, BS, MS, Ph.D., Massachusetts Institute of Technology—Professor, Physics: characterization of structure and phase transitions in surfactant systems (micelles, microemulsions, and liquid crystals) using scattering techniques; mass and surface fractals in condensed matter systems, theories of liquids; chaos in simple non-linear physical systems

Kathleen Lamkin-Kennard, BS, Worcester Polytechnic Institute; MS, Ph.D., Drexel University—Assistant Professor, Mechanical Engineering: biomedical engineering and biomaterials.

Vern Lindberg, BS, University of Alberta (Canada); MS, Ph.D., Case Western Reserve University—Professor, Physics: deposition of metals onto polymeric substrates, effects of surface modification of polymer substrates on growth of PVD (physical vapor deposited) films, glow discharge and ion bombardment, stress in sputtered thin films, adhesion of PVD thin films, multilayer optical filters

Massoud Miri, BS, MS, Ph.D., University of Hamburg (Germany)—Associate Professor, Chemistry: polymerization mechanisms, polymer properties, catalysis

Ali Ogut, B.Ch.E., Hacettepe University (Turkey); MS, Ph.D., University of Maryland—Associate Professor, Mechanical Engineering: polymer processing, heat and mass transfer, rheology, transport phenomena

Sannasi Ramanan, BS, BE, M.Tech., Ph.D., Indian Institute of Technology (India)—Associate Professor, Electrical Engineering: semiconductor materials, IC processing, epitaxial growth of semiconductors, quantumwell heterostructures, simulation and design of solid state devices

Andrew Robinson, BSc, Ph.D., University of Manchester (United Kingdom)—Professor, Physics: astronomy, active galactic nuclei, supermassive black holes, radio galaxies, high redshift quasars

K. S. V. Santhanam, BSc, MA, Ph.D., Sri Venkateswara University (India)—Professor, Analytical Chemistry: organic conducting polymers, electrochemistry, sensors and carbon nanotubes

Bruce Smith, BS, MS, Ph.D., Rochester Institute of Technology—Professor, Microelectronic Engineering: 193 nm lithography, multilayer resist processing, attenuated phase shift mask materials

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan—Professor, Chemistry: synthesis and device applications of block copolymer systems and nano composites

David A. Sumberg, BA, Utica College of Syracuse University; MS, Ph.D., Michigan State University—Associate Professor, Electrical Engineering: fiber optics and applications of fiber optics (polarization properties, microwave transmission on optical fiber, sensors, couplers); integrated optics (couplers, materials for integrated optics)

Gerald A. Takacs, BS, University of Alberta (Canada); Ph.D., University of Wisconsin—Professor, Chemistry: physical chemistry, chemical kinetics, photochemistry, atmospheric chemistry, plasma etching and modification of materials

Jayanthi Venkataraman, BS, MS, Bangalore University (India); Ph.D., Indian Institute of Science (India)—Professor, Electrical Engineering: electromagnetic fields

Jerome Wagner, BS, Case Institute of Technology; MS, Ph.D., University of Wisconsin—Professor, Physics: solid state physics, nuclear physics, medical physics, diagnostic nuclear medicine, defect properties in insulating materials, radiation-induced defects, color center

Scott Williams, BS, Purdue University; Ph.D., Montana University—Associate Professor, CIAS: printed electronics, bioactive paper technology, ink chemistry and formulation

Astrophysical Sciences and Technology

Stefi A. Baum, BA, Harvard University; Ph.D., University of Maryland—Director; Professor, Imaging Science: astrophysics, astronomical imaging, and astronomical mission development, including radio, optical, UV, and x-ray observations; active galaxies, black holes, galaxies and cluster of galaxies

Manuela Campanelli, Laurea in Mathematics, University of Perugia (Italy); Ph.D., University of Bern (Switzerland)—Professor, Mathematics: numerical relativity,

computational astrophysics, black holes, gravitational waves

Sukanya Chakrabarti, B.Sc., North Carolina State University; MS, Georgia Institute of Technology; Ph.D., University of California at Berkeley—Assistant Professor, Physics: computational astrophysics, galactic evolution and dynamics

Joshua Faber, BS, State University of New York at Stony Brook; Ph.D., Massachusetts Institute of Technology—Assistant Professor, Mathematics: numerical relativity, general relativistic magnetohydrodynamics, relativistic astrophysics

Donald F. Figer, BA, Northwestern University; MS, University of Chicago; Ph.D., University of California—Professor, Imaging Science: massive stars, massive star clusters, galactic center, imaging detectors

Joel H. Kastner, BS, University of Maryland; MS, Ph.D., University of California—Professor, Imaging Science: astronomical imaging, including x-ray, infrared and radio spectroscopy; young stars and planet formation; evolved stars and planetary nebulae

Carlos Lousto, MS, Universidad Nacional De La Plata (Argentina); Ph.D., Universidad De Buenos Aires (Argentina)—Professor, Mathematics: numerical relativity, relativistic astrophysics, black hole physics, perturbation theory

David Merritt, BS, Santa Clara University; Ph.D., Princeton University—Professor, Physics: theoretical astrophysics, galaxy dynamics, supermassive black holes, gravitational N-body problem, computational dynamics

Zoran Ninkov, BSc, University of Western Australia (Australia); MS, Monash University (Australia); Ph.D., University of British Columbia (Canada)—Professor, Imaging Science: detector array development and characterization, development of novel astronomical instrumentation, studies of young stellar clusters, planetary detection

Christopher O'Dea, BS, Massachusetts Institute of Technology; Ph.D., University of Massachusetts—Professor, Physics: astronomy, active galactic nuclei (Seyfert galaxies, radio galaxies, quasars), clusters of galaxies, cooling flows

Richard O'Shaughnessy, BA, Cornell University; Ph.D., California Institute of Technology—Assistant Professor, Mathematics: gravitational wave astronomy, numerical and general relativity

Michael W. Richmond, BA, Princeton University; MA, Ph.D., University of California at Berkeley—Professor, Physics: observational astronomy, supernovae, variable stars, reduction of optical data, automatic telescopes

Andrew Robinson, BSc, Ph.D., University of Manchester (United Kingdom)—Director, Astrophysical Sciences and Technology; Professor, Physics: astronomy, active galactic nuclei, supermassive black holes, radio galaxies, high redshift quasars

John Whelan, BA, Cornell University; Ph.D., University of California at Santa Barbara—Associate Professor, Mathematics: quantum physics, gravitational wave data analysis, astrophysical relativity

Yosef Zlochower, BS, Ph.D., University of Pittsburgh—Assistant Professor, Mathematics: numerical relativity, relativistic astrophysics, black hole physics

Imaging Science

Stefi A. Baum, BA, Harvard University; Ph.D., University of Maryland—Director and Professor, Imaging Science: astrophysics, astronomical imaging, and astronomical mission development, including radio, optical, UV, and x-ray observations; active galaxies, black holes, galaxies and cluster of galaxies

Charles Bachmann, A.B., Princeton University; Sc.M., Ph.D., Brown University—Associate Professor, Imaging Science and Frederick and Anna B. Wiedman Chair: coastal characterization from remote sensing; advanced retrieval algorithms for hyperspectral and multi-sensor imagery; spectroscopy, BRDF, and advanced instrumentation for calibration and validation; pattern recognition; graph and manifold descriptions of high-dimensional data

Gabriel J. Diaz, BFA, Skidmore College; MS, Rensselaer Polytechnic Institute; Ph.D., Rensselaer Polytechnic Institute—Assistant Professor, Imaging Science: visually guided action; human motor control; eye movements; visual prediction

Roger Dube, BS, Cornell University; Ph.D. Princeton University—Research Professor, Imaging Science: space weather, cosmology, stellar astrophysics, holographic data storage, computer security, artificial intelligence

Roger L. Easton, BS, Haverford College; MS, University of Maryland; MS, Ph.D., University of Arizona—Professor, Imaging Science: application of imaging technologies to manuscripts of cultural importance; optical holography; digital and optical signal/image processing

James Ferwerda, 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

Richard Hailstone, BS, Northern Illinois University; MS, Indiana University—Associate Professor, Imaging Science: characterization of materials using electron microscopy, synthesis of nanoparticles, imaging system modeling

Maria Helguera, BS, National Autonomous University of Mexico (Mexico); MS, University of Rochester; Ph.D., Rochester Institute of Technology—Associate Professor, Imaging Science: medical imaging, ultrasound tissue characterization, digital image processing

Joseph P. Hornak, BS, Utica College of Syracuse University; MS, Purdue University; Ph.D., University of Notre Dame—Professor, Joint Appointment with Department of Chemistry: physical chemistry, magnetic resonance spectroscopy and imaging

Emmett Ientilucci, BS, MS, Ph.D., Rochester Institute of Technology—Assistant Research Professor, Imaging Science: remote sensing, hyperspectral image processing, multivariate statistics, target detection, radiometry

Joel H. Kastner, BS, University of Maryland; MS, Ph.D., University of California—Professor, Imaging Science: astronomical imaging, including x-ray, infrared and radio spectroscopy; young stars and planet formation; evolved stars and planetary nebulae

John P. Kerekes, BS, MS, Ph.D., Purdue University—Professor, Imaging Science: multispectral remote sensing systems, multidimensional imaging system, pattern recognition

Robert L. Kremens, BS, The Cooper Union; MS, University of Rochester; MS, Ph.D., New York University—Research Professor, Imaging Science: wildland fire behavior and effects, remote sensing instrumentation, autonomous remote instruments for environmental monitoring, electronics measurement systems

Poorna Kushalnagar, BA, Gallaudet University; MA, Ph.D., University of Houston—Research Assistant Professor, Imaging Science: cognitive learning, technology, and QoL for people with sensory disabilities; eye tracking, language, and emotion; literacy in Deaf and Hard of Hearing people

David W. Messinger, BS, Clarkson University; Ph.D., Rensselaer Polytechnic Institute—Associate Research Professor, Imaging Science: remote sensing image exploitation, advanced mathematical approaches to spectral image processing, LWIR hyperspectral processing

Zoran Ninkov, BSc, University of Western Australia (Australia); MS, Monash University (Australia); Ph.D., University of British Columbia (Canada)—Professor, Imaging Science: detector array development and characterization, development of novel astronomical instrumentation, studies of young stellar clusters, planetary detection

Jake Noel-Storr, MSci, University of Birmingham (United Kingdom); MA, M.Phil., Ph.D., Columbia University—Assistant Research

Professor, Imaging Science: Supermassive black holes, active galactic nuclei, science education and learning, outreach

Jeff Pelz, BFA, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Frederick Wiedman 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

Jie Qiao, BS, University of Science and Technology Liaoning (China); MS, Tsinghua University (China); MBA, University of Rochester; Ph.D., University of Texas at Austin—Associate Professor, Imaging Science: optical metrology, optical instrumentations, adaptive optics and active optics, ultrafast laser systems and applications (remote sensing, material processing), optical system design and performance evaluation

Navalgund Rao, MS, Banaras Hindu University (India); Ph.D., University of Minnesota—Research Professor, Imaging Science: industrial and medical applications of ultrasound imaging, digital signal processing; modeling and analysis of medical imaging systems

Carl Salvaggio, BS, MS, Rochester Institute of Technology; Ph.D., Syracuse University and the State University of New York College of Environmental Science and Forestry—Professor: novel techniques for the measurement of spectral optical properties, quantitative reflective and emissive remote sensing, digital image processing, three-dimensional geometry extraction from imagery, and scene simulation and modeling

John Schott, BS, Canisius College; MS, Ph.D., Syracuse University and the State University of New York College of Environmental Science and Forestry—Research 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 (South Africa); 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—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

Iris Asllani, B.Sc., University of Tirana (Albania); M.Sc., Ph.D., University of Washington at Seattle—Assistant Professor, Biomedical Engineering: development and implementation of multimodal functional MRI methods for applications in basic neuroscience and clinical research

Peter Bajorski, BS, MS, University of Wroclaw (Poland); Ph.D., Technical University of Wroclaw (Poland)—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 (India); 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 (United Kingdom)—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

Donald F. Figer, BA, Northwestern University; MS, University of Chicago; Ph.D., University of California—Professor, Imaging Science: massive stars, massive star clusters, galactic center, imaging detectors

Ernest Fokoue, BS, University of Yaoundé (Cameroon); MS, Aston University; Ph.D., University of Glasgow—Associate Professor, Quality and Applied Statistics: statistical machine learning and data mining

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

Thomas Gaborski, BS, Cornell University; MS, Ph.D., University of Rochester—Assistant Professor, Biomedical Engineering: NanoBio Devices at the interface of nanomaterials, biology and imaging

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 (Canada); MA, Ph.D., University of Western Ontario (Canada)—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

Cristian Linte, BSc, University of Windsor (Canada); MESc, Ph.D. University of Western Ontario (Canada)—Assistant Professor, Biomedical Engineering: image-guided visualization and navigation for minimally invasive therapy

Sildomar Monteiro, MSc, Aeronautics Technological Institute (Brazil); Ph.D., Tokyo Institute of Technology (Japan)—Assistant Professor, Electrical Engineering, machine learning, statistical signal and image processing, and their applications in robotics, remote sensing, and biomedical engineering

Michael Pierce, BS, Rensselaer Polytechnic Institute; MS, Ph.D., University of Washington—Assistant Professor, Physics: experimental physics, condensed matter physics, surface science,

magnetism, x-ray science, and phase transitions

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 (Canada)—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 (India)—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 (Switzerland); Ph.D., Swiss Federal Institute of Technology (Switzerland)—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

Color Science

Roy S. Berns, BS, MS, University of California; Ph.D., Rensselaer Polytechnic Institute—Richard S. Hunter Professor, Color Science: spectral-based digital-image capture, digital archiving, and reproduction of works of art; art conservation science including pigment identification for in painting and quantifying the optical properties of painting varnishes; spectral models and color profiles for multi-ink printing; colorimetry

Mark D. Fairchild, BS, MS, Rochester Institute of Technology; MA, Ph.D., University of Rochester—Associate Dean of Research and Graduate Education; Professor and Director, Color Science Program/Munsell Color Science Laboratory: color appearance perception and modeling; image quality metrics and models; HDR imaging; human perception

Color Science Graduate Program Allied Faculty

Susan Farnand, BS, Cornell University; MS, Ph.D., Rochester Institute of Technology —Research Scientist, Program of Color Science

James Ferwerda, BA, MS, Ph.D., Cornell University—Associate Professor, Imaging Science

Joseph Geigel, BS, Manhattan College; MS, Stevens Institute of Technology; D.Sc., George Washington University—Associate Professor, Computer Science

Andrew Herbert, BS, McGill University (Canada); MA, Ph.D., University of Western Ontario (Canada)—Professor and Chair, Department of Psychology

Garrett Johnson, BS, MS, Ph.D. Rochester Institute of Technology—Apple Computer

Noboru Ohta, BS, MS, Ph.D., Tokyo University (Japan)—Fuji Film (retired)

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 technologyprogram.) **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
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; Co-requisite: 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 Galatic 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 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**

ASTP-790 Research and Thesis
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Department approval required) **Credit 1-6 (F, S, Su)**

ASTP-791 Continuation of Thesis
Continuation of Thesis

ASTP-799 ASTP 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)**

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; Co-requisites: 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 doctoral-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**

ASTP-890 **Research and Thesis**
Dissertation research by the candidate for an appropriate topic as arranged between the candidate and the research adviser. (Department Approval required) **Credit 1-6 (F, S, Su)**

ASTP-891 **Continuation of Thesis**
Continuation of Thesis

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 doctoral-level student. (Department approval required) **Credit 1-3**

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 Algorithms**
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 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-650 **High Throughput Sequencing Analysis**
Students will utilize commonly used bioinformatics tools to analyze a real High Throughput Sequencing data set starting with raw data, proceeding with quality control, either aligning to a reference genome or performing de novo assembly, assessing differential gene expression determination, and finally annotating their results. Weekly lab reports will be required, and a group manuscript is expected at the end of the semester. (Graduate standing; permission of instructor) **Class 1, Lab 2, 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 **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-789 **Graduate Special Topics**
This is a graduate 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, Su)**

BIOL-790 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Permission of instructor.) **Credit variable (F, S, Su)**

BIOL-791 **Continuation of Thesis**
Continuation of Thesis

BIOL-798 **Grad 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)**

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-699 **Chemistry Graduate Co-op**
Cooperative work experience for graduate chemistry students. **Credit 0**

CHEM-771 **Graduate Chemistry Seminar I**
Chemists are required to communicate information about their research, 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, 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, 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, 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 adviser. (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 adviser. (Permission of instructor.) **Credit 1-6 (F, S, Su)**

CHEM-791 **Continuation of Thesis**
Continuation of Thesis

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-621 **Advanced Instrumental Analysis Lab**
This is a capstone course requiring students to develop experimental protocols involving advanced techniques in instrumental analysis. This course is intended to give an opportunity to develop innovative skills and writing proficiency. Library, literature and textbook research will be required. (CHMB-405 Biochemistry Lab or CHMP-445 Experimental Physical Chemistry) **Lab 6, Credit 3 (S)**

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 of 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-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 the synthesis of 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. This course may be repeated for credit. (CHMO-637 Advanced Organic Chemistry, graduate standing in chemistry, and permission of instructor) **Class 1, Credit 1 (F, S)**

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 3, Credit 3 (F)**

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, titrations, thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC), measurement of swelling, and viscometry. (CHMO-336 Comprehensive Organic Chemistry Lab II and permission of instructor) **Lab 8, Credit 3 (F)**

Color Science

CLRS-601 **Principles of Color Science**
This course covers the principles of color science including theory, application, and hands-on experience incorporated into the lectures. Topics include color appearance (hue, lightness, brightness, chroma, saturation, colorfulness), colorimetry (spectral, XYZ, xyY, L*a*b*, L*C*abhab, ΔE*ab, ΔE00), the use of linear algebra in color science and color imaging, metamerism, chromatic adaptation, color inconstancy, color rendering, color appearance models (CIECAM02), and image appearance models (S-CIELAB, iCAM). (Prerequisites: Graduate standing in imaging science, color science or permission of instructor.) **Class 3, Credit 3 (F)**

CLRS-602 **Color Physics and Applications**
This course explores the relationship between a material's color and its constituent raw materials such as colorants, binding media, substrates, and overcoats. These can be determined using a variety of physical models based on absorption, scattering, luminescence, and interference phenomena. These models enable the production of paints, plastics, colored paper, printing, and others to have specific colors. Accompanying laboratories will implement and optimize these models using filters, artist opaque and translucent paints and varnishes including metallic and pearlescent colorants, and inkjet printing. Statistical techniques include principal component analysis and linear and nonlinear optimization. (Prerequisites: Graduate standing in imaging science, color science or permission of instructor.) **Class 3, Credit 3 (F)**

CLRS-699 **Color Science Graduate Co-op**
Cooperative work experience for graduate color science students. **Credit 0**

CLRS-720 **Computational Vision Science**
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**
Color Science Seminar II 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 adviser. (Permission of instructor.) **Credit variable (F, S, Su)**

CLRS-791 **Continuation of Thesis**
Continuation of Thesis

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-890 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Permission of instructor.) **Credit variable (F, S, Su)**

CLRS-891 **Continuation of Thesis**
Continuation of Thesis

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 effective communication to a diverse 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 **Hydrologic Applications of Geographic Information Systems**
Aerial photography, satellite imagery, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) are extremely useful tools in hydrologic modeling and environmental applications such as rainfall runoff modeling, pollution loading, landscape change analyses, and terrain modeling. This course will: 1) introduce students to spatial analysis theories, techniques and issues associated with hydrologic and environmental applications; 2) provide hands-on training in the use of these spatial tools and models while addressing a real problem; 3) provide experience linking GIS and model results to field assessments and monitoring activities; 4) enable students to solve a variety of spatial and temporal hydrologic and environmental problems; and 5) provide tools useful for addressing environmental problems related to the graduate thesis or project. (COS-ENVS-250 or equivalent; or permission of instructor)

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 adviser. (Permission of instructor.) **Credit variable (F, S, Su)**

ENVS-789 **Graduate Special Topics**
This is a graduate 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, 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-791 **Continuation of Thesis**
Continuation of Thesis

ENVS-795 **Environmental Science Graduate Research**
Graduate Environmental Science Research This course is a graduate level, faculty-directed, student project or research involving laboratory or field work, computer modeling, or theoretical calculations that could be considered of an original nature. The level of study is appropriate for students in environmental science graduate program. (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. (Department consent required) **Credit 1-4 (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. (IMGS Ph.D. students or permission of instructor) 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. (IMGS Ph.D. students or permission of instructor. 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-628 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-632 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, PHYS-112, or permission of instructor) **Class 2, Lab 3, Credit 3 (S)**

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-639 Principles of Solid State Imaging Arrays
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-642 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-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 Graduate Co-op
This course is a cooperative education experience for graduate imaging science students. (Permission of department) **Credit 0 (F, S, Su)**

IMGS-711 Computational Methods for Imaging Science
This course addresses computational topics that are important in a variety of applications in imaging science. Examples of topics that may be included are: vector space operations, including matrix factorizations and solutions of systems of equations (used in hyperspectral target detection and image compression, among many other applications); linear and nonlinear optimization (used for the design of detectors, camera calibration, bundle adjustment, etc.); iterative methods and dynamic systems (Kalman filtering, tracking, optical flow, etc.); random number generation and use (Monte Carlo methods, system performance evaluation, etc.); and energy minimization techniques applied to image processing (used for image enhancement, segmentation, etc.) (Prerequisites: IMGS-616 or IMGS-682, or permission of instructor) **Class 3, Credit 3 (F)**

IMGS-712 Multi-view Imaging
Images are 2D projections gathered from scenes by perspective projection. By making use of multiple images it is possible to construct 3D models of the scene geometry and of objects in the scene. The ability to derive representations of 3D scenes from 2D observations is a fundamental requirement for applications in robotics, intelligence, medicine and computer graphics. This course develops the mathematical and computational approaches to modeling of 3D scenes from multiple 2D views. After completion of this course students are prepared to use the techniques in independent research. (Prerequisites: IMGS-616 or IMGS-682, or permission of instructor). **Class 3, Credit 3 (S)**

IMGS-715 Computational Photography
Computational photography is an emerging field that aims to overcome the limitations of conventional digital imaging and display devices by using computational techniques and novel programmable sensors and optical devices. In this course, we will study start-of-the-art techniques for capturing, modeling, and displaying complex appearance phenomena. We will cover topics such as computational sensor with assorted pixel designs, mobile camera control, light field capture and rendering, computational flash photography, computational illumination for appearance modeling and 3D reconstruction, light transport analysis, and light sensitive display and printing techniques. We will integrate the latest smart imaging devices into the course for homework and term projects. (Graduate standing in a science or engineering program, or permission of instructor) **Class 3, Credit 3 (F)**

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-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 (S)**

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-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-740 Imaging Science MS Systems Project Paper
The analysis and solution of imaging science systems problems for students enrolled in the MS Project capstone paper option. **Credit 3 (F, S, Su)**

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-765 Performance Modeling and Characterization of Remote Sensing Systems
This course introduces the techniques utilized for system performance predictions of new imaging platforms during their design phase. Emphasis will be placed on systems engineering concepts and their impact on final product quality through first principles modeling. In addition, the student will learn techniques to characterize system performance during actual operation to monitor compliance to performance specifications and monitor system health. Although the focus of the course will be on electro-optical collection systems, some modality specific concepts will be introduced for LIDAR, broadband infrared, polarimetric, and hyperspectral systems. (IMGS-616 Fourier Methods for Imaging and IMGS-619 Radiometry) **Class 3, Credit 3 (F)**

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-789 Graduate Special Topics
This is a graduate-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**

IMGS-790 Research and Thesis
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Permission of instructor.) **Credit 1-6 (F, S, Su)**

IMGS-791 Continuation of Thesis
Continuation of Thesis

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 department) **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
Doctoral-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Permission of instructor.) **Credit 1-6 (F, S, Su)**

IMGS-891 Continuation of Thesis
Continuation of Thesis

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 variable 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 covered 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-606 Graduate Seminar I
The course prepares students to engage in activities necessary for independent mathematical research and introduces students to a broad range of active interdisciplinary programs related to applied mathematics. (None) **Class 2, Credit 1 (F)**

MATH-607 Graduate Seminar II
This course is a continuation of Graduate Seminar I. It prepares students to engage in activities necessary for independent mathematical research and introduces them to a broad range of active interdisciplinary programs related to applied mathematics. (Prerequisite: COSMATH-606) **Class 2, Credit 1 (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-values 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, Cauchs 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 Rouchs 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 Peans 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-645 GraphiTheory
This course introduces the fundamental concepts of graph theory. Topics to be studied include graph isomorphism, trees, network flows, connectivity in graphs, matchings, graph colorings, and planar graphs. Applications such as traffic routing and scheduling problems will be considered. (Permission of instructor) **Class 3, Credit 3 (F)**

MATH-646 Combinatorics
This course introduces the fundamental concepts of combinatorics. Topics to be studied include counting techniques, binomial coefficients, generating functions, partitions, the inclusion-exclusion principle and partition theory. (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-699 **Math and Stats Graduate Co-op**
This course is a cooperative education experience for graduate math and stats students.

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-735 **Mathematics of Finance I**
This is the first course in a sequence that examines mathematical and statistical models in finance. By taking a mathematical viewpoint the course provides students with a comprehensive understanding of the assumptions and limitations of the quantitative models used in finance. Topics include probability rules and distributions, the binomial and Black-Scholes models of derivative pricing, interest and present value, and ARCH and GARCH time series techniques. The course is mathematical in nature and assumes a background in calculus (including Taylor series), linear algebra and basic probability. Other mathematical concepts and numerical methods are introduced as needed. (Prerequisites: COS-MATH-181, 241,251, or permission of instructor) **Class 3, Credit 3 (F)**

MATH-736 **Mathematics of Finance II**
This is the second course in a sequence that examines mathematical and statistical models in finance. By taking a mathematical viewpoint the course provides students with a comprehensive understanding of the assumptions and limitations of the quantitative models used in finance. Topics include delta hedging, introduction to Ito calculus, interest rate models and Monte Carlo simulations. The course is mathematical in nature and assumes a background in calculus (including Taylor series), linear algebra and basic probability. Other mathematical concepts and numerical methods are introduced as needed. (Prerequisites: COS-MATH-735) **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, Duhamels principle, and Greens 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 scheme (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. 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. **Class 1-6, Credit 1-6**

MATH-790 **Research and Thesis**
Masters-level research by the candidate on an appropriate topic as arranged between the candidate and the research adviser. (Permission of department) **Credit 0-9 (F, S, Su)**

MATH-791 **Continuation of Thesis**
Continuation of Thesis

MATH-799 **Math Graduate Independent Study**
Independent Study

Materials Science and 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, Credits 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 adviser. (Permission of department) **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 adviser, and the off-site research mentor. (Permission of department) **Credit 1-4 (F, S, Su)**

MTSE-793 **Continuation of Thesis**
Continuation of Thesis

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 department) **Credit 1-4**

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 or graduate standing.) **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
sustainability.rit.edu/

Programs of Study

Golisano Institute for Sustainability is a comprehensive academic, training, and technology-transfer center focusing on multidisciplinary studies in sustainable production systems and the built environment. The institute's research areas include sustainable products, sustainable mobility, alternative energy systems, Eco-IT, and pollution prevention.

Admission requirements

Each college makes all decisions regarding graduate admission. Please refer to the individual program descriptions 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 Integrated Manufacturing Studies* combines applied research with technology transfer to help manufacturers remain competitive in the global marketplace.
- *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.
- *Center of Excellence in Sustainable Manufacturing* is dedicated to enhancing the environmental and economic performance of products and processes.
- *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's headquarters are located in the new 84,000 sq. ft. Sustainability Institute Hall, which is certified LEED® (Leadership in Energy and Environmental Design) Platinum by the U.S. Green Building Council—the highest standard that can be achieved in the rating system. The building is adjacent to the Center for Integrated Manufacturing studies that houses additional laboratories. Labs and facilities include:

- *Clean Technologies Demonstration Lab:* Features a wide variety of environmentally friendly cleaning technologies utilized in remanufacturing processes.
- *Eco-Design Lab:* Focuses on developing and testing product design solutions that reduce the environmental impact of information technology products throughout their lifecycle.
- *Electronics Lab:* GIS' focal point for the development and testing of embedded systems for prognostic applications.
- *Environmental Chemistry Lab:* Fundamental chemistry techniques are used to reduce life-cycle environmental impacts of products and processes with an emphasis on end-of-life material recovery processes.
- *Fuel Cell Testbed:* Innovations in fuel cell technologies are developed and tested with research focused on improving reliability and reducing costs.
- *Imaging Products Laboratory:* Provides state-of-the-art evaluation and research to enhance the sustainability of imaging products.
- *Materials Integration Lab:* Investigates how the bulk physical properties of materials lead to wear and the failure of components and subsystems.
- *Materials Science Lab:* Focuses on the analysis of material composition and how material properties drive failure of components.
- *Microgrid Testbed:* Information about the building's variable energy production and usage is analyzed to determine how to optimally use this energy in Sustainability Institute Hall.
- *Rapid Reverse Engineering Lab:* Equipped with instruments to accurately reconstruct missing product design information to enable new production, improve design, and enhance opportunities for remanufacturing.
- *Staples Sustainable Innovation Lab:* Supports the innovation and development of products having low environmental impact.
- *Sustainable Manufacturing Testbed:* This lab is devoted to developing advanced manufacturing, remanufactuirng, and recycling processes.
- *Vehicle Dynamics Lab:* Testing of engines, as well as complete vehicles, is conducted in order identify ways of improving energy efficiency and reducing emissions due to alternative fuels.

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. It 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; conservation of energy and natural resources; economic viability; and safety for workers, communities, and consumers. Course work and research take a systems level and interdisciplinary approach to solving seemingly intractable sustainability problems.

Students have the opportunity to work with multidisciplinary faculty and researchers in numerous RIT research centers, including the Center for Remanufacturing and Resource Recovery, the Center for Sustainable Manufacturing, the Center for Sustainable Mobility, the Center for Sustainable Energy Systems, and the New York State Pollution Prevention Institute–all of which are housed in the Golisano Institute for Sustainability.

Curriculum

Students must complete 60 semester credit hours of course work and research.

Sustainability, Ph.D. degree, typical course sequence

COURSE		SEMESTER CREDIT HOURS
First Year		
ISUS-600	Graduate Seminar	2
ISUS-802	Fundamentals of Sustainability Science	3
ISUS-804	Industrial Ecology	3
	Elective	3
ECON-810	Economics of Sustainability	3
ISUS-806	Risk Analysis	3
ISUS-807	Research	2
ISUS-808	Multicriteria 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-890	Dissertation Research	16
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. Referees should send recommendation letters by email to gradinfo@rit.edu or via postal service directly to Graduate Enrollment Services.
- Participate in a personal interview with the faculty committee (by teleconference if 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.rit.edu/gis/academics/ms-sustainability/

Gabrielle Gaustad, Assistant Professor
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Program overview

The MS degree in sustainable systems focuses on sustainable production systems, which create goods and services using processes that are non-polluting; conservation of energy and natural resources; economic viability; and safety and health for workers, communities, and consumers. Course work and research take 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.

Students have the option of choosing one of three tracks: sustainable manufacturing, sustainable mobility, or sustainable energy systems. Students can also create additional tracks using elective courses (selected in consultation with the student's adviser) from a wide variety of courses offered by the Golisano Institute for Sustainability or any one of RIT's other colleges.

Graduates are prepared to pursue careers in their chosen field with an understanding of basic sustainability principles and the expertise to analyze and solve complex sustainability issues.

Curriculum

Students must complete 24 semester credit hours of course work plus a 6 semester credit hour thesis or capstone project. Full-time students may complete the degree in one year (two semesters plus one summer term).

Sustainable systems, MS degree, typical course sequence (semesters)

COURSE		SEMESTER CREDIT HOURS
First Year		
ISUS-802	Fundamentals of Sustainability Science	3
ISUS-804	Industrial Ecology	3
ECON-711	Microeconomics for Graduate Students*	3
ISUS-806	Risk Analysis	3
ISUS-708	Sustainability Practice	3
	Electives	6
ISUS-705	Technology Policy and Sustainability*	3
ISUS-807	Thesis or Capstone	6
Total Semester Credit Hours		**30**

* This course may be replaced by an approved elective.

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 appropriate background is permitted to take graduate courses as a non-matriculated student. If the student is subsequently admitted to the graduate program, a limited number of 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.

http://www.rit.edu/gis/architecture/
Dennis A. Andrejko, FAIA Chairman
(585) 475-4990, archdept@rit.edu

Program overview

At a time of significant transition in the profession, RIT's architecture program allows for full incorporation of the skills and knowledge critical to the 21st century architect. The program will 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 curriculum has been shaped by the global emphasis of sustainability, factors that impact urbanism, and the application of the principles of design and craft; along with a focus around building technology, materials, construction, and systems.

Sustainability

With a global need for a more sustainable world, including buildings and their impact on energy consumption and carbon footprints, the focus of many courses reflect the conditions of sustainable design and practice.

Technology

Design exploration is enhanced through the understanding of 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 focuses on the practices and principles of preservation and adaptive reuse. The city of Rochester, New York, serves 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 105 credit hours. Designed as a full-time program, courses are offered on campus, primarily during the day. Much of the course work is studio-based and includes technical courses, sustainability courses, and some elective. In addition to three required sustainability courses, students will take one sustainability elective. All students prepare a thesis, during their final year of study. Students take four graduate electives, drawn from courses offered by the colleges of Applied Science and Technology, Business, Engineering, Imaging Arts and Sciences, and Liberal Arts.

Architecture, M.Arch. degree, typical course sequence

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-641	Fundamentals of Building Systems	3
Second Year		
ARCH-731	Architectural Studio I: Site	6
ARCH-741	Integrated Building Systems I	3
ARCH-751	Architectural Theory	3
ARCH-732	Architectural Studio II: Tectonic	6
ARCH-742	Integrated Building Systems II	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-743	Integrated Building Systems III	3
ARCH-753	Research Seminar/Thesis Prep	3
ARCH-763	Sustainable Building Metrics	3
ARCH-734	Architectural Studio IV: Urban	6
ARCH-744	Integrated Building Systems IV	3
ARCH-771	Professional Practice	3
	Graduate Elective	3
Fourth Year (fall only)		
ARCH-790	Thesis Studio	6
	Sustainability Elective	3
	Graduate Electives	6
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 in architecture, 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,
- Successfully complete at least one semester each of college-level math (e.g. algebra, pre-calc, calculus) and science (e.g. physics, earth science, chemistry).
- Submit official transcripts (in English) of all previously completed undergraduate and graduate course work,
- Submit a one page personal statement and a 90 second video (maximum length) explaining your interest in studying architecture at the graduate level.
- Submit scores from the Graduate Record Examination (GRE).
- Submit three letters of recommendation (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 PDF digital portfolio (see portfolio guidelines) of 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).
- 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) 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 Guidelines

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 8.5"x11" format and cannot exceed 6.0mb. Alternatively students may use the PDF portfolio feature (found under FILE, in more recent versions of Adobe Acrobat) to create a portfolio.
- 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 submitted. Please use caution. It is important to maintain the integrity of the original artwork.
- File name: Only one PDF portfolio file is allowed. It should be labeled using the following format: UARC_XX_LASTNAME.PDF, (XX is equal to the code for the academic year to which you are applying, ex: 2013 would be 13, 2014 would be 14, etc.) Enter 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 gradinfo@rit.edu. Students should Include their name in the subject line of the email. Files delivered on CD/ROM or USB drives will not be reviewed or accepted.

Nabil Nasr, BS, Helwan University (Egypt); 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—Department of Architecture Chair; Associate Professor

Alex Bitterman, BS, M.Arch., State University of New York at Buffalo; Ph.D., State 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

Paul H. Stiebitz, BS, ME, Rochester Institute of Technology; MS, State University of New York at Buffalo—Professor; Interim 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—Associate Professor

Eric Williams, BA, Macalester College; Ph.D., State University of New York at Stony Brook—Associate Professor

Anahita Williamson, BS, MS, Ph.D., Clarkson University—Research Assistant Professor

Architecture

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 3 (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. (Prerequisites: ARCH-611 Architectural Representation I) **Class 2, Studio 4, Credit 3 (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)**

ARCH-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 and small scale 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, ARCH-741 Integrated Building Systems I). **Classroom 3, Studio 9, Credit 6 (S)**

ARCH-641 **Fundamentals of Building Systems**
In this course, students will receive an overview of the various systems that comprise a building project but also focus on residential construction. Systems studied will include architectural material and methods, land use, site, climate, human factors, building structure systems and active and passive support systems. The constraints that control these systems will also be studied such as building and zoning codes, construction costs, and sustainability factors. (Co-requisites: ARCH- 632 Architectural Design II) **Class 3, Credit 3 (S)**

ARCH-699 **Co-op Architecture**
This course provides a ten-week (350-400 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. (Prerequisites: ARCH-632 Architectural Design II, Co-requisites: ARCH-741 Integrated Building Systems I). **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. (Prerequisites: ARCH-731 Architectural Studio I, Co-requisites: ARCH-742 Integrated Building Systems II). **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. (Prerequisites: ARCH-732 Architectural Studio II: Tectonic. Co-requisites: ARCH-744 Integrated Building Systems III). **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. (Prerequisites: ARCH-733 Architectural Studio III: Adaptive, Co-requisites: ARCH-744 Integrated Building Systems IV). **Class 3, Studio 9, Credit 6 (S)**

ARCH-741 **Integrated Building Systems I**
This course presents the various systems that comprise a project's site work; architectural materials/methods, civil engineering, and landscaping architecture as well as site constraints. (ARCH-641 Fundamentals of Building Systems, co-requisite ARCH-731 Architectural Studio I: Site) **Class 3, Credit 3 (F)**

ARCH-742 **Integrated Building Systems II**
The major tectonic components of a building will be studied in this course focusing on the building envelope and typical structural configurations. Structural inquiry will fully cover the field of statics. (Prerequisites: ARCH-741 Integrated Building Systems I, co-requisites: ARCH-732 Architectural Studio II: Tectonic) **Class 3, Credit 3 (S)**

ARCH-743 **Integrated Building Systems III**
Typical interior building components will be studied in this course from subdivision of space down to selection of material finishes as they realate to building code regulations. Structural inquiry will continue with full coverage of strength of materials. (Prerequisites: ARCH-742, Integrated Building Systems II, co-requisites: ARCH-733 Architectural Studio III: Adaptive) **Class 3, Credit 3 (F)**

ARCH-744 **Integrated Building Systems IV**
Various building core and sub-systems will be studied in this final course of the sequence including acoustics and illumination. A deeper inquiry into mechanical, electrical, and plumbing systems will also occur. (Prerequisites: ARCH-743 Integrated Building Systems III, co-requisites: 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. (Prerequisites: ARCH-621 Architectural History I and ARCH-622 Architectural History II) **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-621 Architectural History I and ARCH-622 Architectural History II) **Class 3, Credit 3 (S)**

ARCH-753 **Research Seminar/Thesis Prep**
This seminar experience exposes architecture students to a range of contemporary architectural, 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. In preparation for the culminating studio experience students will also engage in seminar format-research, through analysis of precedent, site investigation, critical readings and exploration of technique. Through this, each student will be required to develop a hypothesis as the basis for their thesis proposal. (Second-year status) **Class 3, Credit 3 (F)**

ARCH-761 **Understanding Sustainability**
This course will introduce graduate students to the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society. Students will understand critical thinking and the scientific method as it applies in a systems-based, transdisciplinary approach to sustainability, and be prepared to identify problems in sustainability and formulate appropriate solutions based in scientific research, architecture, or applied science. **Class 3, Credit 3 (F)**

ARCH-762 **Industrial Ecology Fundm**
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 built environments on the natural environment by utilizing life-cycle assessment tools and principles of sustainability. (Prerequisites: 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*, and the Whole Building Design Guide, among others will also be reviewed. **Class 3, Credit 3 (F)**

ARCH-771 **Professional Practice**
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. (Third year status) **Class 3, Credit 3 (S)**

ARCH-789 **Architecture 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.

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. (Prerequisite: ARCH-753 Research Seminar/Thesis Preparation) **Class 3, Studio 9, Credit 6 (F)**

ARCH-799 **Independent Study**

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 preposals, and as well as teaching skills, will also be covered. (Enrollment in the sustainability Ph.D. program) **Class 1, Credit 1 (F, S)**

ISUS-619 **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 sustainable systems MS program or the permission of the instructor). **Class 3, Credit 3 (offered occasionally)**

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 sustainable systems MS 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 MS program). **Class 1-3, (Variable Credit) (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 sustainable systems MS; exceptions are by 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 sustainable systems MS program; exceptions are by permission of instructor.) **Class 3, Credit 3 (S)**

ISUS-705 **Technology, Policy, and Sustainability**
Public policy is a multidisciplinary field aimed at understanding how policy and regulation can be used to achieve certain social goals. These goals may include the notion of sustainability, whereby society's present needs are met without compromising the ability to meet society's future needs. 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 in the sustainability Ph.D. or sustainable systems MS program or permission of instructor.) **Class 3, Credit 3 (F)**

ISUS-708 **Sustainability Practice**
This course covers theoretical and practical issues associated with analysis and progress towards sustainability. Methods and concepts covered include optimization, stochastic analysis, multicriteria decision-making and resource economics. Societal perception and response to sustainability is covered sector by sector (industry, government, academia and civil society) and through integrative case studies of particular sustainability issues (e.g. natural gas fracking). Emerging sustainability governance mechanisms are explored, in particular environmental certifications and standards (e.g. LEED, EnergyStar) and multilateral agreements. (enrollment in the sustainability Ph.D. or MS program or the permission of the instructor). **Class 3, Credit 3 (F)**

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. (GIS graduate student or by approval of instructor). **Class 3, Credit 3 (S)**

ISUS-712 **Sustainable Product Realization**
This course draws on concepts and methods pertaining to risk, life-cycle assessment, innovation, and policy introduced in various core courses to make strategic product-system decisions during the earliest stages of product development. (Enrollment in the sustainability Ph.D., sustainable systems MS program, or permission of instructor) **Class 3, Credit 3 (S)**

ISUS-718 **Sustainable Energy Systems**
Energy will play an increasingly vital role in economic, environmental and political developments around the world. This course first investigates the current trends in energy production, distribution, and consumption associated with the primary incumbent energy system technologies: fossil fuel combustion and nuclear power. An understanding of the economic, environmental and social limitations of these technologies will lead to analysis of the potential benefits of 3 key renewable technologies: solar (including wind), biomass and hydrogen/fuel cells. Potential paths to market penetration for these technologies will be introduced, including geographical variations expected to occur globally and within the United States. (Graduate standing or permission of instructor) **Class 3, Credit 3 (offered occasionally)**

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 program and approval of the academic director). **(Variable Credit 1-6) (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). **(Variable Credit 1-6) (F, S, Su)**

ISUS-791 **Continuation of Thesis**
MS or Ph.D. students requiring additional time to complete their thesis (Enrollment restricted to students enrolled in the sustainable systems MS or sustainability Ph.D. program). **Class 0, Credit 0 (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 sustainable system MS programs. (enrollment in the sustainability Ph.D. or sustainable systems 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**
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 sustainable systems MS programs. (ISUS-806 Risk Analysis or the permission of the instructor). **Class 3, Credit 3 (S)**

ISUS-810 **Thermodynamics for Sustainability**
As energy plays a fundamental role in the system sustainability framework, it is essential that students and practitioners have an understanding of the laws of thermodynamics which govern the processes of energy usage and conversion. This course investigates the differences between energy and exergy analysis, where the latter includes not only the quantities of energy exchanged, but also the quality of the energy relative to some reference state. After establishing the fundamentals of exergy analysis, this concept is applied to practical sustainability problems associated with sustainable development, industrial systems and energy policy. Specific examples are also explored, including thermal storage and fuel cell systems, and life cycle assessment. (Undergraduate thermodynamics course) **Class 3, Credit 3 (offered occasionally)**

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 (offered occasionally)**

ISUS-822 **Materials Cycling**
This class will explore the economic and environmental incentives for recycling and resource recovery. The focus will be on end-of-life fate of materials (including plastics, metals, glass, and e-waste) while setting these within the context of overall ecosystem flows (carbon, sulfur, and nitrogen cycles, waste water, etc.). Technologies for the upgrading of secondary material streams will be studied including: physical and physico-chemical (beneficiation, electrostatic and magnetic separation), hydrometallurgical (selective precipitation, leaching, ion exchange), biotechnological (biosorption, sulfate reduction),and pyrometallurgical (filtration and fluxing). Production issues (product quality, remelt thermodynamics, exergy accounting, etc.) within the secondary industry will be explored with an emphasis on removing barriers to increased usage of scrap. Efforts for enhanced collection efforts and motivation of consumer and firm participation will also be covered (municipal collection fees, corporate take-back initiatives, legislation such as the WEEE directive, state deposits, etc.) (Enrollment in the sustainability Ph.D. or sustainable systems MS program or the permission of the instructor). **Class 3, Credit 3 (offered occasionally)**

ISUS-877 **Research Internship**
The Research Internship is designed to enhance the educational experience of Ph.D. students through full-time employment (Enrollment restricted to students enrolled in the sustainability Ph.D. program. Requires department approval). **Credit 0 (F, S, Su)**

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 1-9 (F, S, Su)**

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.

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 e-mails about three weeks before the online course begins welcoming them to the online learning experience and directing them to orientation information. 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

Master's degrees:

- Applied Statistics
- Business Administration (Online Executive MBA)
- Environmental, Health and Safety Management
- Facility Management
- Health Systems Administration
- Human Resource Development
- Human Computer Interaction
- Imaging Science
- Manufacturing Leadership
- Microelectronics Manufacturing Engineering
- Networking and System Administration
- Product Development
- Professional Studies
- Service Leadership and Innovation
- Telecommunications Engineering Technology

Advanced certificates:

- Applied Statistics
- Finance in Health Care
- Leadership in Health Care
- Lean Six Sigma
- Network Planning and Design
- Organizational Learning
- Project Management
- Service Systems
- Training, Design and Assessment

Graduate Admission

Admission decisions for graduate applicants are made by the department or college offering the program, and upon receipt of a completed application folder from the Office of Graduate Enrollment Services. 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 units may informally advise non-degree students, but no formal program of study can be approved prior to admission.
8. The formal program is laid out by the dean's designee (department head, coordinator or program director, etc.) and is the one that must be followed by all students applying for admission or readmission in that program.
9. The basic entry requirements for graduate degree candidates include the completion of a baccalaureate degree and whatever other evidence of the applicant's potential to complete graduate studies may be required by the particular program. Rare exceptions to the baccalaureate requirement can 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 or director and the approval of the appropriate dean and the Graduate Council are required.

The U.S. Government expects international students to prove competency in the English language prior to their acceptance to an American college or university. In keeping with this expectation, students whose native language is not English and whose secondary or higher education was completed in a non-native English speaking country must take a test of English language proficiency. Students must achieve the following minimum scores prior to consideration for admission into graduate studies: 550 (paper-based) or 79 (Internet-based) on the Test of English as a Foreign Language (TOEFL), 6.5 on the International English Language Testing System (IELTS), or 58 on the Pearson Test of English – Academic. Individual academic units may require higher standards or additional requirements.

Applicants whose test results fall below the minimum scores for admission but who otherwise meet academic requirements will be referred to the English Language Center. They will not be admitted to academic programs until they meet proficiency criteria established by the English Language Center.

In certain cases graduate students may be admitted prior to, but conditional upon completion of the baccalaureate degree. Applicants should not be considered for admission prior to the start of their final year of undergraduate study. The student must present a final transcript signifying successful completion of their baccalaureate degree by the end of the first term they are enrolled in the graduate program.

Graduate applicants who do not fully satisfy all admission criteria as to grades, test scores or other credentials, but do show sufficient promise to qualify for a trial period of graduate study may be admitted on probation to the university. Such students must achieve a 3.00 (B) program grade point average by the end of their first 9 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 academic unit in consultation with the Office of Graduate Enrollment Services and the Office of the Registrar.

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

Students who leave a graduate program, or have a lapse in enrollment greater than or equal to three terms, including summer but not including intersession, and wish to return to that program must reapply through the Office of Graduate Enrollment Services. All student applications are subject to admissions standards at the time of reapplication. The program of study shall be subject to review and may be rewritten. Previous waiver and/or transfer credit may be lost, and program deficiencies may need to be made up.

Each college has the responsibility, upon a student's readmission, of determining which previous courses if any, are applicable toward the degree. Be aware that standards and degree requirements may have changed and previous waiver, transfer, or competency credit may be lost and program deficiencies may need to be made up. All readmission decisions are made by the academic unit. Readmission is not guaranteed.

Graduate students must complete the graduate program within seven years of the date of the oldest course counted toward their program. This does not apply to prerequisites, bridge program courses or similar requirements.

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 $1,209/credit hour for each hour of study exceeding 18.

Board for full-time students for 2014-15 will be $2,405 per semester for a standard meal plan and $3,379 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 semester 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, Visa, 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: www.rit.edu/fa/sfs/billing-dates-and-payment-options.

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 Semester—August 15, 2014
Spring Semester—January 15, 2015
Summer Term—May 15, 2015

Payment plan option information can be found at: www.rit.edu/fa/sfs/billing-dates-and-payment-options.

Graduate Costs

TUITION	PER SEMESTER*	PER YEAR
Full-time (12–18 credit hours)	$19, 334	$38,688
Part-time (11 credit hours or less)	$1,612/credit hour	$1,612/credit hour
Student activities fee	$130	$260

* Tuition rate is for fall and spring semesters. Contact Student Financial Services for information on tuition rates for summer term and intersession.

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 semester, 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 semester. 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 semester 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

For information regarding refund policies for withdrawal during the semester, please contact the Student Financial Services Office or visit their website at: www.rit.edu/fa/sfs/refund.

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—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.

Academic Progress Requirements

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, non-matriculated 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 and not to exceed 150 percent timeframe for degree completition, 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 three terms.

Financial Aid Refund Policy

Return of federal funds

In accordance with federal regulations, the Office of Financial Aid and Scholarships recalculates federal aid eligibility for students who withdraw, drop out, are suspended, or take a leave of absence prior to completing 60 percent of a term. "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 term 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 term. 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 semester 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; D=remaining credit balance, and E=amount returned to scholarship program.

$$A/B = C$$

$$CxD = E$$

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, and demonstrate significant financial need.	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.
Federal Direct PLUS Loans for Graduate Students	Matriculated students who are enrolled at least half-time and who are U.S. citizens or permanent residents.	The maximum amount cannot exceed the cost of education minus all financial aid awarded.	File the Free Application for Federal Student Aid (FAFSA) and complete a Federal Direct PLUS Loan application.

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 2014. 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.

Enrollment 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. A statement verifying that a degree has been awarded will be posted to the transcript and diplomas are mailed to all graduates.

Enrollment

1. Student should complete the enrollment and payment process in accordance with university enrollment/billing procedures, as indicated in the current enrollment 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 three successive academic terms, including summer but excluding Intersession, can result in the loss of active student status.
5. RIT considers graduate-level students to be "full time" in every academic term in which they are enrolled for at least 9 semester 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.

Student classification

Active 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 enroll for graduate-level courses (600 and above) that fit their home department-approved programs. When enrolling for graduate courses outside the home department, students may need to secure the approval of the department offering the course.

Non-degree-seeking 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 non-degree-seeking student will not necessarily apply to any given academic program.

Active and non-degree-seeking graduate students may enroll for undergraduate-level courses with the understanding that these courses may not apply to any RIT graduate program

Degree Requirements

Credit requirements

The minimum credit requirement for a master's degree is 30 semester credit hours. At least 80 percent of these credit hours must be earned at the graduate level and in residence at the university.

Transfer credit

A maximum of 20 percent of the total required semester hours for the graduate degree may be awarded through any combination of transfer credit, waived credit, and credit by competency. 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 term 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 enrollment for that term. For the purpose of verifying credit, an end-of-term grade of R should be submitted for each enrollment 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 enroll for the Continuation of Thesis/Project/Dissertation course each term (including summer but excluding intersession). This course costs the equivalent of one-semester credit hour, although it earns no credit.

1. Enrollment 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 enroll 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, a maximum of 20 percent of previous RIT master's degree earned hours can normally 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 30 semester credit hours be required for the second degree. If duplication of courses causes a student to go below the 30-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 or degrees. 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 30 semester credit hours for the master's degree. At least 80 percent of graduate-level course work and research (courses numbered 600 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 and dean of Grdaute Studies, 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 enrolled are given on a grade report form at the end of each term of attendance. The letter grades are as follows:

GRADE	DESCRIPTION	QUALITY POINTS
A	Excellent	4.00
B	Good	3.00
C	Satisfactory	2.00
D	Minimum Passing Grade	1.00
F	Failure	0.00

D and F grades do not count toward the fulfillment of program requirements for a graduate degree.

The grades of all courses attempted by graduate students will count in the calculation of the cumulative grade point average. The 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.

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 instructor at the end of a term.

Registered (R)—This permanent grade used in graduate course work indicating that a student has registered for a given course but has yet to meet the total requirements for the course or has continuing requirements to be met. The grade is given in graduate thesis work. Completion of this work will be noted by having the approved/accepted thesis or dissertation title, as received by the registrar from the department, added to the student's permanent record. Full tuition is charged for these courses. "R" graded courses

are allowed in the calculation of the residency requirement for graduate programs; however, they do not affect GPA calculations.

Incomplete (I)—This notation is given when an instructor observes conditions beyond the control of a student such that the student is unable to complete course requirements in the given term or session. The instructor determines and advises the student of the due date by which the student must complete course requirements. This is a temporary grade that reverts to an F if the registrar has not received a change of grade directive by the end of the second succeeding term (including summer but excluding intersession). Full tuition is charged however credit hours are not earned and the GPA is not affected until a permanent grade is assigned.

Withdrawn (W)—This notation will be assigned in courses from which a student withdraws through the end of the twelfth week of classes, or if a student withdraws from all courses in a given term.

Audit (AU)—This notation indicates a student has audited a 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 audit to credit status for a course only during the first seven calendar days, excluding Sundays and holidays, of the full fall, and spring terms and summer session. 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 competency (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. For graduate students, the combined total amount of credit applied through external (non-RIT) transfer credit, waived courses, and credit by competency may not exceed 20 percent of the total credits in the graduate program.

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 30 semester 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 an instructor, 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 instructor must complete the appropriate form. The completed form must be approved by the head of the department in which the instructor 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.

Academic probation and suspension

Any active graduate student whose cumulative or program cumulative GPA falls below a 3.0 after 9 credit hours (attempted or earned) 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 cumulative and program cumulative GPA to the 3.0 level within 9 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

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

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

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 in a comprehensive group counseling program and with selected students individually on concerns ranging from the everyday challenges of university life to more severe and 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
- 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.

Confidentiality: All counseling services are confidential and free to eligible students.

Making an initial appointment: Schedule an intake appointment by calling (585) 475-2261 or by visiting the center.

Disability Services

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
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
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
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
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

rit.edu/studentaffairs/elc/
(585) 475-6684 (voice/TTY)

Academic English
The ELC offers advanced courses in English to prepare international students for academic reading and writing at the university level. Specialized courses are offered for Graduate students. Depending on their TOEFL or IELTS scores, international students may be required by admissions or their department to take a battery of English language assessments upon arrival. Based on the results, students may be required to enroll in English courses to meet their language needs. Course grades appear on transcripts, however, courses do not bear academic credit.

For non-degree and provisionally admitted students
For full-time English language students, the intensive English language program consists of 20 to 25 hours of classroom instruction per week at six proficiency levels (from basic to advanced). The program prepares students for academic study in English and also assists in helping students acclimate to life in the U.S. The intensive program meets the immigration requirements for the Certificate of Eligibility I-20 for F-1 student status.

Global Connections
Every term, the ELC offers events to connect its students with others on campus and in the community. These include weekly activities and events with other RIT student and Rochester community groups. The Conversation Partner program sets up one-on-one or small group experiences for students of different linguistic and cultural backgrounds. Students learn form one another while speaking in English.

ETC Production Services

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

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 and spring semester 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 term, holidays, and breaks:
Monday-Friday: 7:30 a.m. to 5 p.m.
Saturday-Sunday: Closed

International Student Services

rit.edu/studentaffairs/iss/
(585) 475-6943 (voice/TTY)

International Student Services (ISS) is the primary resource for more than 2,000 international students from more than 100 countries. ISS manages RIT's Student & Exchange Visitor Information Systems to assist students with immigration regulations, employment authorization, travel authorization, and adjustment to academic and cultural expectations in the United States. The office also provides cross-cultural programming for international students and the campus at large. The staff works closely with Global Union, several international student clubs, and International House. Off-campus programs are regularly coordinated with the Rochester Global Connections.

Libraries

library.rit.edu

The RIT Libraries includes the Wallace Library, the Cary Collection, the RIT Archive Collections, and the RIT museum as well as the Writing Commons and the RIT American Sign Language and Deaf Studies Community Center.

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. There are two open computer labs equipped with Microsoft Office, Adobe Creative Suite, and more and laptops are available for loan.

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 numerous academic libraries within 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 available to help with student research. In-depth assistance is available by appointment. You can connect with the subject experts by phone, e-mail 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 Wallace Library. Study rooms can be reserved online via our website at library.rit.edu. Our newly renovated first floor features comfortable, flexible furniture for collaboration and relaxation, including a collaboration station for group projects.

The Cary Library is a unique collection of thousands 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 120-hours-a-week, with 24/7 hours during finals week.

Leadership Institute and Community Service Center

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

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

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

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

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

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

rit.edu/fa/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 semester, 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

rit.edu/studenthealth/
(585) 475-2255

The Student Health Center, located on the Quarter Mile, provides comprehensive primary medical care as well as education for maintaining good health. The staff includes physicians, a psychiatrist, nurse practitioners, a physician assistant, nurses, an interpreter for the deaf and support staff. Services are available by appointment.

During the academic year, 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. During breaks and summer, students are seen Monday-Friday, 8:30 a.m. to 4:00 p.m. Hours are subject to change and the changes are posted.

The Center offers an on-call nurse advice service for immediate medical concerns when the office is closed. The nurse advice service cannot assist with making or cancelling appointments or managing prescription issues. If you need health advice when the Student Health Center is closed, please call 585-475-2255 and choose the option for the nurse service.

The student health fee is mandatory for all full-time undergraduate students. All other students may pay either the health 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.

Students are required to maintain health insurance coverage through family coverage, a personal policy or through the RIT sponsored plan. The RIT Student Insurance Plan is available through Aetna Student Health. More information about the RIT

plan may be obtained by contacting University Health Plans at 800-437-6448 or www.universityhealthplans.com.

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 six credit hours in a term and born after January 1, 1957, must provide proof of having received the appropriate immunizations against measles, mumps, and rubella, and to sign a meningitis awareness form. The law applies to all full time and part time students including RIT employees. Immunization requirements include:

- Two MMR vaccinations at least one month apart and after the first birthday;
- A Meningitis Awareness Form, signed by all students regardless of age; and
- Immunization against meningitis, which is required by RIT for all students age 21 and under.

Failure to comply with the New York State immunization law may result in exclusion from classes and the campus, and a $200 fine.

NOTE: An email notification is sent to students' RIT email account with directions to complete the necessary health information through the SHC portal. Please note that the immunization form is to be completed by the student online and then downloaded and taken to the student's health provider or school official for verification. The form must then be forwarded to the Student Health Center for approval (fax: 585-475-7530).

Veteran Enrollment Services

rit.edu/emcs/ptgrad/military
(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. To ensure a smooth transition and successful academic program completion, start benefits paperwork early.

The Center For Women and Gender

rit.edu/studentaffairs/womenscenter/
(585) 475-7464

The Center for Women and Gender is committed to promoting a campus community that is safe, equitable, and respectful of all members. The center fosters an educational environment in which all community members 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 address relationship and sexuality issues, pregnancy, body image issues, harassment and discrimination, assertiveness, and sexual assault. Services and programs serve women, men, deaf, hearing, and the LGBT communities.

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FCMG . . . . Facility Management
HSPT . . . . . Hospitality Management
HRDE. . . . . Human Resource Development
MCET, MFET
. . . . . Manufacturing and Mechanical Engineering Technology
PACK . . . . . Packaging Science
SERQ . . . . . Service Leadership and Innovation
TCET . . . . . Telecommunications Engineering Technology
GRCS . . . . . Graduate Writing and Research Courses

Saunders College of Business

ACCT. . . . . Accounting
BLEG . . . . . Business Legal Studies
DECS . . . . . Decision Science
ESCB . . . . . Economics
FINC . . . . . Finance
INTB . . . . . International Business
MGMT. . . . Management
MGIS . . . . . Management Information Systems
MKTG . . . . Marketing

B. Thomas Golisano College of Computing and Information Sciences

CSCI. . . . . Computer Science
CISC. . . . . Computing and Information Sciences
CSEC . . . . . Computing Security
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

CMPE. . . . . Computer Engineering
EEEE . . . . . Electrical Engineering
ISEE . . . . . Industrial and Systems Engineering
MECE. . . . . Mechanical Engineering
MCEE. . . . . Microelectronic Engineering
MCSE. . . . . Microsystems
CQAS. . . . . Center for Quality and Applied Statistics

College of Health Sciences and Technology

HLTH. . . . . Health Systems Administration
ILLM . . . . . Medical Illustration
PHYA. . . . . Physician Assistant

College of Imaging Arts and Sciences

ITDI . . . . . Interdiscip. Imaging Arts

School for American Crafts
CCER. . . . . Ceramics
CGEN. . . . . General Crafts Studies
CGLS . . . . . Glass
CMTJ . . . . . Metals & Jewelry Design
CWTD. . . . Textiles
CWFD . . . . Furniture Design

School of Art
ARED. . . . . Art Education
ARTH. . . . . Art History
FNAS . . . . . Fine Arts Studio
ILLS . . . . . Illustration

School of Design
IDDE . . . . . Industrial Design
VCDE. . . . . Visual Comm. Design

School of Film and Animation
SOFA . . . . . Film and Animation

School of Media Sciences
PPRT . . . . . Printing Management

School of Photographic Arts and Sciences
PHGR. . . . . Graduate Photography

College of Liberal Arts

COMM . . . Communication and Media Technology
CRIM . . . . . Criminal Justice
ENGL. . . . . English
PSYC . . . . . Experimental Psychology
PHIL. . . . . Philosophy
PUBL . . . . . Public Polity
SPSY. . . . . School Psychology
STSO . . . . . Science, Technology and Society

Center for Multidisciplinary Studies

BUSI. . . . . Business Administration Management
PROF . . . . . Professional Studies
QTLM . . . . Quality Management
TCOM . . . . Technical Communications

National Technical Institute for the Deaf

MSSE . . . . . Secondary Education of Students Who Are Deaf or Hard of Hearing
NCOM. . . . Deafness Specialty Preparation Program in Speech-Language Pathology

College of Science

ASTP . . . . . Astrophysical Sciences and Technology
BIOL. . . . . Biological Sciences
CHEM, CHMA, CHMB, CHMI, CHMO, CBMP, CHPO
. . . . . Chemistry
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Golisano Institute for Sustainability

ARCH . . . . Architecture
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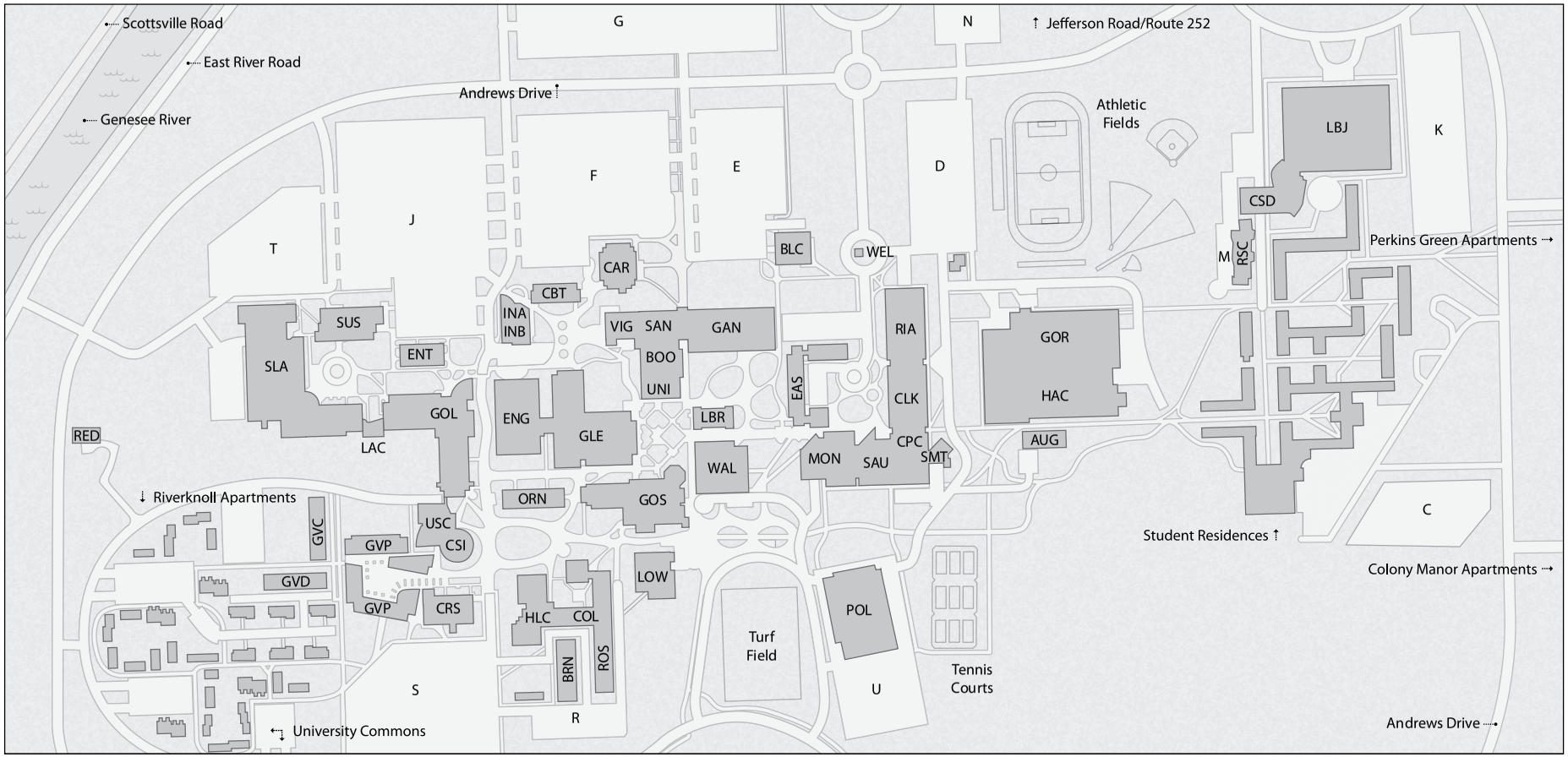

RIT CAMPUS MAP

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
POL	Gene Polisseni Arena
RED	Red Barn
RIA	Frank Ritter Ice Arena
ROS	Lewis P. Ross Hall
RSC	Rosica Hall (under construction)
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

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Periodicals