2006

2006-2007 Graduate Bulletin

Rochester Institute of Technology

Rochester Institute of Technology
2006–2007 Institute Calendar

Fall Quarter (20061)

April 25-September 4, 2006
Fall Registration. Use telephone, Student Information System, walk-in, fax, or mail-in options. Students will be billed.*

September 4
Day and evening classes begin

September 9
Saturday classes begin

September 11
Last date to add/drop courses

October 13
Last date to withdraw with a "W" grade

November 10
Last day class

November 13–17
Final exams-day classes

November 17
Last evening class

November 18
Last Saturday class

November 20–December 1
Fall/Winter break

Winter Quarter (20062)

October 17-December 4, 2006
Winter Registration. Use telephone, Student Information System, wak-in, fax, or mail-in options. Students will be billed.*

December 4
Day and evening classes begin

December 9
Saturday classes begin

December 11
Last date to add/drop courses

December 22
Last day of classes before break

December 23
Last Saturday of class before break

January 6, 2007
Saturday classes resume

January 8
Day and evening classes resume

January 26
Last date to withdraw with a "W" grade

February 23
Last day class

February 26, 27, 28, March 1,2
Final exams–day classes

March 2
Last evening class

March 3
Last Saturday class

March 5-9
Winter/Spring break

Spring Quarter (20063)

January 30-March 12, 2007
Spring Registration. Use telephone, Student Information System, walk-in, fax, or mail-in options. Students will be billed.*

March 12
Day and evening classes begin

March 17
Saturday classes begin

March 20
Last date to add/drop courses

April 21
Last date to withdraw with a "W" grade

May 18
Last day class

May 19
Last Saturday class

May 19–24
Final exams-day classes

May 25
Last evening class

May 25
Academic Convocation

May 26
Commencement

May 28–June 1
Spring/Summer break

Summer Quarter (20064)

April 17-June 4, 2007
Summer Registration. Use telephone, Student Information System, walk-in, fax, or mail-in options. Students will be billed.*

June 4
Day and evening classes begin

Jun 9
Saturday classes begin

June 11
Last date to add/drop courses

July 4
Holiday-Classes will be held

July 13
Last date to withdraw with a "W" grade

August 10
Last day class

August 13–16
Final exams–day classes

August 17
Last evening class

August 18
Last Saturday class

** Refer to quarterly schedule of courses for specific registration dates and times.*

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RIT is chartered by the legislature of the State of New York 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, N.Y. 12234, 518-474-2593.

In addition to institutional accreditation, curricula in the colleges are accredited by appropriate professional accreditation bodies. Where applicable, specific mention of these is included in the college descriptions. Students wishing to review documents describing accreditation should contact the Office of the Provost.

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Rochester Institute of Technology

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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 the *Graduate Bulletin* was published. Course and curriculum changes, modifications of tuition, fee, dormitory, meal, and other charges, plus unforeseen changes in other aspects of RIT life sometimes occur after the *Graduate Bulletin* has been printed but before the changes can be incorporated in a later edition of the same publication. Because of this, Rochester Institute of Technology does not assume a contractual obligation with its students for the contents of this *Graduate Bulletin.*

RIT will admit and hire men and women; veterans; persons with disabilities; and individuals of any race, creed, religion, color, national or ethnic origin, sexual orientation, age or marital status in compliance with all appropriate legislation, including the Age Discrimination Act and Title VI of the Civil Rights Act of 1964 (P.L. 88–352).

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www.rit.edu/grad

Graduate Bulletin 2006–2007
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 70 graduate programs in high-growth and high-tech career fields including business, computer science and information technology, engineering, science, and art, RIT offers the choices you want in graduate education.

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

Quality

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

At RIT, you'll interact with faculty members who have e xtensive teaching experience and are internationally respected for their contributions in their professional fields. RIT enrolls more than 15,000 students from across the United States and in 95 foreign countries.

Selected faculty and student awards, honors, and partnerships

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

Reputation

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

RIT is the 20th-largest private university in the U.S., and has been consistently recognized by leading college guides, industry publications, and the media. RIT has been cited by U.S. *News e World Report* as the most comprehensive university in the North for academic reputation.

More than 90,000 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. Our graduate students are currently working for such companies as Amazon.com, IBM, Bausch & Lomb, NASA, Xerox, Boeing, Johnson & Johnson, and Heidelberg.

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

Graduate Education at RIT

Katherine Mayberry
Vice President for Academic Affairs

The graduate learning experience at RIT is *focused.* RIT graduate programs focus on the conceptual structure and organization of knowledge in the chosen subject — an understanding that is essential to both accept and lead technological change in the professions. They also build an educational base for additional learning and offer access to, and mobility within, one or more professional areas.

The programs themselves are centered in fields that combine both theoretical knowledge and practical applications, especially those with a proven need in the marketplace. Thesis topics often relate directly to situational concerns, rather than theoretical discourse. Programs that do not require a thesis or project encourage other avenues for professional experience, such as optional or required cooperative education or an internship.

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

A philosophy supported by campus resources

RIT's international reputation as an applied technological university gives graduate students the advantage of working with the sophisticated technology and laboratories found both on and off campus. Students in microelectronic engineering lhave access to clean-room facilities that meet industry standards. Computer graphics design students 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 were donated by an industry eager to hire students experienced with equipment used in their own laboratories. Students in the clinical chemistry MS program may take a research course it a laboratory outside of RIT.

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

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

RIT, founded in 1829, is a privately endowed university in suburban Rochester, N.Y. Its eight colleges include:

Applied Science and Technology

Business

B.Thomas Golisano College of Computing and Information Sciences

Imaging Arts and Sciences

Kate Gleason College of Engineering

Liberal Arts

Science

National Technical Institute for the Deaf

For additional information, write, phone or e-mail:
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gradinfo@rit.edu
www.rit.edu/grad

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 a technologically advanced university is matched by our commitment to offer programs designed to meet 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 mix exciting research and stimulating dialogues with faculty and such distinguished visitors as George Bush, Joe Torre, Jesse Jackson, John Hockenberry, Maya Angelou, Annie Leibovitz, Jerry Uelsmann, and Greg Heisler. The 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 Institute continues to receive international recognition for the quality of its academic programs. In a recent ranking of national photography programs, *U.S. News e 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 software development and management; information technology; environmental, health and safety management; telecommunications engineering technology; imaging science; print media; 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 offers professionals an opportunity to earn a master's degree by studying on campus Friday and Saturday, every other week. Professionals from California to England visit RIT every summer for executive leader master's degree programs in service management, hospitality and tourism management, training and instructional design, 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, technological 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 of career education in preparing students for technological and professional careers. 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, technological, 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 applications 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, which offers undergraduate and graduate students in selected programs the opportunity for paid, professional work experience while they are completing their degrees.

History of graduate education

Starting in *1955* with the master of fine arts degree, RIT has continually 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, RIT's Center for Microelectronic and Computer Engineering began a master's degree in microelectronic engineering. Other graduate programs have taken similar routes, and all eight RIT colleges exhibit continuous concern for the emerging needs of the business, industrial, and scholarly communities.

A recent example of RIT's continuing endeavor to provide education in emerging career fields is the Ph.D. in Microsystems engineering, RIT's second doctoral program. The Ph.D. is one of more than 70 graduate degrees now offered by the university.

Sponsored research projects

Externally sponsored projects are a vital and integral component of RIT's educational and research activity. Faculty and students undertake sponsored projects for a variety of important reasons: to add to the body of knowledge, for professional development, and to strengthen academic programs. Sponsored projects enhance the Institute'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 for research comes from federal and state agencies, private foundations, professional societies, and corporations. RIT's major sponsors include the National Science Foundation, the National Institutes of Health, the Department of Education, the Department of Defense, the National Aeronautics and Science Administration, and New York State. The office of Sponsored Research Services projects more than $35 million in awarded projects for the 2006–07fiscal year. Contact SRS at (585) 475-7985 or research@rit.edu, or visit the website at www.research.rit.edu.

Accreditation

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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
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Albany, NY 12234
(518) 474-2593

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RIT Research Centers and Organizations

- Center for Bioscience Education and Technology
- Center for Electronics Manufacturing and Assembly (CEMA)
- Center for Excellence in Lean Enterprise
- Center for Imaging Science
- Center for Integrated Manufacturing Studies
- Center for International Business and Economic Growth
- Center for Materials Science and Engineering
- Center for Quality and Applied Statistics
- Center for Remanufacturing and Resource Recovery
- First in Class Initiatives
- High Technology Incubator
- Image Permanence Institute
- IT Collaboratory
- Laboratory for Applied Computing
- National Technology Training Center
- Northeast Technical Assistance Center at NTID
- Printing Applications Laboratory
- Sloan Printing Industry Center
- Sponsored Research Services
- Technology Licensing Office

Graduate Programs of Study

		Degree and HEGIS Code						
	College	Advanced Certificate	PhD.	MBA	ME	MFA	MS	MST
Business and Management								
Accounting	Business			0502				
Business Administration	Business			0506†				
Elements of Health Care Leadership	Applied Science and Technology	1202						
Finance	Business						0504	
Health Information Resources	Applied Science and Technology	1202*						
Health Systems Administration	Applied Science and Technology						1202*	
Health Systems Finance	Applied Science and Technology	1202*						
Hospitality-Tourism Management	Applied Science and Technology						0510.1†	
Human Resource Development	Applied Science and Technology	0515					0515.00†	
Management	Business						0513	
Manufacturing Leadership	Engineering						0599	
Senior Living Management	Applied Science and Technology	0599						
Service Leadership and Innovation	Applied Science and Technology	0510						
Service Management	Applied Science and Technology						0599†	
Computer and Information Sciences								
Computer Engineering	Engineering						0999	
Computer Science	Computing and Information Sciences						0701	
Computing Security and Information Assurance	Computing and Information Sciences						0799	
Computing and Information Sciences	Computing and Information Sciences		1701					
Information Technology	Computing and Information Sciences						0699*	
Interactive Multimedia Development	Computing and Information Sciences	0699						
Learning and Knowledge Management Systems	Computing and Information Sciences	0799					0799	
Software Development and Management	Computing and Information Sciences						0799*	
Technical Information Design	Applied Science and Technology	0605*						
Cross-Disciplinary Studies (Individualized Program)								
Cross-Disciplinary Professional Studies	Applied Science and Technology						4999*	
Education and Liberal Arts								
Applied Experimental Engineering Psychology	Liberal Arts						2099	
Art Education	Imaging Arts and Sciences							0831
Communication and Media Technologies	Liberal Arts						0605.00	
Human Resource Development	Applied Science and Technology	0515					0515†	
School Psychology	Liberal Arts	0826.02					0826.02	
Science, Technology and Public Policy	Liberal Arts						2102	
Secondary Education of Students Who Are Deaf or Hard-of-Hearing	NTID						0803	
Training and Instructional Design#	Applied Science and Technology						0699†	

	College	Degree and HEGIS Code						
		Advanced Certificate	**Ph.D.**	**MBA**	**ME**	**MFA**	**MS**	**MST**
Engineering and Technology								
Applied Statistics	Engineering						1702*	
Computer Engineering	Engineering						0999	
Electrical Engineering	Engineering						0909	
Engineering Management	Engineering				0913			
Environmental, Health and Safety Management	Applied Science and Technology						0420*	
Industrial Engineering	Engineering				0913		0913	
Manufacturing and Mechanical Systems Integration	Applied Science and Technology						0913	
Manufacturing Engineering	Engineering				0913			
Manufacturing Leadership	Engineering						0599	
Materials Science and Engineering	Engineering/Science	0915					0915	
Mechanical Engineering	Engineering				0910		0910	
Microelectronic Engineering	Engineering						0999*	
Microelectronics Manufacturing Engineering	Engineering				0999*			
Microsystems Engineering	Engineering		0999					
Packaging Science	Applied Science and Technology						4999†	
Product Development	Engineering						0599	
Statistical Quality	Engineering	1702*						
Systems Engineering	Engineering				0913			
Telecommunications Engineering Technology	Applied Science and Technology						0925*	
Photography, Fine Art, and Graphic Communication								
Art Education	Imaging Arts and Sciences							0831
Ceramics	Imaging Arts and Sciences					1009		
Computer Graphics Design	Imaging Arts and Sciences					1009		
Fine Arts Studio	Imaging Arts and Sciences					1002		0831
Glass	Imaging Arts and Sciences					1009		
Graphic Design	Imaging Arts and Sciences					1009		
Imaging Arts/Computer Animation	Imaging Arts and Sciences					1011		
Imaging Arts/Film	Imaging Arts and Sciences					1011		
Imaging Arts/Photography	Imaging Arts and Sciences					1011		
Industrial Design	Imaging Arts and Sciences					1009		
Medical Illustration	Imaging Arts and Sciences					1299		
Metals	Imaging Arts and Sciences					1009		
Non-toxic Intaglio Printmaking	Imaging Arts and Sciences	1009						
Print Media	Imaging Arts and Sciences						0699*	
Wood	Imaging Arts and Sciences					1009		
Science, Mathematics, and Imaging Science								
Applied Mathematics	Science						1799	
Applied Statistics	Engineering						1702*	
Bioinformatics	Science						0499	
Chemistry	Science						1905	
Clinical Chemistry	Science						1223	
Color Science	Science						1099	
Environmental Science	Science						0420	
Imaging Science	Science		1999.20				1999.20*	
Materials Science and Engineering	Engineering/Science	0915					0915	
Statistical Quality	Engineering	1702*						
Statistical Methods for Product and Process Improvement	Engineering	1702*						

* These programs include opportunities for degree completion through online learning.

† These programs include degree completion through Executive Education option.

This program has been approved for discontinuance. No new students will be admitted 2005-2006.

College of Applied Science and Technology

www.rit.edu/~700www/

Programs

Master of Science degrees in:

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Advanced Certificates in:

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= Health Systems Finance	p. 18
= Human Resource Development	p. 16
Senior Living Management	p. 18
Service Leadership and Innovation	p. 15
= Technical Information Design	p. 20

Executive Leader:
This program is an accelerated delivery of graduate education, encompassing two summers, for degrees in hospitality-tourism management, service management, human resource development, training and instructional design, and packaging science.

= *Online learning option available*

Graduate education in any discipline requires commitment of both the student and the institution involved. The diverse, graduate-level academic areas within the College of Applied Science and Technology represent RIT's commitment to curricular innovation, program flexibility, and academic rigor. We are also committed to advancing the state of our education through the latest technology, management theories, and educational philosophies.

Wiley R. McKinzie, Dean

Faculty

The faculty is experienced at preparing individuals for current career opportunities. They are accessible to students or individual guidance, and their ongoing participation as professional consultants and researchers allows them to integrate the latest technical innovations into their classes.

Resources

In fall of 1999, the college opened a new building containing state-of-the-art laboratories. The new facilities support courses that address current and future applications in the areas of electrical-computer-telecommunications engineering technology, manufacturing and mechanical engineering technology, and packaging science. In addition to laboratories in computer networking and telecommunications, a circuits "studio," and mechanics and materials, the new building includes student study space and departmental and faculty offices.

RIT's $22 million Center for Integrated Manufacturing Studies gives graduate students the opportunity to test new technologies

for actual companies seeking solutions to real problems. Continual computer laboratory upgrades mean we have the technology that is considered the industry standard.

Most importantly, the state, national, and international education communities recognize the academic leadership of our programs. In addition, our close ties to business and industry mean that 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.

Department of Civil Engineering Technology, Environmental Management and Safety

Master of Science in Environmental, Health, and Safety Management

Maureen Valentine, Department Chair
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Joseph Rosenbeck, Graduate Program Coordinator
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www.rit.edu/~704www

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

Established in 1997, RIT's master of science degree in environmental, health, and safety management is offered by the department of civil engineering technology, environmental management and safety. Developed by experienced EHS professionals from the department's advisory committee and faculty, the MS program is designed to provide graduates with a solid grounding in both technical and managerial aspects of leading practices in EHS management. RIT's program in environmental, health, and safety management utilizes an integrated systems focus to ensure that graduates can:

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

Distance learning option

The program is designed to be completed on campus or through distance learning in 15 months by full-time students, or in two years of part-time study while working full time. Students can tailor an individual program of study by complementing core and foundation courses with professional electives that match their academic and career interests.

Admission requirements

Unconditional admission to the MS degree program in environmental, health, and safety management requires:

- a bachelor's degree from an accredited university or college;
- a minimum undergraduate grade-point average of 3.0 (B) over the junior- and senior-level years;
- at least 20 quarter credit hours (or 15 semester credit hours) of college-level science course work, with at least 4 credit hours (or 3 semester credit hours) in each of the following three categories: general chemistry or organic chemistry; biology, microbiology, ecology, or biochemistry; and physics, geology, hydrology, or geochemistry;
- at least one college-level course in statistics; and
- at least one college-level course or equivalent experience in computer science.

Graduate Record Examination (GRE) scores are not required. Applicants who do not meet the above requirements, however, may be required to submit GRE scores to support their candidacy.

International students are required to have achieved a score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) on the Test of English as a Second Language (TOEFL). In addition to the RIT graduate application, applicants to this program must submit: two writing samples to demonstrate written communication skills and a current résumé or CV with sufficient detail to identify specific tasks and levels of responsibilities.

Generally, applicants are expected to have formal academic training or documented experience in the areas of environmental management (air, water, solid, and hazardous waste), occupational health, and occupational safety. Academic and experiential gaps in these areas may be addressed through program foundation courses and electives.

The program was designed for EHS professionals with some work experience. Applicants with less than one year of relevant work experience may be expected to complete one or more quarters of graduate-level cooperative education experience during their program of study. Potential applicants are strongly encouraged to contact the graduate program coordinator at (585) 475-6469 for informal advising and additional information about the program.

Transfer credit

Up to 12 quarter credit hours of graduate course work may be accepted toward the program if appropriate and approved by the student's major professor or the admissions committee.

Curriculum

The MS program in environmental, health, and safety management consists of 48 credit hours of graduate study. The program is available in both classroom and distance-learning formats, although some courses are taught only in the distance-learning format. The curriculum consists of a sequence of core courses (24 credits), professional electives chosen from the program or other departments (18 credits), and a graduate thesis or project (6 credits).

Foundation courses are intensive survey courses that allow each student to fill the gaps in their academic preparation/work experience related to the environmental, health, and safety fields. Necessary foundation course work will be determined at the time of admission to the program. Up to 18 credits of foundation course work may be counted toward the degree as professional elective course work.

Core courses include:

0630-720	Environmental, Health and Safety Management
0102-740	Organizational Behavior and Leadership
0630-725	EHS Accounting and Finance
0630-740	EHS Management System Design
0630-760	Integrating EHS Into Business Management
0630-790	EHS Internal Auditing

Master of Science in Facility Management*

Maureen Valentine, Department Chair
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www.rit.edu/~704ww

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

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

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

RIT's master of science degree in facility management is offered by the department of civil engineering technology, environmental management and safety. Developed by a panel of experienced FM professionals, the MS program is designed to provide graduates with a solid grounding in both the technical and managerial aspects of facility management. The curriculum was developed using educational standards established by the International Facility Management Association (IFMA).

Distance Learning

The program is designed to be completed through distance learning or on campus in 20 months by full-time students, or in two years of part-time study while working full time. Students can tailor an individual program of study by complementing core courses with professional electives that match their academic and career interest.

Admission Requirements

Unconditional admission to the MS degree in facility management requires:

- A BS degree from accredited university or college. Generally, applicants are expected to have formal academic training or documented experience in the areas common to facility management (i.e., engineering technology, engineering, construction management, interior design, architecture, technology, and business). Academic and/or experiential gaps in these areas may be addressed through program electives.
- A minimum undergraduate GPA of 3.0 overall or over the junior and senior years
- GRE scores are not normally required. Applicants who do not meet the above requirements, however, may be required to submit GRE scores to support their candidacy.
- Two writing samples to demonstrate written communication skills
- Current resume or CV with sufficient detail to identify specific work experience tasks and levels of responsibility
- Students who do not meet the above requirements may be asked to complete certain undergraduate courses as a bridge for the content knowledge required for the graduate program. The graduate program coordinator will design a bridge program specific to individual student needs based on the evaluation of academic records and documented work experience.
- Students who are already qualified for one or more of the core courses through work experience may substitute other course work with the permission of the graduate program coordinator and in accordance with RIT policy.
- A minimum Test of English as a Foreign Language (TOEFL) score of 570 (paper-based) or 230 (computer-based), a GRE score of 1200 (V&Q), and an analytical writing score of 3.5 or higher are required for international applicants seeking admission from non-English speaking countries. Applicants with low GRE scores may be admitted conditionally and will take a prescribed English language test and, if required, English language courses along with a reduced MS program course load.

The admission requirements for the facility management program ensure that students entering the program will have a reasonable chance for success in college. The requirements also establish areas of prerequisite knowledge that students will need to integrate into graduate level courses.

Applicants without documented relevant experience in the facility management profession will be expected to satisfy a graduate cooperative education requirement of two quarters during their program of study. Potential applicants are strongly encouraged to contact the graduate program coordinator (585) 475-2183 for informal advising and additional information about the program. The program website address is www.rit.edu/~704www.

Transfer Credit

Up to 12 quarter credits of graduate course work may be accepted into the program in appropriate and approved by the student's major professor or the graduate coordinator.

Curriculum

The MS in facility management consists of 52 quarter credit hours of graduate study. The program is available predominately in the distance learning format, although some courses and electives are available in the classroom. The curriculum consists of a sequence of core courses (40 credits), professional electives chosen from the program or other departments (8 credits), and a graduate project (4 credits). Project topics should complement the student's interests and professional position, and are generally considered applied in nature.

Core courses include:

0632-700	Principles and Practice in Facility Management
0632-720	Environmental, Health and Safety Management for FM
0681-710	Introduction to Project Management
0632-760	Space Planning in Facility Management
0101-703	Accounting for Decision Makers
0632-800	Operation and Maintenance of Facilities I
0632-810	Operation and Maintenance of Facilities II
0632-830	Real Estate of Facilities
0102-740	Organizational Behavior and Leadership
0632-850	Digital Communication and Analytical Tools in Facility Management

* *This program is pending approval by the New York State Department of Education.*

Department of Manufacturing and Mechanical Engineering Technology/Packaging Science

Master of Science in Manufacturing and Mechanical Systems Integration

S. *Manian Ramkumar, Program Adviser*
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www.rit.edu/~719www/PROGRAMS/MS/MAIN.HTM

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

Admission requirements

Applicants should have completed a baccalaureate or equivalent degree from an accredited academic institution in the field of engineering, engineering technology, computing, or business with a minimum grade point average of 3.0. Students with degrees in other disciplines will be considered on an individual basis. Calculus, computer programming, and probability and statistics are required backgrounds.

Applicants should submit two professional recommendations, transcripts from previous college attendance, and a clearly written one-page statement of purpose in addition to the graduate application form.

A minimum TOEFL score of 550 (paper-based), 213 (computer-based), or 88 (Internet-based); a GRE score of 1200 (V&Q), and an analytical writing score of 3.5 or higher are required for international applicants seeking admission from non-English-speaking countries. Applicants with low GRE scores may be admitted conditionally and will take a prescribed English language test and, if required, English language courses along with a reduced MS program course load.

Curriculum

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

Core courses (20 credits)

0617-850	Flexible Manufacturing and Assembly Systems
0617-730	Data Management and Communication
0617-631	Computer Aided Engineering
0101-794	Cost Accounting in the Manufacturing Environment
0106-744	Project Management

Concentration options (20 credits)

Product Design

0610-630	Tolerance Design
0610-710	Product Development and Integration
0610-820	Concept Design and Critical Parameter Management
0610-830	Instrumentation and Computer Aided Data Acquisition
0610-870	Robust Design

Automated Manufacturing

0617-833	Robotics in CIM
0617-870	Manufacturing Automation Controls
0610-830	Instrumentation and Computer Aided Data Acquisition
0303-710	Systems Simulation
0303-729	Advanced Systems Integration

Management

0101-703	Financial Accounting Systems
0102-742	Introduction to Technology Management
0106-743	Operations Management and Process Improvement
0106-749	Manufacturing Strategy and Tactics
0307-781	Quality Management

Software Development

0610-830	Instrumentation and Computer Aided Data Acquisition
4002-710	Object Technologies
4002-720	Data Object Development
4002-733	Fundamentals of Computer Communication
4002-750	Distributed Systems

Electronics Packaging

0617-855	Electronics Packaging Fundamentals
0617-856	Advanced Concepts in Electronics Packaging
0307-721	Statistical Process Control
0307-770	Design of Experiments for Engineers and Scientists
0307-862	Reliability Statistics I

Quality Improvement

0307-721	Statistical Process Control
0307-731	Statistical Acceptance Control
0307-781	Quality Management
0307-801	Design of Experiments I
0307-802	Design of Experiments II

Electives (8 credits)

Each student must take two graduate-level elective courses according to his or her concentration Courses selected must be:

1. Any course from another concentration.
2. Any course from another graduate program, if approved by the program adviser and faculty member teaching the course.
3. Any independent study course if approved by the student's academic adviser.

Capstone project/thesis (4 credits)

Master of Science in Packaging Science

Deanna Jacobs, Program Coordinator
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www.rit.edu/packaging

The MS program in packaging science is designed to meet the needs of professionals who have been working in the field for a number of years, and it is suitable for those students who wish to pursue a graduate program immediately upon earning a BS degree.

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

Admission requirements

Students entering the program will have a graduate academic adviser appointed and will develop their programs of study in consultation with their adviser. They may utilize the model curriculum to complete their degree requirements, or may propose alternative course work. All programs must be consistent with the general outline of the model curriculum and have advisory approval. In instances where the student has insufficient academic or practical preparation to study packaging at the graduate level, he or she will work out an appropriate program to correct such deficiency, generally by completing the following undergraduate courses: Packaging Materials, Container Systems and Concepts to Consumer. These courses may not be used for credit toward the MS degree.

Further, a basic competence in statistics and basic computer literacy will be assumed. Applicants for graduate study may satisfy these requirements by completing the equivalent of 0307-711 and completing a course in computer applications. Lacking this background, applicants will be required to take 0307-711 and/or 0607-341, or equivalent course work to remedy a background deficiency.

Application for admission for graduate study in packaging will be made through the Office of Graduate Enrollment Services. Final acceptance of the candidate for graduate study will be determined by the department of packaging science. All applicants must have earned a 3.0 ("B") average grade in their final two years of undergraduate degree work. Submit transcripts of undergraduate work to RIT's Office of Graduate Enrollment Services, along with two letters of recommendation to the department of packaging science. In those cases where there may be some question of the capability of the applicant to complete this program, he or she may be required to submit his or her scores on the Graduate Record Examination to support the candidacy.

Curriculum

The curriculum is composed of three components: packaging core courses, research, and elective credit. The MS program requires completion of 48 credits of graduate-level course work, as follows:

Packaging core course work

Completion of a minimum of 20 credits in graduate-level packaging courses, including Research Methods (0607-701), and any four of the following:

0607-721	Packaging Administration
0607-731	Advanced Packaning Economics
0607-742	Distribution Systems
0607-750	Graduate Seminar
0607-752	The Legal Environment
0607-763	Packaging for End-Use
0607-770	Advanced Computer Applications
0607-783	Packaging Dynamics
0607-798	Advanced Food Packaging
0607-799	Advanced Packaging Design

Cores and electives must have advisory approval. Courses selected for elective credit can be combined to create specialties in packaging science, print media, or service management, for example.

Research

Students in the master's program will be required to prepare and defend a 12-credit graduate thesis (0607-890) completed under the supervision of their adviser. The type of research done and the area of study will be agreed upon by the student and the adviser before the student enrolls for graduate thesis credits. Students may also elect to take up to eight credits of Independent Study (0607-798), but this may NOT be used as credit toward the 20 credits of packaging core course work.

Elective credit

In addition to the packaging core and the thesis each student will complete a minimum of 16 elective credits selected in consultation with the adviser to complete the degree requirement.

Students may also elect to take up to eight credits of Independent Study (0607-978), but this may not be used as credit towards the 20 credits of packaging core course work.

In general, graduate-level course work will be selected to meet degree requirements, but, in limited circumstances where individual need indicates it would be appropriate, a limited number of 500-level undergraduate courses (not to exceed 12 credits, in total) may be used to fulfill elective credit.

Executive leader option

This intensive program consists of two two-week summer sessions, online learning, and a research project. It is conducted over two consecutive summers. Candidates should be practicing packaging professionals with a minimum of five years of work experience beyond the baccalaureate degree. Admission to the executive leader MS program also requires endorsements from the student's senior management or administrative personnel.

The structure of the program provides individuals an opportunity to obtain their advanced degree without disrupting their employment. Graduate credit granted for life and professional experiences is determined by an executive leader portfolio assessment.

The program concentrates on the application of packaging technology to the supply chain. Candidates are encouraged to align research project goals with current job responsibilities.

Electrical, Computer, and Telecommunications Engineering Technology Department

www.rit.edu/~706www/

Master of Science in Telecommunications Engineering Technology

Michael Eastman, Department Chair
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Throughout the 20th century and continuing into the 21st, 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. Now, RIT offers a unique program that is focused on telecommunications that develops the advanced level of skill and knowledge needed by future leaders in the industry.

The master of science degree in telecommunications engineering technology accommodates individuals with both technical and nontechnical baccalaureate degrees who are seeking graduate education to advance into managerial and leadership roles in the dynamic telecommunications environment. RIT's vision is to provide this opportunity through traditional on-campus education and distance learning using the Internet.

Admission requirements

Applicants should have a baccalaureate degree in engineering technology, engineering, or a related degree from an accredited institution, and a minimum cumulative grade point average of 3.0 (B). Applicants with a related degree must submit two professional recommendations, which address how the applicant has obtained the competencies required for the engineering technology or engineering baccalaureate degrees. Bridge programs are available for applicants without experience in the telecommunications industry or applicants who do not have engineering technology or engineering degrees. Applicants from universities outside the United States should submit Graduate Record Examination (GRE) scores. The GRE score is recommended for those whose undergraduate grade point average is less than 3.0.

Applicants whose native language is other than English must take the TOEFL examination. A score of at least 570 (paper-based) or 230 (computer-based) is required. Applicants with a lower TOEFL score may be admitted conditionally and will take a prescribed program in English and a reduced program course load.

Transfer credit

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

Curriculum

The MS in telecommunications engineering technology is a 48 quarter-credit-hour program. It includes *six* core courses (24 quarter credit hours) that introduce essential fundamental concepts and skills. Four other courses (16 credit hours) must be chosen from the technical electives or the management courses. One of these four courses must be a technical elective. Each student is required to complete a capstone project (4 to 8 credit hours), which is either a graduate project or a graduate thesis. Students who choose to complete a graduate project must com-

plete an additional technical elective or management course. The management courses are offered by the College of Business.

Core courses

0614-720	Telecommunications Concepts
0614-722	Principles of Telecommunications Networks
4002-746	Telecommunications Network Protocols
0614-780	Telecommunications Policy and Regulation
0614-726	Telecommunications Project Management
0614-728	Operating Systems for Telecommunications

Technical electives

Network Design

0614-761	Telecommunications Network Engineering
0614-774	WAN/LAN Planning and Design
0614-836	Next Generation Networks

Fiber Optic Telecommunications

0614-732	Fiber Optic Telecommunications Technology
0614-832	Fiber Optic Telecommunications Systems

Wireless Telecommunications

0614-764	Telecommunications Systems
0614-783	Telecommunications Transmission Systems
0614-864	Wireless RF Telecommunications Systems

Management courses

Management courses offered by the College of Business are included in the MS in telecommunications engineering technology course offerings. Students may take a maximum of three courses. Students who choose the graduate project instead of the graduate thesis may take an additional College of Business graduate course.

Master's project/thesis

Each student is required to take the thesis/project planning seminar and complete either a graduate project or a graduate thesis as the capstone project. Students who elect the graduate project must take an additional course from the technical electives or the management courses.

Hospitality and Service Management Department

www.rit.edu/~702www/

Master of Science in Hospitality-Tourism Management

Francis M. Domoy, Chair
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Linda Underhill, Graduate Program Chair
(585) 475-7359, lmuism@rit.edu
www.rit.edu/~702www/grad-tourmanag.html

Graduates of the MS in hospitality-tourism management program are well prepared to step into numerous mid-level service management and training director positions. The program is focused on service innovation and leadership, as well as leadership functions within many service and corporate settings and at postsecondary academic institutions.

The hospitality-tourism management program may be taken on a full- or part-time basis. The length of time required to earn a degree varies according to the student's undergraduate preparation and the number of graduate courses taken per quarter. All students must earn a minimum of 48 quarter hours of graduate credit (36 of which must be registered through RIT) to earn the MS degree. For full-time students, the program will require a minimum of four quarters of study at the graduate level. Part-time students generally will require seven or eight quarters of study at the graduate level.

Admission requirements

Prior to admission to the MS program, applicants must illustrate to the chair of the program that their previous training, ability, practical experience, and education indicate a reasonable chance of success. Applicants may be admitted who hold a baccalaureate degree from an accredited institution. They must have undergraduate GPAs of 3.0 or higher. The complete admission requirements are as follows:

- Graduate application
- Earned baccalaureate degree
- Official undergraduate transcript(s)
- Two professional recommendations
- An on-campus interview (when possible)
- A resume
- Undergraduate GPA of 3.0 or higher (a GPA of 2.75 will be considered if applicant has superior recommendations; length of time since the candidate's college graduation also will be considered)
- Foundation course work that is 3.0 or higher (if required).

For international applicants, a Test of English as a Foreign Language (TOEFL), with minimum scores of 550 (paper-based), 213 (computer-based), or 89 (Internet-based), must be submitted. All international students will take the Michigan Test upon arrival, unless otherwise approved.

Students who are already qualified for one or more required courses may substitute other course work with the permission of the chair of the program. After a review of their work by the program chair, students whose prior undergraduate work has been in areas other than hospitality-tourism may be required to complete additional courses. The student may choose elective courses with the approval of the chair of the program.

Curriculum

The curriculum is a combination of a required core in service management plus concentration courses. It also contains elective courses appropriate for the candidate's background and interests, and either a research thesis or a graduate project. Course offerings generally are scheduled on evenings or weekends, and also are offered during the summer and online to facilitate part-time students.

Program requirements

The MS in hospitality-tourism management shares several of the same core courses used in the MS in service management. These courses introduce the major concepts associated with all aspects of service management, whether they are applied specifically to the hospitality-tourism industries or the wider service amalgam. This commonality becomes even more evident when the nature of the concepts is depicted. Among the general concepts investigated are service strategy formulation and delivery (understanding and co-creating customer value, innovation and creativity, service leadership, service design implementation, and metrics development), customer-focused research (understanding what customers value, building service environments, and change in service organizations), and human resource issues (workforce development training and evaluation, human capital development, and metrics for evaluation).

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

0625-750	Elements of Service Management: A Systems Approach
0624-825	Strategic Process of Service Firms
0625-849	Service Performance Metrics
0626-891	Workforce Development or
0626-780	Human Resource Management I
0624-770	Service Leadership: Examining and Implementing Change

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

The Foundations of Applied Social and Managerial Research core course provides a logical path for the student who is developing a research proposal. Among the elements discussed are problem statement, purpose and significance, hypothesis and assumptions, scope and limitations, methodology and the nature of research, procedures (sampling, developing research instruments, analysis), and literature review. These concepts are applicable to both hospitality-tourism and service management.

Each of the seven professional "cluster" courses focuses on specific industry issues and applications:

0624-826	Tourism Policy Analysis
0625-844	Breakthrough Thinking
0624-846	Travel Marketing Systems
0624-867	Tourism Planning and Development
0625-842	Customer Relationship Management
0625-846	Service Leadership Futures

Elective courses provide students with an opportunity to individualize their graduate programs in line with their career and professional interests. Students are allowed to take a selection of elective courses, upon approval from the department chairperson. Courses may be taken from the colleges of Business and Engineering, and from the programs of hospitality and service management, human resource development, and instructional technology. However, students are cautioned to observe course prerequisites in their selections.

Of the 8 to 12 hours of electives, students are relatively free to select courses that they feel best meet their needs. The only limitations are:

- all courses must be graduate level,
- a maximum of 12 graduate quarter hours may be transferred from another university, and
- a maximum of 8 graduate quarter hours may be taken in independent study or practicum courses.

Master's thesis/project

A thesis or project is required of all candidates. Thesis topics should complement the candidate's undergraduate training, career experiences, and graduate interests. The thesis is, by nature, a formal document that reflects the candidate's professional preparation. Projects are, by nature of an applied research genre, a reflection of the student's ability to utilize professional modeling and other techniques to explain decision making within the hospitality-tourism industry.

The graduate faculty, in addition to the chair of the program, can aid the candidate in selecting a relevant thesis topic.

Master of Science in Service Management

Linda Underhill, Chair
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www.rit.edu/~702www/grad-servmanag.html

This program fills an emerging need in the many service businesses and industries that focus on understanding various customer relationships. Such businesses will find this program in tune with their educational and training investments. Attention is focused on the management interface between the customer and the service provider, innovation of products and services, and building customer relationships. This program gives individual students access to the interdisciplinary expertise of a technological university.

The program is flexible: Five core courses (20 credit hours) are required. The choice of professional electives from a wide array of disciplines (information technology, quality and applied statistics, business, project management, human resources) respond to individual student needs.

Both full- and part-time study are allowed. Courses are offered in the evening and on weekends. Full-time students may complete the MS program within one calendar year (four academic quarters). The program also is offered in the executive leader format (eight one-week sessions delivered over two summers).

This is a broad-based and cross-disciplinary program. Careful selection of courses can provide unique educational

preparation for individuals in varying service industries. An individualized professional concentration might include courses from instructional technology, human resource development, computer science, information technology, and the College of Business's MBA program. The student may choose to earn a graduate certificate in statistical quality through the Center for Quality and Applied Statistics in the College of Engineering.

The research/project capstone of the program may be guided under the mentorship of faculty in the various disciplines represented in the professional concentration.

Most individuals working in service-based industries will find no need to take "bridge" courses, regardless of their undergraduate preparation.

Admission requirements

Prior to being admitted to the MS program, applicants must illustrate to the program chair that their previous training, ability, practical experience, and education indicate a reasonable chance of success. The complete list of admission requirements includes the following:

- Graduate application
- Baccalaureate degree or equivalent from an accredited institution
- Official undergraduate transcript (s)
- Two professional recommendations
- An on-campus interview (when possible)
- A resume
- Undergraduate GPA of 3.0 or higher (a GPA of 2.75 will be considered, given superior recommendations, GRE or MAT scores, and length of time since the candidate's college graduation)
- Foundation course work with grades of 3.0 or higher (if required)

Test of English as a Foreign Language (TOEFL) score of at least 550 (paper-based), 213 (computer-based), 89 (Internet-based) for international students. All international students will take the Michigan Test at entry unless approved otherwise. Students should arrive on campus early enough to guarantee they have sufficient time to take the English test before starting their normal graduate course work.

Curriculum

The service management program includes a minimum of 48 quarter credit hours of graduate credit (36 of which must be registered through RIT) and can be completed in four full-time quarters or in seven to eight part-time quarters. The basic curriculum is a combination of required core, professional concentration, and elective courses that will satisfy the student's individual needs. Students who already are qualified for one or more required courses may substitute other course work with the permission of the program chair. Students whose prior undergraduate work has not been in the service industries field may be required to complete additional courses and/or a co-operative educational experience. This will be determined after a review of their work by the program chair. A thesis or final project also is required for all students.

The student may choose elective courses with the approval of the program chair. Elective courses may be selected from the colleges of Business and Computing and Information Technology, or from the programs of hospitality and service management, project management, or human resource development. Of the possible 8 to 12 hours of electives, students are relatively free to select courses they feel best meet their needs. The only limitations are:

- all courses must be graduate level,
- all course prerequisites must be met,
- a maximum of 12 graduate quarter credit hours may be transferred from outside RIT, and
- a maximum of eight graduate quarter credit hours may be taken in independent study or practicum courses.

Note: Students matriculated in RIT's MBA program may use service management courses offered through the hospitality-tourism management and service management programs as a concentration within their degree program.

Required core courses (20 credits)		**Qtr. Cr. Hrs.**
0625-750	Elements of Service Management: A Systems Approach	4
0624-770	Service Leadership: Examining and Implementing Change	4
0624-825	Strategic Process of Service Firms	4
0626-780	Human Resource Management I or	4
0626-891	Workforce Development	4
0625-849	Service Performance Metrics	4

Professional concentration 16-18 Qtr. Cr. Hrs.

Hospitality and Service Management		**Qtr. Cr. Hrs.**
0625-841	Benchmarking and the Process of Continuous Improvement*	4
0625-842	Customer Relationship Management	4
0625-844	Breakthrough Thinking	4
0625-845	Relationship Management in Service Firms*	4
0625-846	Service Leadership Futures	4
0625-847	Re-engineering Service Environments*	4
0625-849	Service Performance Metrics	4
0697-798	Introduction to Project Management	4

Concentrations:

Human Resource Management		**Qtr. Cr. Hrs.**
0626-710	Theories of Organizational Development	4
0626-720	Theories of Career Development	4
0626-730	Theories of Human Resource Development	4
0626-891	Workforce Development	4

Information Technology		**Qtr. Cr. Hrs.**
4002-718	Current Themes in Information Technology	4
4002-745	Foundations of Human Computer Interaction	4
4002-741	Fundamentals of Web-based Multimedia	4
4002-746	Telecom Network Protocol	4

College of Business		**Qtr. Cr. Hrs.**
0102-763	Behavioral Skills in Total Quality	4
0106-745	Quality Control and Improvement	4

(Prerequisites or approval of the associate dean of graduate studies, College of Business, may be required.)

College of Engineering —Center for Quality and Applied Statistics

Graduate Certificate in Statistical Quality **Qtr. Cr. Hrs.**

0307-721	Statistical Quality Control I	3
0307-731	Statistical Quality Control II	3
0307-781	Quality Management	3
0307-782	Quality Engineering	3
0307-801	Design of Experiments I	3
0307-802	Design of Experiments II	3

Facilities and equipment

The school maintains a broad array of computer software and computer equipment for student use. Other computer laboratories are available across the campus and, in particular, at the Wallace Library.

There are 15 dedicated Deu computers tied to RIT's high-speed Ethernet, one high-volume black and white printer, and one high-quality Xerox Color Laser printer. Applied software packages include: business application software such as MS Office; document publishing software such as Adobe Acrobat Professional and Adobe InDesign; the graphics design programs Adobe Photoshop, Corel Draw and Photo-Paint, Adobe Illustrator, and Macromedia Freehand; the Web development tools Macromedia Dreamweaver, Fireworks, Flash, and Adobe GoLive; nutritional analysis programs Diet Analysis Plus, The Food Processor, and Nutrition Life Cycle; and Statistical Programs Minitab and SPSS.

Executive Leader MS program

James W. Jacobs, Jr., Program Chairman
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This is an intensive program consists of eight, one-week summer sessions and an independent research project, both conducted over the span of two summers. It emphasizes the strategic dimensions of service innovation, leadership, and customer relationship management, and the development of metrics for the 21st century. It is designed to enhance the continued lifelong learning and career development of executives and midlevel hospitality professionals without disruption of employment. Graduate credit is granted for life and management experiences. Students can also elect to participate in various international locations to complete the required coursework.

Executive Leader courses

0625-750	Elements of Service Management
0625-844	Breakthrough Thinking, Innovation, and Creativity
0626-891	Workforce Development
0624-825	Strategy Process of Service Firms
0625-849	Service Performance Metrics
0625-842	Customer Relationship Management
0625-846	Service Leadership Futures
0624-770	Service Leadership: Examining and Implementing Change

The executive leader MS program is offered to service management practitioners who have a minimum of five years of experience beyond the baccalaureate degree. Certification through various professional associations (such as CFE, CFP, CCM, CCTE, CHA, CTC, CTP, CMP) is accepted as documentation of professional commitment. Endorsements from senior management and administrators are preferred. Graduate credit granted for life and professional experiences is determined by an executive leader portfolio assessment.

Advanced Certificate in Service Leadership and Innovation

This certificate has been developed to offer service professionals and organizations cutting edge skills, abilities, and applied service knowledge. More specifically, the certificate is for those seeking to achieve service leadership and change, build service performance packages and delivery systems, use multiple service metrics from feedback systems, employ creativity to achieve innovation, and construct and implement strategic direction. The certificate will heighten the student's capacity to function in today's highly competitive and quickly evolving service environment.

The certificate in service leadership and innovation combines five courses from the existing master's degree program in service management. Concepts mastered during the program include:

- understanding service performance system design and implementation parameters,
- understanding and using service value delivery system structures and processes,
- comprehending the evolving strategic environment of service-sector businesses,
- establishing and using service-system elements,
- building service metrics from feedback processes,
- understanding and implementing customer relationship management, and
- constructing innovative approaches to service and managing those changes.

Program Content (20 credits) **Qtr. Cr. Hrs.**

0625-750	Elements of Service Management	4
0625-825	Strategic Processes of Service Firms	4
0625-842	Customer Relationship Management	4
0625-844	Breakthrough Thinking	4
0625-849	Service Performance Metrics	4

Admission requirements

The 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. The certificate may be completed as a stand-alone credential, serve as an entry point for the MS program, or be used to fulfill the requirements for a professional concentration in the cross-disciplinary professional studies MS program. Qualified students may use individual courses, or the certificate, in other RIT graduate programs with the appropriate approvals.

Master of Science in Human Resource Development

Linda Underhill, Graduate Program Chair
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www.rit.edu/~702www/grad-humanrsrc.html

The mission of this program is to provide education, training, research, and consultation for human resource development (HRD). Human resource development is the integrated use of training and development, organization development, and career development to improve individual, group, and organizational productivity and effectiveness.

The HRD program is characterized by a philosophy of pragmatism, theoretical foundations in the social sciences, and mastery of relevant technologies and human productivity methodologies. The program is a 48 quarter-credit-hour program with four major curriculum components: career development, organization development, training and human resource development, and human resource management. Students have the option of concentrating in a specific area or developing a broad program that best meets their needs.

The HRD internship is designed to assist students in accomplishing three objectives: to gain on-the-job professional experience in the HR field; to become acquainted with the daily HR work challenges and strategies used to resolve these; and to develop professional contacts and build experience-based credentials, which will enable the student to find professional employment upon graduation.

Classes are offered in the evenings and online.

Admission requirements

Admission requirements for the MS degree include:

- successful completion of the baccalaureate degree at an accredited college or university,
- a cumulative grade point average of 3.0 or above or evidence of relevant professional performance,
- two letters of reference,
- a writing sample designated by the department,
- a TOEFL score of 570 (paper-based), 230 (computer-based), or 89 (Internet-based), and
- an interview with a faculty member.

All admissions information must be submitted and reviewed by the faculty prior to the completion of 12 quarter credit hours of graduate work in the program. Application forms are available from the Office of Graduate Enrollment Services. For more information, please contact the Office of Graduate Enrollment Services at (585) 475-2229, or visit their website at www.rit.edu/~625www/.

Curriculum

The degree requires completion of a minimum of 48 quarter credit hours at the graduate level and can usually be completed in four consecutive quarters. However, the majority of students attend part time and take three years to complete the degree program. Students must maintain a "B" average and complete the degree within seven years of the first course counted toward the degree.

Students choose the electives they feel best meet their needs. The only restrictions are that all courses must be graduate level or approved for graduate credit. A maximum of 12 quarter credit hours (not counted toward another degree) may be transferred from another college or university, or granted for extensive human resource experience.

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

Required core courses

0626-707	Applied Data Analysis in Human Resource Development
0626-780	Human Resource Management I
0626-877	Internship

Choose three of the following four courses:

0626-710	Theories of Organizational Development
0626-720	Theories of Career Development
0626-730	Theories of Human Resource Development
0626-781	Human Resource Management II

Elective/technique courses

- Planning and Evaluation in Organizational Development
- Practice of Consultation in Organizational Development
- Career Counseling Techniques
- Group Leadership Skills
- Design and Delivery of Training
- Needs Assessment and Proposal Development
- Psychology Assessment and Measurement in Human Resource Development
- Global Aspects of Human Resources
- Human Resource Information Systems
- Workforce Development
- Employment Law
- Compensation and Benefits

Note: 48 credit hours for MS degree; courses may be taken in other graduate-level programs at RIT and other institutions with permission of adviser.

Advanced Certificate in Human Resource Development

The advanced certificate in human resource development is available to those students who hold a bachelor's or master's degree in another discipline, but may want to enhance their knowledge while gaining an HRD credential. This advanced certificate can be completed through distance learning or in the classroom, and courses can be transferred into the HRD master's degree if students decide to continue their education. A total of 16 quarter credits is required for certification.

The courses are:

		Qtr. Cr. Hrs.
0626-710	Theories of Organizational Development	4
0626-720	Theories of Career Development	4
0626-780	Human Resource Management I	4

Electives

(choose one from below or a course approved by an adviser):		4
0626-891	Global Aspects of HR	
0626-733	Needs Assessment and Proposal Development	

Admissions requirements are the same as those for the master's degree. The certificate must be approved by an adviser before the student takes any courses. Please contact the department to schedule an advising meeting.

Master of Science in Health Systems Administration

Linda Underhill, Chair
585-475-7359, lmuism@rit.edu
www.rit.edu/healthsystems

The health systems administration program is designed to provide strategic skills to today's health care management. Now, as never before, we are realizing the rapid transformation of health care. The pace of technology and innovation are changing how, when, and where health care is provided, and who is providing it. Concurrently, health care customers have high expectations for quality and expect a high degree of responsiveness to their needs - all delivered in a cost-effective manner. To provide these strategic skills to health care management, the program builds on a foundation of courses in policy and law formation, health care economics, innovation, and leadership. Additional options are provided in course selections to build an integrated program that meets the individual challenges of participating students. To find out more about these options, please refer to the program's website: www.rit.edu/healthsytems.

One of the advantages of this program is the online format. Students can pursue their degree while maintaining full-time employment in locations around the world. Another distinct advantage of the program is the diversity of our student population, which allows for creative discussion and comprehension of global health care issues, and how these relate to the standards and practices of the American health care system. The ability to share information and ideas, to contrast and compare strategies, allows our students a level of creativity and scope of practice not found in the traditional classroom.

RIT provides excellent online learning support for the adult learner that leads the student through registration and use of distance learning tools. In addition, for select subject areas, the HSA program plans special learning sessions that blend presentation styles. This could be through attendance at a seminar in Naples, Fla. These formats provide a combination of both distance learning and the ability to interact with presenters who provide a strategic view of health care delivery models.

Admission requirements

Admission requirements for the MS degree include:

- completion of a baccalaureate degree in a regionally accredited college or university,
- a cumulative grade point average of 3.0 or above (or superior endorsement),
- two letters of reference from individuals who have the opportunity to observe the applicant's work output,
- official undergraduate and, if applicable, graduate transcripts, and
- participation in a telephone interview with the health systems administration program chair.

Applicants also must have three or more 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 health systems administration courses as a bridge for the content knowledge required for the graduate program and/or complete a graduate level internship in health care prior to graduation.

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

Degree requirements

The MS degree in health systems administration currently requires 48 quarter credit hours at the graduate level. The program can be completed in approximately two years by taking two courses per quarter. Students may take longer to complete the course work and take one course per quarter. However, students must complete their degree requirements within seven years of the date of the oldest course identified on their RIT course records. Students must maintain a 3.0 (B) average throughout their academic career. Toward the end of their program of study, students will complete a business plan for an innovative topic related to their work environment. The paper is developed and written within a course that is taken during the last year of study for the degree. Upon matriculation, each student works with the program chair for advice and direction to develop a plan of study.

Curriculum

Required courses

0626-707	Data Analysis
0625-842	Breakthrough Thinking, Creativity and Innovation
0635-840	Health Systems Policy and Law
0635-820	Health Systems Economics and Finance
0624-770	Service Leadership

Concentrations/Electives

Health Information Resources

0635-715	Information Systems for Health Administrators
0635-754	E-Health
0635-752	Clinical Information Systems
0635-753	Health Administration Application

Elements of Health Care Leadership

0635-830	Health Systems Planning
0635-882	Bioethics
0625-750	Elements of Service
0625-842	Customer Relationship Management

Senior Living

0635-721	Senior Living Management
0625-750	Elements of Service
0626-891	Workforce Development
0625-842	Customer Relations Management

Health Systems Finance

0635-815	Finance for Operations
0635-881	Health Insurance and Reimbursement
0635-715	Information Systems for Health Administrators
	Elective

Students may fulfill elective from other concentrations or from other graduate courses offered in the School of Hospitality and Service Management with permission of their adviser and program chairs.

Executive Leader MS program

The Executive Leader MS program in health systems administration is designed for colleagues with a bachelor's degree in healthcare, information technology, business, and/or education, and three to five years of managerial experience within their industry. The program's interdisciplinary focus makes it attractive to those with bachelor's degrees in related subjects who also have extensive experience in various sectors of health care such as senior living, pharmacy, food service, development, fundraising, marketing, and communications. Executive Leader course work focuses on all aspects of strategic skill development in the areas of leadership and planning. The focal point of the interaction with the Cleveland Clinic in Naples, Fla., is the "healing hospitality" leadership practices found in the clinic for the business of caring.

Curriculum

The program may be completed in an accelerated format. Students may complete their studies in five academic quarters or over the course of two years. This format is designed to accommodate the working professional.

- Nine unique courses provide a total of 36 credit hours.
- Up to 12 credits are earned for health-care industry experience.
- An application-oriented approach is found in classroom projects and discussions.

RIT offers the executive leader MS degree using a variety of delivery formats, including classes onsite in Naples, Fla., online classes, and classes onsite at the RIT campus in Rochester, N.Y. Course delivery and scheduling is designed to alleviate significant disruptions to career, family, and other commitments. Colleagues in the program will bring their personal computers to class and will be able to use the RIT First-class Online System to access support services and the library for research. Classes onsite in Naples will run Thursday (afternoon) through Monday (morning). Although rigorous, the focused nature of the program provides constant motivation and assistance to succeed.

For more information on this highly focused, strategic program, visit the program website at www.rit.edu/healthsystems.

Certificates in Health Administration

The health systems administration program strives to meet the needs of health care professionals. The four concentrations offered within the program can be taken as stand-alone courses, which will provide a certificate at their completion. If, at a later date, a student wishes to enter the MS program, these courses can be applied toward the HSA degree. The certificates can also be used to update skills or change career paths of health care professionals. To meet the needs of working professionals, all the certificate courses are taught online. The certificates are referred to as advanced as they are offered on a graduate level.

The certificates are as follows:

Certificate in Elements of Health Care Leadership	**Qtr. Cr. Hrs.**
Bioethics	4
Health Systems Planning	4
Customer Relationship Management	4
Elements of Service	4
Certificate Total	16

Certificate in Health Information Resources	**Qtr. Cr. Hrs.**
Clinical Information Systems	4
Information Systems for Health Administrators	4
Health Administration Application	4
E-Health	4
Certificate Total	16

Certificate in Health Systems Finance	**Qtr. Cr. Hrs.**
Finance for Operations	4
Information Systems for Health Administrator	4
Health insurance and Reimbursement	4
Elective	4
Certificate Total	16

Certificate in Senior Living Management	**Qtr. Cr. Hrs.**
Senior Living Management	4
Elements of Service	4
Customer Relationship Management	4
Workforce Development	4
Certificate Total	16

Center for Multidisciplinary Studies

www.rit.edu/cms

Master of Science in Cross-Disciplinary Professional Studies

James Myers, Director
(585) 475-4772, jamisr@rit.edu
Samuel McQuade III, Program Coordinator
(585) 475-4368, scmgcj@rit.edu
www.rit.edu/~801www/grad/masters.html

The cross-disciplinary professional studies program is specifically designed to enable the mature learner to fashion a customized plan of graduate study tailored to his or her personal and professional goals. This degree offers an opportunity to draw on more than 50 RIT graduate programs in order to gain the advanced knowledge and skills necessary to respond successfully to new and emerging career opportunities. The degree is completed with a practical, hands-on project directly related to the student's individualized plan of study. The cross-disciplinary professional studies master's degree (with certain concentrations) also can be pursued through online learning.

The MS in cross-disciplinary professional studies requires the completion of 48 quarter credit hours as specified in an individualized plan of study consisting of two or three professional concentrations. Each concentration consists of 12 to 24 credit hours drawn from an existing RIT graduate program. Graduate credits earned in other programs can be used in completing a concentration (upon approval). Concentrations that can be completed online include:

- Applied Statistics
- Human Resource Development
- Environmental Management
- Health Systems Administration
- Information Technology
- Product and Production Systems Design
- Technical Information Design
- Project Management
- Imaging Science

Besides course work in two or three concentration areas, there are two required courses, Context and Trends and The Capstone Project. Credit hours not required in a student's concentration areas can be used for electives. All elective courses and transferred courses need to be integrated into the proposed plan of study. For further information or advising, call the CMS main office at (585) 475-2234.

Admission requirements

The program is especially suitable for individuals with career experience who can define the skills and knowledge they wish to obtain through graduate study. Admission requirements include:

- successful completion of a baccalaureate degree at a regionally accredited college or university,
- a minimum undergraduate cumulative grade point average of 3.0 or superior endorsements,
- three to five years full-time work experience,
- letters of reference from two individuals who have served recently as either the applicant's supervisor or instructor,
- a statement of career objectives and description of the skills and knowledge sought through graduate study, and
- a proposed plan of study, to be developed with the program adviser.

International students must submit the results of the Test of English as a Foreign Language (minimum score of 550) as part of the application process. The TOEFL requirement is waived for native speakers of English or those submitting educational transcripts and diplomas from American colleges and universities.

All applicants are urged to discuss their plans with the cross-disciplinary professional studies program adviser before submitting a formal application.

Required courses

Context and Trends (4 credits)
This course introduces students to interdisciplinary thinking, personal self-assessment, problem solving, goal setting, and research techniques using electronic information resources. Students also work toward finalizing a plan of study.

The Capstone Project (4 credits)
This course is a supervised, hands-on experience in which students apply the skills and knowledge developed through their individualized plans of study and concludes with oral and written presentations.

The following are examples of the cross-disciplinary professional studies format. Many other combinations are possible.

1. Cross-Disciplinary Professional Studies with Two Professional Concentrations

		Qtr. Cr. Hrs.
0699-705	Context and Trends	4
Concentration A Marketing		
0105-761	Marketing Concepts	4
0105-762	Advanced Marketing Management	4
0105-772	Marketing on the Internet	4
	Marketing Elective	4
Concentration B: Communication and Media		
0535-705	Electronic Communication	4
0535-710	Visual Communication	4
0535-704	Communication Law and Ethics	4
0535-709	Public Relations and Advertising	4
Electives		
0626-740	Group Leadership	4
0626-730	Theories in Human Resource Development	4
0699-775	Capstone Project	4
Total		48

2. Cross Deisclinary Professional; Studies with Three Professional Concentrations

		Qtr. Cr. Hrs
0699-25	Context and Trends	4

Concentration A: Project Management

0681-710	Introduction to Project Management	4
0681-711	Advanced Project Management	4
0681-712	International Project Management	4
0688-732	Managing Scientific and Technical Communication	4

Concentration B: Manufacturing and Mechnaical Engineering Technology

0304-618	Computer-Aided Engineering	
0304-801	Design for Manufacture	4
0304-964	Production Tool Design	4
0610-710	Product Development and integration	4

Concentration C: General Management

0102-740	Organizational Behavior and Leadership	4
0102-741	Managing Organizational Change	
0102-763	Behavioral Skills for Managers	4
0699-775	The Capstone Project	4
Total		**48**

Financial aid

Applicants seeking graduate scholarships or assistantships should identify this in the graduate application. A limited number of scholarships and assistantships are available on a competitive basis. Applicants seeking financial aid should apply by April 1. Information about student loans may be obtained from the RIT Office of Financial Aid and Scholarship by calling (585) 475-2186.

Advanced Certificate in Technical Information Design

Technical information design is a growing multidisciplinary communication field that requires understanding and skills in the development and use of text, graphic design, multimedia, and other techniques to enhance contemporary technical communication. Success in this field demands that the practitioner have superior writing skills, adeptness at selecting and using available and emerging media, and the ability to recognize excellence in the visual aspects of communication design. This program focuses on the information designer's use of technology to create documentation and deliver information to the intended audience.

Admission requirements

Certificate applicants should have a baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 3.0 (B). Students with lower grade point averages may take courses on a nonmatriculated basis and be admitted after successful completion of two or more courses and permission of the program chair. Two professional recommendations also must be submitted.

Applicants whose native language is other than English must take the TOEFL examination. A score of at least 550 is required. Students with a lower score may be admitted conditionally and will take a prescribed in English with a reduced program course load

Students entering this program are also expected to have basic skills in technical writing and editing and technical document designs.

Curriculum

Required courses		Qtr. Cr. Hrs.
0688-711	Technical Information Design	4
0688-731	Technical Procedures	4
0688-741	Usability Design and Testing	4

These core courses are available through distance education. In addition, students are required to complete a minimum of 11 elective credits, chosen with the approval of their program adviser.

Elective courses

4004-730	Interactive Media Implementation	4
4004-741	Fundamentals of Web-based Multimedia	4
4004-745	Theories in Interactive Computing	4
0688-721	Creating Technical Proposals	4
0688-732	Managing Technical and Scientific Communication	4
2081-723	Contemporary Publishing	4
0688-714	Science Writing	4

Many of these electives are available through distance education. Other electives, human-computer interface, computer graphics, project management, and other relevant fields may be used with an adviser's approval. For more information or advising, please call Thomas Moran at (585) 475-4936.

Financial aid

Applicants seeking graduate scholarships or assistantships should identify this in the graduate application. A limited number of scholarships and assistantships are available on a competitive basis. Applicants seeking financial aid should apply by April 1.

Graduate Faculty

Wiley R. McKinzie, MS, State University of New York at Buffalo — Dean; Professor

Linda A. Tolan, BS, State University of New York at Geneseo; MS, Rochester Institute of Technology — Associate Dean; Associate Professor

Department of Civil Engineering Technology, Environmental Management and Safety

Abi Aghayere, BS, University of Lagos; MS, Massachusetts Institute of Technology; Ph.D., University of Alberta; PE — Professor

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

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

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

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

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

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

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

Mark Piterman, MCE, Odessa Marine Engineers Institute — Professor Emeritus

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

Jennifer Schneider, BS, Roberts Wesleyan College; MS, University of Rochester; Ph.D., University of Massachusetts-Lowell — Associate Professor

Maureen S. Valentine, BSCE, Tufts University; MECE, Virginia Polytechnic Institute; PE — Chair, Civil Engineering Technology, Environmental Management and Safety; Associate Professor

Scott B. Wolcott, AAS, State University of New York at Canton; BS, MS, State University of New York at Buffalo; PE — Associate Professor

Adjunct Faculty

Environmental Management and Technology

Joseph Deeb, BS, MS, Ph.D., State University of New York at Buffalo

Wayne Loomis, MS, University of Rochester

Edward Mullen, BS, Clarkson University; MS, Johns Hopkins University

Ravi Nabar, BS, Birla Institute of Technology; MS, University of Michigan; MBA, University of Saskatchewan; Ph.D., University of Michigan

Michael Pilla, MS, Rochester Institute of Technology

George Thomas, MS, Johns Hopkins University

Tom Wickerham, BA, Theil College

Faculty

Department of Manufacturing and Mechanical Engineering Technology/Packaging Science

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

Scott Anson, BSME, MSME, State University of New York at Binghamton; PE — Assistant Professor

Philip J. Batchelor, BSME, Marquette University; MSME, University of Illinois — Visiting Lecturer

Mario H. Castro-Cedeno, BSME, MSME, Puerto Rico-Mayaquez; MEMS, University of California-Berkeley — Assistant Professor

Louis B. Gennaro, BS, United States Military Academy; MS, Northeastern University — Professor Emeritus

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

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

Deanna M. Jacobs, BS, State University of New York at Plattsburgh; MA, State University of New York at Geneseo; MS, Rochester Institute of Technology — Packaging Science Graduate Program Adviser, Professor

Daniel Johnson, BS, MS, Rochester Institute of Technology — Assistant Professor

Seung Kim, BS, Hanyang University; MS, Ph.D., University of Illinois — Associate Professor

Ti-Lin Liu, MS, Tsinghua University — Associate Professor

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

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

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

S. Manian Ramkumar, BE, PSG, College of Technology–Bharathiar; ME, Rochester Institute of Technology — Professor; Graduate Program Adviser

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

John A. Stratton, MS, Rensselaer Polytechnic Institute — Professor

George Sutherland, BSME, University of Alberta; MEng, McMaster University: Ph.D., Stanford University — Department Chair, Professor

Thomas Voss, BS, MS, Michigan State University — Assistant Professor

Fritz J. Yambrach, BS, Michigan State University; BS, MBA, Utah State University; Ph.D., University at Buffalo — Associate Professor

Adjunct Faculty

Packaging Science

Dennis Young, BS, Michigan State University — Dennis Young and Associates, Inc.

Beth Aubry, BS, Rochester Institute of Technology

Lesley Bates, BFA, Rochester Institute of Technology

Craig E. Densmore, BS, MS, Rochester Institute of Technology

Lisa Talty, BS, MBA, Rochester Institute of Technology

Faculty

Electrical Computer and Telecommunications Engineering Technology

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

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

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

William P. Johnson, BA, Kings College; BSEE, MSEE, Syracuse University — Professor

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

Anthony P. Trippe, PE, BS, Rochester Institute of Technology; MS, Fairleigh Dickinson University (DBA U.S. International University) — Assistant Professor

Faculty

Hospitality and Service Management Department

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

Stanley Bissell, BA, Ohio Wesleyan University; MA, University of Auckland, New Zealand; MLS, State University of New York at Geneseo — Associate Professor

David Crumb, BS, Florida State University; MBA, Michigan State University — Assistant Professor

Barbara Cerio Iocca, RD, BS, M.Ed., State University of New York at Buffalo — Associate Professor

Jon Home, BA, Colorado State University; MA, University of Phoenix, MS, Rochester Institute of Technology

James Jacobs, MS, Troy State University; Ph.D., State University of New York at Buffalo — Graduate Chair; Associate Professor

Elizabeth Kmiecinski, RD, BS, Ohio State University; MS, University of Kentucky — Assistant Professor

Dianne C. Mau, BS, Rochester Institute of Technology; MS, State University of New York at Brockport — Graduate Program Chair

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

Edward Steffens, BS, MBA, Rochester Institute of Technology — Assistant Professor

Linda Underhiil, Ph.D., RD, State University of New York at Buffalo — Associate Professor, Graduate Program Chair

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

Adjunct Faculty

Hospitality and Service Management Department

Donna A. Dickson, BA, State University of New York at Buffalo; MS, Rochester Institute of Technology

Arnold S. Gissin, MPH — Administrator, Jewish Home of Rochester

Katherine Hiltunen, MBA, BSN — Director, QM/UM Analysis, Blue Cross and Blue Shield of Rochester

Donald Jacobs, BS, Buffalo State College; MS Ph. D., State University of New York at Buffalo

Joan Johnson, BS, MBA, Rochester Institute of Technology; Ph.D., Syracuse University

Marcia Marriott, BS, MA, State University of New York at Brockport; Ph.D., Southwest University

Dianne C. Mau, BS, Rochester Institute of Technology; MS, State University of New York at Brockport; Ed.D., Columbia University

Todd Mittler, BA, Canisius College

James Myers, BS, MS, Rochester Institute of Technology; Ph.D., Michigan State University

Denise Pierotti, BA, Binghamton University; MS, University of Vermont; MS, University of Washington

Damon Revelas, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo

Patricia Seischab, MS, Rochester Institute of Technology

Christine Sevilla, BA, University of Southern California at Santa Barbara; MPA, State University of New York at Brockport; MS, Rochester Institute of Technology

J. Wixson Smith, BS, State University of New York at Geneseo; MS, Rochester Institute of Technology

C. J. Wallington, BS, University of Missouri at Kansas City; Ph.D., University of Southern California — Graduate Program Chair; Professor

Karen Vignare, BS, Frostburg State University; MBA, University of Rochester

Beverly Voos, MS, President and Chief Executive Officer, Rochester Healthcare Information Group, Rochester, New York

Carl Winkelbauer, Ed.D., University of Rochester

Faculty

Center for Multidisciplinary Studies Department

Mary Boyd, BA, Earlham College; MS, University of Iowa — Associate Director, Assistant Professor

Samuel McQuade III, BA, Western Washington University; MPA, University of Washington; Ph.D., George Mason University — Graduate Program Coordinator

James Myers, BS, MS, Rochester Institute of Technology; Ph.D., University of Michigan — Director, Associate Professor

Richard Morales, BA, Michigan State University; MA, State University of New York at Brockport; MSW, Ph.D., Syracuse University — Faculty Emeritus

Thomas F. Moran, BSME, California Polytechnic State College; MSME, California State College at Long Beach — Associate Professor

Carol Romanowski, BA, State University of New York at Plattsburgh; BS, MS, Ph.D., University at Buffalo — Assistant Professor

Linda A. Tolan, BS, State University of New York at Geneseo; MS, Rochester Institute of Technology — Associate Dean, Associate Professor

Packaging Science

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

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

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

0607-742 **Distribution Systems**
Study of the shipping and handling environment encountered by goods in packages during distribution to the product user. Materials handling, warehousing and the impact of the distribution environment on shipping container design and development are considered. Case study or individual research appropriate to student's interest. **Credit 4 Class 3, Lab 2**

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

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

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

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

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

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

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

0607-890 **Graduate Thesis**
An independent research project to be completed by the student in consultation with the major professor. A written thesis and an oral defense of the thesis are required. (Consent of department) **Credit variable (maximum of 12)**

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

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

Manufacturing and Mechanical Engineering Technology

0610-710 **Product Development & Integration**
This course covers a broad set of topics, processes and best practices related to the disciplined development of products & production systems. The course takes two major views of product development: first is total quality development and second is system engineering as applied to the earliest phases of new product development. A thorough review of product and technology development processes & best practices will be covered in the context of reducing time to market. Skills will be developed to enable the student to construct & actively participate in a modern, concurrent new product development process. The student will be introduced to critical parameter management to aid in fulfilling voice of the customer requirements. System integration for total product life cycle performance is a major focus. Studies & reading in diverse product & system development topics are required. **Credit 4**

0610-820 **Concept Design & Critical Parameter Management**
This course focuses on gathering the voice of the customer, translating it into technical requirements, defining functions to fulfill the requirements, generating concepts to physically fulfill the functions & the evaluation and selection of superior product and subsystem concepts that are safe to take to commercialization. Team labs will be conducted in QFD, functional analysis and decomposition, concept generation and PUGH'S concept selection process. Critical parameter management techniques will be covered in detail. **Credit 4**

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

0610-870 **Robust Design for Product & Systems**
This is an advanced course in Taguchi's dynamic methods of robust design. Students learn to optimize design parameter nominal set points to promote insensitivity to sources of variation in the manufacturing & customer use environments. Development of robust & tunable systems and their manufacturing processes is a major focus. The role of engineering methods for designing for additively is used to promote rapid system integration. The role of robust design in critical parameter management will be demonstrated. Team labs in robust design projects will be required. **Credit 4**

Telecommunications Engineering Technology

0614-720 **Telecommunication Concepts**
Transmission, switching and signaling are each important elements of any communication network. Topics included are the architecture of the public switched telephone networks, modulation, multiplexing, data communication protocols, various types of switching, introduction to optical fiber, emerging technologies, and an introduction to traffic engineering. (BS in engineering technology, engineering, or a related degree) **Lecture 4, Credit 4**

0614-722 **Principles of Telecommunications Networks**
The course provides the student with a solid understanding of local access and backbone networks, topology, equipment and technology. Topics in the course are the public switched telephone network, local and wide area networks, carrier transport networks and emerging technologies in each of these areas. (BS in engineering technology, engineering, or a related degree) **Lecture 4, Credit 4**

0614-726 **Telecommunications Project Management**
This course addresses the processes and skills needed for successful project management in the Telecommunications industry. Topics in the course are project life cycle, planning templates, project deliverables, project work breakdown structure, estimating resources and task costs, Gantt charts, PERT techniques, project team duties and responsibilities, project team management techniques and sohare tools for large projects. The course includes an applied project planning assignment in which students define a project related to the telecommunications industry and use Microsoft (MS) Project sohare and "best practices" to properly plan the project tasks, schedule and budget. (BS in engineering technology, engineering, or a related degree) **Lecture 4, Credit 4**

0614-728 **Operating Systems for Telecommunications**
The course starts by examining the features and operation of a typical operating system. Basic functions are to' execute user commands, provide for system resource sharing, management of memory, the creation and management of files, networking and communications of distributed computer systems, and to provide security and protection functions. Students will examine typical methods and techniques which implement the key operating system functions. A sequence of commonly used operating systems will be studied to compare and contrast how each provides its services and determines the benefits and short comings that exist between them. The course includes real-time and embedded operating systems along with how the operating system interfaces with telecommunications applications and hardware. (BS in engineering technology, engineering, or a closely related degree) **Lecture 4, Credit 4**

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

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

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

0614-774 ***WAN/LAN*** **Planning and Design**
This course provides participants with an introduction to the art and science of wide area network (WAN) design. Topics are often illustrated with real-world examples. Various design approaches are introduced and several heuristic design algorithms are utilized. Blocking networks and delay networks are studied. A PC design tool is utilized in the course and project work is focused on complicated WAN design and local area network planning and design. (0614-720, 0614-722) (This course is not appropriate if the student has completed the RIT undergraduate course, Network Planning and Design (0614-574) course with an A or B or an equivalent course at another university in the past five years.)

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

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

0614-798 **Special Topics in Telecommunications**
Special Topics in Telecommunications is an experimental graduate level course that will allow innovative topics in the rapidly changing telecommunications field to be offered and evaluated as potential permanent components of the ET curriculum. **Class 4, Credit 4**

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

0614-836 **Next Generation Networks**
The course provides graduate telecommunications engineering technology students the opportunity to research and report on "Next Generation Networks." The course consists of professor led discussions on one of Next Generation Network followed by each student researching two additional Next Generation Network types. A case study approach will be utilized. Immediately after completing the research and written paper regarding one's selected topic/case, each student will present to all other students in the class. As a result, every student will not only benefit from their own research of two topics/cases but also be informed of other Next Generation Network issues by other students. (Prospective students must have completed ALL core MSTET requirements and must have completed at least *16* graduate credit hours of study. Students should have good understanding of how to perform research and must possess at least adequate writing skills.)

0614-864 **Wireless RF Telecommunication Systems**
The fundamental principles that govern the application of wireless mobile and fixed radio frequency communication systems are studied in this course. At the end of this course students will understand the radio frequency mobile wireless environment, the common wireless systems, and the zoning/public policy aspects related to deployment of the wireless infrastructure. (Telecommunication Systems *(061 4-764)* and Calculus and Differential Equations) **Lecture 4, Credit 4**

0614-890 **Grad Thesis/Project Pían**
This is the first of a two-course sequence in which each TET graduate student will design and conduct research and prepare a proposal for either a graduate thesis or a graduate project. **Credit 2**

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

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

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

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

Manufacturing and Mechanical Systems Integration

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

0617-850 **Flexible Manufacturing and Assembly Systems**
The course provides an in-depth knowledge of automated manufacturing and assembly systems, their design, operation and implementation. Topics include system hardware, software, controls, programming, and integration. Emphasis will be placed in providing a thorough understanding of computer controlled machines, tooling, tool management, part feeding, part orientation, part holding, material handling systems, robots, AGVS, coordinate measuring machines, sensors system controls, general purpose and special purpose assembly systems and management issues. Concepts pertaining to design of products for automated manufacturing, handling and assembly will also be discussed. **Class 4, Credit 4**

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

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

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

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

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

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

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

Hospitality-Tourism Management

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

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

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

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

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

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

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

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

Service Management

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

0625-791 **Foundations of Applied Social and Managerial Research**
This is an introductory applied research/project development course for the HSM graduate program. The purpose of this course is to introduce learners to foundation concepts and methods in applied social and managerial problems. Emphasis is placed on developing an understanding of the scientific method with application to social and managerial problems. Participants will cultivate this understanding by engaging in the development of a research/project proposal. The proposal will serve as the foundation for subsequent research coursework, thesis, projects, or capstone projects. Topics covered in the course include: 1) the philosophy of research, 2) research ethics, 3) conceptualization of research, 4) evaluation research, and 5) an introduction to basic quantitative, qualitative and systems research techniques. **Credit 4**

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

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

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

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

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

0625-846 **Service Leadership Futures**
This course changes each year as it evolves from students' interpretations of what it should entail. In general, students will gain the capacity to examine both current status and future route(s) of service industries. It is a first in a series of courses that will prepare career-minded individuals to function in our rapidly changing environment and, more important, in the future. The goal is to create leaders for tomorrow's service organizations and society. **Credit 4**

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

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

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

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

Human Resource Management

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

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

0626-712 **Planning & Evaluation Organization Development**
Introduces participants to a strategic planning model, which they then use to develop a strategic plan for an organization. (0626-710) **Credit *4***

0626-713 **Practices of Consulting Organization Development**
Explores the role and skills of the consultant. Participants engage in an assessment of an organization's needs, write a proposal, and from the assessment data, make recommendations for interventions. They also explore their interests and aptitudes as consultants. (0626-710) **Credit 4**

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

0626-721 **Career Counseling Techniques**
Introduces participants to theories and techniques used in individual career counseling situations. Participants plan, practice, and analyse non-clinical techniques used in career counseling. (0626-720) **Credit 4**

0626-725 **Human Resource Information Systems**
This course will examine the emergence of HRIS and how it is influencing all HR disciplines in the way they collect, process, and deliver information. There will be foundations presented in the components of an HRIS-systems infrastructure, application architecture, relational databases, and security. Significant emphasis will be placed on web-enabling HRIS deliveries through HR Portal and Employee/Manager Serf Service models. Specific HR functions or processes will be analyzed to determine how technology can be employed to increase the effectiveness each process, paying special attention to four focus areas: leveraging data, creating process efficiencies, cost benefits, and HR customer service. **Class 4, Credit 4**

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

0626-730 **Theories of Human Resource Development**
Professionals in the HR fields of employee education, career development, organization development and training require both a conceptual understanding of human learning and performance and systematic procedures for inducing learning and performance. This course presents recent investigations, both theoretical and empirical, into human learning, motivation and performance. Through readings and group activities, students will increase their understanding of theories of human resource development as the basis for practical applications. **Credit 4**

0626-732 **Design & Delivery of Training**
Emphasizes the techniques used for design and development of instruction. During the course, participants design a training module, deliver a portion of it, and evaluate its success. (0626-730) **Credit 4**

0626-733 **Needs Assessment and Proposal Development**
Shows participants how to develop and conduct a needs assessment, design an evaluation and write a proposal to do a needs analysis or evaluation. (0626-707 or equivalent statistics course) **Credit 4**

0626-734 **Global Aspects of Human Resources**
Students will research and discuss international business with an emphasis on labor and human resource issues. Topics include cultural and workforce characteristics, human resource management practices in host countries, labor law, and foreign workers in the U.S. **Class 4, Credit 4**

0626-740 **Group Leadership Skills**
Combines theory and practice to give participants the skills needed to use interactive techniques for training, to facilitate meetings and to take leadership responsibility as a participant. **Credit *4***

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

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

0626-877 **Internship**
The internship is required of all students. This course consists of four parts: at least 200 hours of professional accomplishments in an appropriate setting, attendance at a seminar, an oral presentation and formal summary report. Students will work with their advisors to complete all necessary arrangements. Students should plan to meet with their advisors at least two months before planning to take the internship. Proposals for the internship must be approved and on file before registration. **Credit 1-6**

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

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

Environmental, Health and Safety

0630-710 **Special Topics**
Permits students to pursue certain advanced undergraduate course work at a graduate level. Examples include contaminant hydrology, wetland delineation and remedial investigation/ corrective action. **Credit 1-4**

0630-711 **Occupational Health**
An intensive foundation course that provides students with an overview of the fundamentals of Industrial Hygiene. Emphasis will be placed on a) the toxicological effects of various industrial substances on the body; b) monitoring and personal sampling for these substances and c) personal protection against such substances. (Graduate students who have completed Biology (1004-212 or 1101-201) and Chemistry (1011-208 or 1011-211) or by permission of department. Students who have completed 0630-450/451 or 0630-610 may not take this course.) **Class 4, Credit 4**

0630-712 **Occupational Safety**
This course is an overview of the safety management tools utilized in today's industry. Students are expected to have a foundational knowledge of safety management techniques upon completion of this course. Topics examined include recordability and safety indices; incident investigation; guarding; electrical and material handling; welding, fire prevention; excavation; medical surveillance and worker's compensation; inspection and techniques and auditing; committees; incentives, and voluntary programs. Students will be required to research a leading edge safety topic. (No prerequisites. Open to all graduate students. Students who have completed 0630-454 or 0630-611 may not take this course.) **Class 4, Credit 4**

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

0630-714 **Industrial Wastewater Management**
An intensive foundation course for students who lack academic preparation or practical experience in wastewater management. Identifies and characterizes the sources of industrial wastewater and examines the related environmental impacts, regulatory implications, and technical and cost considerations of treatment and disposal methodologies. (General chemistry (1011-211) or permission of instructor. Open to all graduate students. Students who have completed 0630-621 may not take this course.) **Class 4, Credit 4**

0630-715 ***Air* Emissions Management**
This is an intensive foundation course which will present an overview of industrial air pollution; it's sources, methods of 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. (Open to all graduate students. Students who have completed 0630-622 may not take this course.) **Class *4,* Credit *4***

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

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

0630-735 **Resource Reduction**
This course will focus on strategies for reducing the use of materials, energy and environmental resources. It builds upon courses for controlling air emissions, wastewater and solid and hazardous waste and moves upstream into the production process to reduce or eliminate waste by not producing it in the first place. Students learn how to conduct resource reduction assessments and identify opportunities to reduce or conserve resources. This course will take you beyond end-of-pipe controls and look at life-cycle assessment as an environmental management tool. **Class 4, Credit 4.**

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

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

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

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

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

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

0630-790 **EHS Internal Auditing**
This course addresses establishing and maintaining EHS auditing systems to examine how environmental, health and safety aspects are being managed relative to voluntary and regulatory standards. Students will be prepared to design, implement and evaluate auditing programs, and will practice auditing skills. This course includes an Executive Leader session.(0630-740 and all required foundation courses, or permission of instructor) **Class 4, Credit 4**

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

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

0630-890 **Graduate Project/Thesis Planning**
This is the first of a two-course sequence in which each EHS Management graduate student will design and conduct graduate thesis research or a graduate project. In this course graduate students will rigorously develop their research or graduate project ideas, conduct literature reviews, prepare bibliographies, identify and plan methodologies, identify deliverables, prepare schedules, become familiar with report formats and the proper use of literary guides, and gain a clear understanding of the expectations of the faculty and the discipline. Each student will be required to prepare a complete committee approved thesis research or graduate project as a final requirement of this course. **Credit 2**

0630-891 **Graduate Project**
Graduate projects are an applied research project, reflecting the student's ability to utilize professional skills to design, develop and/or evaluate a project and/or management decision. A formal written paper, and/or a draft article suitable for publication in an appropriate journal and an oral presentation are required. (Permission of advisor) **Credit 1-4**

0630-899 **Graduate Thesis**
The graduate thesis is a formal research document that empirically relates theory with practice. A formal written thesis and oral defense are required. (0630-890) **Credit 1-4**

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

Environmental Health and Safety

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

0633-726 **Occupational Health II**
This 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). This course also explores environmental health engineering applications including ventilation systems, process safety and inspection/audit protocol skill building for many different types of processes, including: laboratories, machining centers, painting and solvent usage. This course culminates in a one week block of emerging issues in occupational health—thecontent of which is expected to change accordingly. (0630-450 or 0630-610) **Class 4, Credit 4**

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

Health Systems Administration

0635-715 **Information Systems Health Administration**
Entry level course describing theory and use of computers and information systems in health care delivery and administration is covered in depth. The information needs of clinical and administrative personnel are examined with an emphasis on developing and evaluating comprehensive information systems for health care organizations. **Credit 4**

0635-721 **Senior Living Management**
This course is designed to introduce students to the unique knowledge and skills required to understand and effectively manage in the senior living environment. The course will focus on the demographic realities leading to career and business opportunities in various types of senior living facilities. **Credit 4**

0635-752 **Clinical Information Systems**
This course will present an overview of several of the evolving clinical information systems present in the healthcare marketplace. A sampling of computerized systems including those found in the hospital, payer, nursing home, physician office, and other healthcare settings will be explored. Emphasis will be placed on the understanding of the changes involved in transitioning from manual systems to computerized systems in each of the above named areas. In particular, the student will be exposed to a variety of current technologies, which are being deployed in these areas. The benefits of the use of such technology will be analyzed and the requirements for planning and deployment of such systems will also be studied. (Health care information systems 0635-715-90, introductory technology/systems course or relevant experience. Computer systems hardware and software in health care recommended.)

0635-753 **Health Administration Application**
This course presents an overview of the various types of application used in the health administration arena. Emphasis will be placed on understanding the terminology and functionality of the basic software components that make collect and utilize health care data for administrative support and decision-making as well as insurance, billing and reimbursement. Students will examine the software infrastructure needed to support health care enterprises such as hospitals and smaller health care entities. The goal of this course is to provide students with a sufficient application familiarity so they can make meaningful IT and IT decisions. **Class 4, Credit 4**

0635-754 **E-Health**
This course will give students a broad overview of essential concepts in, and applications of, web based technologies in healthcare. E-Health topics covered will include review, discuss and analyse industry trends explore emerging E-Care solutions and investigate E-Health ethical guidelines and governmental regulations established to ensure privacy, standardization and health content reputability. **Credit *4***

0635-777 **Health System Administration Internship**
This is a health systems administration internship. Consists of a professional placement in an appropriate health care organization of at least 240 hours. Required for students without health care work experience. Can be taken in place of electives. Students will arrange with their program chair or assigned adviser, negotiate any arrangement necessary for on-site supervision and develop a written proposal. Students will present an oral evaluation of their experiences at the final course seminar. **Credit variable 2-8**

0635-798 **Special Topics**
Experimental courses are offered under this number; titles appear in each quarter's course listing. **Credit 1-5**

0635-815 **Finance for Operations**
This course is an introductory course that examines the responsibilities of the finance function in health care entities and its relations to the operating responsible centers (or departments). Subject matter is broad enough to include both not-for-profit and for-profit organizations in the allied health field. While this is a distance learning course, students are invited to participate in the first two on-campus lectures (attendance is optional, and those not attending will receive a videotape of the campus sessions). Topics include terminol*ogy* and measurement, cost finding and allocation, budgeting and the budgeting process, report, reimbursement, interpretation of financial statements, and facilities and materials management. Students must be matriculated in the health systems masters program or have permission of the department chairperson. **Credit 4**

0635-820 **Health Systems Economics and Finance**
Investigation of the efficiency, effectiveness and equity of the economics of health care and a conceptual and practical knowledge of health care finance. Reviews sources of funding, the accounting and reporting process, and the influence of third-party payers on the provision of health care through applied exercises. Provides an integrated overview of managerial economics, financial management, and product management for distinct health care organizations composing the overall health care system. (Accounting Concepts for Managers) **Credit 4**

0635-830 **Health Systems Planning**
A review of the methodology of planning effectively for health care systems. The use of data systems, forecasting, and identifying and analyzing problems is explored, along with the process of strategic planning, setting priorities, developing projects, and allocating resources. Students will prepare actual business plans and applications for new health care programs to regulatory agencies. (Permission of program chair) **Credit 4**

0635-840 **Health Systems Policy & Law**
An examination of the roles and responsibilities of policy makers on the health care system. Compares and contrasts the regulatory functions of varying levels of government and the political process as it relates to health care systems. Examination of control issues and regulatory dynamics, the legislative process, and regulatory trends in the United States. Assessment of health systems' strategies and responses to regulatory oversight. An overview of legislation as it applies to health facilities and administrative law using case studies. **Credit 4**

0635-881 **Health Insurance Reimbursement**
An in-depth look at characteristics of successful managed care plans. The course will familiarize the student with all essential elements of managed care, using the tools needed to model and compare various managed care structures. **Credit 4**

0635-882 **Bioethics**
An overview of what ethics means, the principal ethical theories, and their application to specific bioethical issues. The course will familarize students with ethics and ethical principles, the role of ethics in professional life, what is bioethics and an appreciation of ethical issues and arguments surrounding contemporary bioethical issues such as death, rationing health care and managed care. **Credit 4**

0635-890 **Health Systems Administration Independent Study**
Provides for independent study or research activity in subject areas not included in any existing course in the degree program, but having special value to students. Proposals approved by a supervising faculty member and the program chair are required prior to registration. This course may be taken more than once. **Credit variable 4-8**

0635-896 **Health System Administration Thesis**
An independent research project on a specific health system administration topic or problem, developed by the student with input from a faculty thesis adviser. The research must culminate in a formal written thesis and oral defense. Approval by the program chair and a faculty thesis adviser is required for this course. **Credit variable 4-8**

Project Management

0681-710 **Introduction to Project Management**
Addresses project management from a multidisciplinary perspective, covering the fundamental nature of managing a broad range of projects-public, business, engineering, manufacturing, medical, non-profit, and information systems-as well as techniques required to manage specific types of projects. Topics include Project Environment, Planning, Conflict and Negotiation, Budgeting, Scheduling, Resource Allocation, Monitoring and Controlling, and Project Termination. Addresses the unique and demanding role of the project manager, the challenges of cross-cultural projects, and the behavioral and quantitative facets of project management. Introduces the major areas of the Project Management Body of Knowledge (PMBOK) as defined by the Project Management Institute. (Introductory course(s) in management, college-level business math, and computer, network, and internet environments; equivalent experience or instructor permission.) **Credit 4**

0681-711 **Advanced Project Management**
Course covers the advanced project management topics necessary for implementation of and excellence in project management. Deals with turning the principles and theory of project management into practice. Addresses the best practices for project management in the world; project portfolio management; the project office; project risk management; multinational cultures and cultural failures; integrated project teams; and virtual project teams. Incorporates aspects of the Project Management Body of Knowledge (PMBOK). (Introduction to Project Management 0681-710; or equivalent experience; or by permission of the instructor) **Credit 4**

0681-712 **International Project Management**
With the increasing frequency of globalization, mergers, and acquisitions, international projects are becoming more prevalent and approaching the norm for many organizations. This course addresses a wide range of international projects-based in different industries and multiple countries. Deals with cultural and social differences within firms; cultural and social differences among countries and within countries; languages and dialect variations; different management practices and structures; religious practices; legal, regulatory, and reporting requirements; technology differences in different areas; and time zone differences. Incorporates aspects of the Project Management Body of Knowledge (PMBOK). (Introduction to Project Management 0681-710 and Advanced Project Management 0681-711; or equivalent experience; or permission of the instructor) **Credit 4**

Technical Information Design

0688-711 **Technical Information Design**
Intensive practice in the creation of content for online and multimedia documents with emphasis on the presentation of technical and scientific concepts, products, and processes. A survey of graphic methods for the display of complex technical relationships and ideas. Students will also explore contemporary topics (international technical communication, the future of on-line documentation, ethical considerations in technical information design, etc.) and applications (legal, medical, electronics, environmental, etc.) in Technical Information Design. (0688-333 or equivalent, or permission of instructor) **Credit 4**

0688-712 **Advanced Photoshop Techniques**
This course offers a strategic view of the Photoshop/digital imaging work environment, with an emphasis on preparing high-quality images for print. Instead of specific tools, it will focus on broader techniques and strategies with an emphasis on preparing high-quality images for publication. Topics such as image correction, color models, file formats and additional image pes such as duotones will be discussed in detail. **Credit 3**

0688-713 **Introduction to XML**
This course provides an introduction to XML (Extensible Markup Language) and its applications in information management and a variety of fields. Students will learn how to use this flexible text format that is playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. Programming experience is not required for this course. **Credit 3**

0688-714 **Science Writing**
Students learn the special requirements for gathering information and writing articles about changes and new developments in the world of science. Students look at contemporary outlets for science writing, read and study examples of science journalism from a variety of fields and prepare a feature length science article. Class articles are published in an on-line journal. **Credit 4**

0688-721 **Creating Technical Proposals**
The elements of proposal writing, including responsiveness, establishing credibility, and technical clarity. The proposal process as practiced in government and industry, including an understanding of RFPs, RFIs, and the decision process. Specialized proposals including NDAs, on-line and multi-media proposals and technical marketing presentations. (0688-333 or equivalent or permission of instructor) **Credit 4**

0688-731 **Technical Procedures**
Development of task-oriented and process documentation. Procedures for complex physical and mental tasks including time-constrained activities, emergencies, diagnostics and troubleshooting, and multiple-path processes. Formats for print, electronic, and multi-media instructions. An introduction to the creation of online help including Web-delivered and HTML help. (0688-333 or equivalent or permission of instructor) **Credit 4**

0688-732 **Managing Technical & Scientific Communications**
Course covers the management of technical and scientific communication projects and organizations, including managerial roles, practices, and responsibilities as well as management strategies for content and audience evolution. Covers management of parallel (print and online) projects, single-sourcing, and documentation localization; technological factors in the production and distribution of technical documentation; and consideration of career options and independent contracting. (Technical Writing & Editing 0688-333 or equivalent or permission of the instructor) **Credit 4**

0688-741 **Usability Design & Test**
The elements of successful electronic and print document design. The use of design concepts and tools to increase usability. Introduction to information mapping. Design and usability test considerations for multimedia and user-centered media. (0688-333 or equivalent or permission of instructor) **Credit 4**

Cross-Disciplinary Studies

0697-710 **Toxin Chemical Weapons Threat & Defense**
This course will introduce students to the toxins secreted by bacteria and fungi, as well as marine, venom and plant toxins. Chemical weapons and regulatory peptides will also be discussed. Lectures will include the structure of each toxin type and the mechanism of action of each, as well as various aspects of protection against toxin and chemical weapons. **Lecture 4, Credit 4**

0697-711 **Intelligence Analysis**
This overview will encompass analytical methodologies, direct and indirect challenges, the various types, categories, and modalities, tactical vs. strategic issues, information sources, customers, clients, and policymakers, and current issues in the intelligence field. Students will undertake short research projects as well as engage in small group activities and in-class presentations. During the quarter guest speakers will be invited to present their particular expertise on key issues. **Class 4, Credit 4**

0697-712 **Bacterial & Viral Weapons Threat Defense**
This overview will introduce student to those bacteria that are potential agents of bioterrorism. Lecture topics will include the metabolism, virulence factors, physiology, immunology, and genetics of these agents, as well as the pathology and prevention of disease. **Class 4, Credit 4**

0697-713 **Radiological Threat and Defense**

0697-798 **Special Topics**
Special Topics are experimental graduate courses announced quarterly. Watch for titles in the course listing each quarter. **Credit variable**

0699-705 **Context & Trends**
This course introduces students to interdisciplinary thinking, problem solving and research techniques and also print and electronic information resources appropriate to the student's individualized plan-of-study. **Credit 4**

0699-775 **Capstone Project**
This course is a supervised, hands-on experience in which the students apply the skills and knowledge developed through their individualized plans-of-study and concludes with a specific product and an oral and written presentation. **Credit 4**

0699-798 **Independent Study**
This course number should be used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. **Credit 1-12**

College of Business

www.cob.rit.edu/

Wayne J. Morse, Interim Dean

Success in the 21st century business environment requires leadership and management attuned to rapid changes in technology and increasingly vigorous global competition. Astute problem solvers who have gained a systems perspective must be able to convert product development and management challenges into competitive advantages. The College of Business offers a portfolio of comprehensive, rigorous 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.

Faculty

Our faculty combines 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.

Programs

Master of Business Administration degres in:

Master of Science degree in:

Master of Business Administration

Brian F. O'Neil, Ph. D., Associate Dean and Director, Graduate Programs

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The master of business administration (MBA) 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, mainstream grounding in the functional areas of business and combines that foundation with the flexibility that allows students to specialize in one or two areas of expertise. In the classroom, students learn the latest theories and concepts, and how they can be immediately applied to solve problems in the workplace.

The MBA program requires 72 quarter credit hours and consists of 18 courses, nine of which are devoted to core functional areas and nine available in concentration areas and as electives. All College of Business courses carry four credit hours. Students create at least one concentration field of study by selecting a four-course sequence in a particular area of specialization. Concentrations within the college include accounting, e-business marketing, entrepreneurship, finance, international business, management and leadership, management information systems, marketing and sales

management, marketing research, operations management, product commercialization, quality and applied statistics, quality and organizational improvement, and technology management. Concentrations offered by other departments within RIT include communication and media technology, environmentally sustainable management, health systems administration, human resource management, industrial and systems engineering management, information technology, printing management, and public policy. The College of Business is accredited by the Association to Advance Collegiate Schools of Business (AACSB International).

Admission requirements

Applications are accepted for all four academic quarters. However, most full-time students begin their program of study in the fall. Prerequisites for admission include a baccalaureate degree from an accredited institution and a working knowledge of algebra and statistics. All entering students are required to successfully complete math review courses in algebra and statistics during their first quarter of study. This requirement is waived for students who pass a math diagnostic exam administered during orientation.

MBA-accounting students must begin studies in the fall quarter. Any exceptions must obtain the approval of a graduate adviser.

All full-time students are required to complete Professional Skills Seminar I and II. These noncredit courses give students the skills to successfully complete their graduate degree and prepare them to obtain a job or co-op position.

Completed applications for admission should be on file in the Office of Graduate Enrollment Services four weeks prior to registration for the upcoming academic quarter for students from the United States, and up to 10 weeks for students applying for student visas. Transcripts from all previous undergraduate and graduate work, a Graduate Management Admission Test (GMAT) score, relevant professional experience, a personal statement, and résumé are evaluated by the Graduate Admissions Committee. International applicants must submit the results of the Test of English as a Foreign Language (TOEFL) with a minimum score of 580 (paper-based), 237 (computer-based), or *92* (Internet-based) as part of the application. The TOEFL requirement is waived for native speakers of English and for those submitting transcripts and diplomas from American undergraduate schools.

Accepted students can defer enrollment for up to one year. If beyond one year, a new application must be submitted and will be evaluated on then-current admission standards.

Nonmatriculated status

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

Academic standards

The MBA normally requires 72 quarter credit hours. In certain cases, total credit hours may be reduced by the use of waiver or transfer credit. Students have the responsibility of applying for these credits.

Students must maintain a grade of "B" or better for all courses taken at the College of Business. Grades of all repeated MBA courses will be counted in the GPA computation. The policy on probation and suspension is explained in the section "Registration and Degree Requirements" in this bulletin.

Program completion requirement

University policy requires that graduate programs be completed within seven years of the student's initial registration for courses in the program. A grade point average of 3.0 must be maintained.

Orientation

All new students are required to attend an orientation session prior to beginning their studies. Students must take the math waiver exam, administered during Orientation, before enrolling in courses. Course selection, career planning, program planning, and academic advising are also discussed during orientation.

Waiver policy/transfer credit

Students can waive up to six MBA foundation courses if prior academic preparation from an AACSB International-accredited institution is equivalent to these graduate courses, and the courses were completed within the last five years with a grade of "B" or better. Courses may be waived either outright or through an examination.

A maximum of 12 credit hours may be awarded as transfer credit from other graduate programs. The courses must have been taken at an AACSB International-accredited institution and the student must have earned a grade of "B" or better. The courses must be relevant to the student's MBA program of study.

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

Placement

Preparation for professional placement begins early in the graduate student's program, with completion of Professional Skills Seminar II. The Office of Cooperative Education and Career Services offers individualized career counseling, provides critical job leads, coordinates employers' annual campus recruiting visits, and sponsors two career fairs annually.

Cooperative education

Optional cooperative education affords graduate students the opportunity to hold a paid position for three to six months. No academic credit is granted, but formal recording of the co-op experience is made on the student's transcript. The associate

director for Graduate Business Programs approves the student's written report analyzing the company and experience. Students in good academic standing are eligible for co-op after completing the foundation courses, Professional Skills Seminar I and II, 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 that all students will be placed.

Financial assistance

Financial assistance is awarded for outstanding scholarship and professional promise without consideration of financial need. Matriculated full- and part-time students are eligible for scholarships. Matriculated full-time students are also eligible for graduate assistantships. Students awarded assistantships are assigned to work with College of Business faculty or staff. All applicants are automatically reviewed for these awards. Several alternative loan programs and federal and state programs are also available. Please contact the Office of Financial Aid and Scholarships for further information.

Study abroad programs

Matriculated MBA students have the opportunity to study abroad to enhance their understanding of global business and learn first hand the international business environment. Students must complete the course Global Business Environments (0102-780) prior to their trip. For more information, contact a graduate adviser.

Course offerings

Since it is sometimes necessary to make changes in course schedules or instructors, up-to-date information about courses to be offered in a given quarter is available online at www.cob.rit.edu. RIT makes no guarantee that every catalog course will be offered in any given year or that courses will be offered in a particular quarter or sequence. All MBA students take the following nine core courses:

	Qtr. Cr. Hrs.
0101-703 Accounting for Decision Makers*	4
0102-740 Organizational Behavior and Leadership*	4
0103-705 Economics for Managers*	4
0104-721 Financial Analysis for Managers*	4
0105-761 Marketing Concepts*	4
0106-743 Operations Management*	4
0106-782 Statistical Analysis for Decision Making*	4
Choose one from the following:	
0102-742 Introduction to Technology Management	
0102-780 Global Business Environment	
0104-760 Finance in a Global Environment	
0112-710 Management Information Systems Concepts	4
0102-759 Competitive Strategy	4

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

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

Students with one concentration area take:
- Nine core courses
- Four courses in a concentration area
- Five electives, outside the selected concentration area. No more than four of these can be taken in any one discipline.

Students with two concentration areas take:
- Nine core courses
- Four courses in a concentration area
- Four courses in a second concentration area
- One elective, outside the selected concentration areas

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

Concentrations

Accounting

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

	Qtr. Cr. Hrs.
0101-704 Corporate Financial Reporting I	4
0101-705 Corporate Financial Reporting II	4
0101-706 Cost Management	4
Choose one from the following:	
0101-707 Advanced Accounting	4
0101-708 Auditing	4
0101-709 Basic Taxation	4

E-Business Marketing

The Internet has become one of the most significant forces to affect marketing since the emergence of mass media. A global electronic marketplace enabled by the Internet has caused dramatic shifts in standard business practices. This has given rise to an enormous need to understand the implications of these shifts for strategic initiatives in marketing and advertising. The e-business marketing path exposes students to the uniqueness of marketing goods and services to other companies as well as individual consumers.

	Qtr. Cr. Hrs.
0105-772 Internet Marketing: Strategy and Tactics	4
0105-773 Database Marketing	4
0105-775 Business to Business E-Marketing	4
One marketing elective	4

Entrepreneurship

Entrepreneurship is a necessary component in today's fast-paced business environment. It involves both the recognition of business opportunities and methods, and the means to commercialize these opportunities. The entrepreneurship concentration is designed to enable students to recognize and

commercialize attractive business opportunities — either by new independent ventures or by established firms seeking growth or rejuvenation. It involves integrating all functions of business (strategy, marketing, innovation, finance, accounting, etc.) within one concerted value-creating initiative. The concentration requires an applied entrepreneurial learning experience that may be satisfied through either the Field Experience in Business Consulting course, or an approved commercialization project. These projects may involve students developing their own businesses or working with RIT incubator companies, local startup firms, or RIT multidisciplinary commercialization projects. Students interested in high-technology initiatives are encouraged to enroll in Introduction to Technology Management as the fourth course in the concentration.

	Qtr. Cr. Hrs.
0102-720 Entrepreneurship and New Venture Creation	4
015-776 Product and Brand Management	4
0102-753* Field Experience in Business Consulting	4
Choose one from the following:**	
0101-709 Basic Taxation	4
0102-742 Introduction to Technology Management	4
0104-722 Financial Management II	4
0104-735 Valuing Private Enterprise	4
0105-763 Buyer Behavior	4
0105-772 Internet Marketing: Strategy and Tactics	4
0110-730 Business Legal Concepts	4

*or an approved entrepreneurial field experience

**or management course, with approval of graduate adviser

Finance (five-course concentration)

The finance concentration is designed to provide foundation knowledge in finance and allow students to choose courses appropriate for a career in investments or corporate finance. Students interested in the investments area have the opportunity to acquire advanced skills in securities evaluation and portfolio management. Students interested in corporate finance have the opportunity to acquire advanced skills in budgeting, planning, global financing, and operations and corporate risk management.

	Qtr. Cr. Hrs.
0104-722 Financial Management II	4
0104-725 Securities and Investment Analysis	4
One advanced economics course	
Choose two courses from the following:	4
0104-724 Problems in Corporate Finance	4
0104-729 Seminar in Finance	4
0104-730 Financial Institutions and Markets	4
0104-732 Portfolio Theory	4
0104-734 Working Capital Management	4
0104-740 Options and Futures	4
0104-760 Finance in a Global Environment	4

International Business

The vast majority of business opportunities exist globally. Competition may stem from many different companies and be internationally based. The rules of international trade are changing, as is the speed and ease with which global business is transacted. This makes almost all business international and requires executives to view business challenges in a global context. Regardless of which of the key business functions (finance, marketing, manufacturing, etc.) the students find employment in, an MBA with a concentration in international business will arm them with the skills necessary to rise to this challenge.

	Qtr. Cr. Hrs.
0102-780 Global Business Environments	4
0102-782 Global Issues and Strategies	4
Choose two from the following:	
0102-760 Managing in a Global Business	4
0104-760 Finance in a Global Environment	4
0105-766 Marketing in a Global Environment	4

Management and Leadership

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

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

Management Information Systems

A concentration in management information systems is designed to enhance students' understanding of modern information systems. It is designed so that a student need not have a background in computers or information systems. Students may elect courses in systems analysis and design, data management, systems management, integrated business systems, applications programming, and information systems consulting, as well as a seminar covering current topics in information systems.

Students may choose one of four different concentrations that focus on systems consulting, information system management, enterprise systems management with an emphasis on SAP/R3, or information systems.

In all concentrations, students gain an understanding of the foundation of management information systems and what is needed to develop and implement an information system. Electives chosen will strengthen their ability for MIS consulting, systems management, or working with large-scale ERP systems.

Information Systems Consulting **Qtr. Cr. Hrs.**

0112-720 Information Systems Design	4
0112-730 Information Systems Consulting	4
0112-755 Information Systems Management	4
Choose one from the following:	
0112-745 Information Systems Development	4
0112-795 Seminar in MIS	4

Information Systems Development **Qtr. Cr. Hrs.**

0112-720 Information Systems Design	4
0112-725 Data Management	4
0112-745 Information Systems Development	4
Choose one from the following:	
0112-735 Network Technologies	4
0112-755 Information Systems Management	4
0112-795 Seminar in MIS	4

Enterprise Information Systems **Qtr. Cr. Hrs.**

0112-755 Information Systems Management	4
0112-760 Integrated Business Systems	4
0112-761 Business Process Analysis and Workflow Design	4
Choose one from the following:	
0112-720 Information Systems Design	4
0112-725 Data Management	4
0112-795 Seminar in MIS	4

Information Systems **Qtr. Cr. Hrs.**

0112-720 Information Systems Design	4
0112-725 Data Management	4
Choose two from the following:	
0112-730 Information Systems Consulting	4
0112-735 Network Technologies	4
0112-755 Information Systems Management	4
0112-795 Seminar in MIS	4

Marketing and Sales Management

Marketing is a key to success in any business today. 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.

Qtr. Cr. Hrs.

0105-762 Advanced Marketing Management	4
0105-764 Channel Management	4
0105-765 Professional Sales Management	4
Choose one from the following:	
0105-758 Seminar in Marketing (various topics)	4
0105-763 Buyer Behavior	4
0105-766 Marketing in a Global Environment	4
0105-767 Marketing Communications	4
0105-771 Marketing Research Methods	4
0102-770 Business Research Methods	4
0105-772 Internet Marketing: Strategy and Tactics	4
0105-773 Database Marketing	4
0105-776 Product and Brand Management	4

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, 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.

Qtr. Cr. Hrs.

0307-801 Design of Experiments I	4*
0102-770 Business Research Methods or	4
0105-771 Marketing Research Methods	4
Choose two from the following:	
0105-762 Advanced Marketing Management	4
0105-772 Internet Marketing: Strategy and Tactics	4
0105-773 Database Marketing	4
0307-802 Design of Experiments II	4*
0307-831 Multivariate Analysis Applications	4*
0307-841 Regression Analysis	4*

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

Operations Management

The operations management concentration is designed to enhance the student's understanding of the manufacturing function as it exists in modern business. In addition to key courses covering project management, quality control and improvement, and manufacturing strategy, an extensive set of electives allow students the ability to broaden their knowledge base.

Qtr. Cr. Hrs.

0106-744 Project Management	4
0106-745 Quality Control and Improvement	4
0106-749 Manufacturing Strategy and Tactics	4
Choose one from the following:	
0101-794 Cost Accounting in Technical Organizations	4
0102-741 Managing Organizational Change	4
0102-742 Introduction to Technology Management	4
0307-781 Quality Management	4*
0307-782 Quality Engineering	4*
0307-721 Statistical Process Control	4*
0307-731 Statistical Acceptance Control	4*
0303-690 Seminar in Computer Integrated Manufacturing	4

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

Product Commercialization

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

Qtr. Cr. Hrs.

0105-776 Product and Brand Management	4
0105-777 Commercializing New Products	4
Choose one of the following:	
0102-770 Business Research Method	4
0105-771 Market Research Methods	4
Choose one of the following:	
0102-742 Introduction to Technology Management	4
0102-762 Managing New Process and Product Development	4

Note: If 0102-742 is taken as part of the MBA core, 0102-762 is required.

Quality and Applied Statistics

This concentration is for those students who would like to study the technical aspect of managing quality, i.e., statistical quality control. Depending on the courses chosen, students may 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.

Choose four from the following:	Qtr. Cr. Hrs.
0106-745 Quality Control and Improvement	4
0307-721 Statistical Process Control*	4
0307-731 Statistical Acceptance Control*	4
0307-782 Quality Engineering*	4
0307-801 Design of Experiments I*	4
0307-802 Design of Experiments II*	4

**Student should register for the four-credit-hour option of these courses*

Quality and Organizational Improvement

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

	Qtr. Cr. Hrs.
0102-741 Managing Organizational Change	4
0106-745 Quality Control and Improvement	4
Choose two from the following:	
0105-771 Marketing Research Methods or	4
0102-770 Business Research Methods	4
0307-782 Quality Engineering	4*
0307-721 Statistical Process Control	4*
0307-731 Statistical Acceptance Control	4*
0625-841 Benchmarking and the Process of Continuous Improvement	4
0106-744 Project Management	4

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

Technology Management

In a constantly changing environment, the ability of an organization to innovate and renew itself is critical if it is to survive and prosper. Technology managers, who typically are responsible for 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.

	Qtr. Cr. Hrs.
0102-742 Introduction to Technology Management	4
Choose one or both from the following:	
0102-761 Managing Research and Innovation	4
0102-762 Managing New Product and Process Development	4
If both courses directly above are taken, choose one course from the following; otherwise choose two:	
0102-741 Managing Organizational Change	4
0110-745 Legal and Ethical Issues in Technology Intensive Environments	4
0105-776 Product and Brand Management	4
0106-744 Project Management	4
0106-749 Manufacturing Strategy and Tactics	4

Please see a graduate adviser before registering for courses in the following concentrations, as they are offered by departments outside the College of Business.

Communication and Media Technologies

Communications, 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. This concentration prepares students for careers as communication experts in commerce and industry, education and entertainment, and government and the not-for-profit sector.

Environmentally Sustainable Management

Environmental issues are central to operational and strategic decision-making in industries such as automobile, chemical, energy, transportation, and agricultural. This concentration is for students interested in understanding how firms can manage social and political demands for more environmentally sustainable products and operations.

Health Systems Administration

This concentration is specifically designed for those students who want to pursue a career in the health care environment. Courses with up-to-date, industry-relevant content are continually developed in response to the changing health care environment. All courses in this concentration are offered online.

Human Resource Management

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

Industrial and Systems Engineering Management

Technology-based organizations need individuals who possess a blend of technical and business skills, who have the integrated systems perspective needed to commercialize complex products and services. This concentration 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 that improves organizational information flow, employee learning, and business performance. The future will include a mixture of computers and other multipurpose devices, information media, and communication technology, all filtered through an understanding of how humans need to use these evolving systems. Four concentrations are available in this area, including Web programming/ multimedia, software project management, programming, and telecommunications.

Printing Management

Leadership and management in the print media industry require understanding cutting-edge technology and emerging markets to articulate a corporate vision that encompasses new opportunities and directions. This concentration 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

Careers are available in all levels of government, as well as in nonprofit organizations and the private sector — where an understanding of the formulation and impacts of public policies are critical. This concentration gives students the skills to effectively formulate public policies and understand their impact, particularly as related to science and technology issues. The courses focus on policy formation, implementation, and analysis.

Fast Track One-Year MBA

An accelerated, intensive MBA program is available to full-time students. The program begins in the summer with courses in a modular format, followed by mainstreaming with the traditional MBA program courses. The following five concentrations are offered in this program: entrepreneurship, finance, management and leadership, marketing, and technology management. Early commitment and merit-based scholarships are available. The admission requirements, course requirements, and total credit hours are the same as those for the traditional MBA.

Executive MBA

Brian F. O'Neil, Ph. D., Associate Dean and Director, Graduate Programs
(585) 475-7784, boneil@cob.rit.edu

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

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

- 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
- Obtain a solid foundation in the functional areas of business

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

Admission requirements

In order to be considered for admission to the Executive MBA program, a candidate must:

1. Have a minimum of six years of professional work experience.
2. Have earned a bachelor's degree.
3. Be interviewed by a representative of the Executive MBA team.
4. Submit a completed admissions package.

Sponsorship

Employer sponsorship includes several dimensions. The sponsor must agree to permit the candidate to attend scheduled Friday/Saturday classes, the two required summer weeks, and the one-week international study trip. Business owners or individuals may sponsor themselves.

Program structure and content

The Executive MBA program consists of six weekends per quarter, for a total of 30 weekends over the program's 15 months. Students must also attend two one-week summer sessions, and a one-week international study trip.

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

The EMBA program also includes 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.

Curriculum

Mid-August		Team Building and Business Ethics (one week)
Quarter One	Fall	Accounting and Organizational Goals Managerial Accounting Leadership Microeconomics Leadership Development Skills I
Quarter Two	Winter	Valuation and Capital Budgeting Financial Planning and Analysis Macroeconomics Data Analysis Leader Development Skills II
Quarter Three	Spring	Strategic Thinking I and II Marketing Strategy Statistics for Decision Making
Late May		Business Simulation: Consulting Skills (one week)
Quarter Four	Summer	Internet Marketing Systems Support for lean Operations Capstone Consulting Project I High Tech Enterpriseship
Quarter Five	Fall	International Business International Finance Capstone Consulting Project II Leadership Development Skills III International Seminar Executive Series

Information and application

All correspondence regarding Executive MBA admission and required documents should be sent to:

Executive MBA Program
College of Business
Rochester Institute of Technology
107 Lomb Memorial Drive
Rochester, NY 14623-5608
(585) 475-7435
(585) 475-6441 (fax)
embamail@rit.edu

Master of Business Administration - Accounting

Brian F. O'Neil, Ph. D., Associate Dean and Director, Graduate Programs
(585) 475-7784, boneil@cob.rit.edu

In addition to the educational preparation for a career leading to top management, the MBA-Accounting program fills the New York State Certified Public Accountancy (CPA) education requirements to sit for the CPA exam. The program also stresses the skills necessary for the design, operation, and control of accounting information systems.

Program for students with an undergraduate degree in accounting:

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

MBA Core Courses:

0102-740	Organizational Behavior and Leadership
0102-759	Competitive Strategy
0105-761	Marketing Concepts

Additional Accounting Courses:

0101-707	Advanced Accounting**
0101-722	Advanced Cost Management
0101-738	Information Systems Auditing and Assurances Services
0101-795	Financial Accounting Theory and Research

Additional Business Courses:

0106-780	Management Science**
0110-731	Commercial Law**
0112-725	Data Management
or	
0112-745	Information Systems Development
0112-760	Integrated Business Systems
or	
0101-737	Accounting and Enterprise Information Systems
	Non-accounting professional elective

The program for students with undergraduate degrees in other areas will vary, most likely between 12 and 27 graduate courses.

***Students taking these courses as part of their undergraduate program may substitute electives or other courses required to meet CPA education requirements.*

Program for students without undergraduate business course work

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

Curriculum

The MBA-Accounting program consists of three sets of courses: MBA core courses, additional accounting courses, and additional business courses.

MBA Core Courses:

0101-703	Accounting for Decision Makers
0102-740	Organizational Behavior and Leadership
0102-759	Competitve Behavior and Leadership
0103-705	Economics for Managers
0104-721	Financial Analysis for Managers
0105-761	Marketing Concepts
0106-743	Operations Management
0106-782	Statistical Analysis for Decision Making

Choose one of the following:

0102-742	Introduction to Technology Management
0102-780	Global Business Environments
0104-760	Finance in a Global Environment
0112-710	Management Information Systems Concepts

Additional Accounting Courses:

0101-704	Corporate Financial Reporting I
0101-705	Corporate Financial Reporting II
0101-706	Cost Management
0101-707	Advanced Accounting
0101-708	Auditing
0101-709	Basic Taxation
0101-710	Advanced Taxation
0101-722	Advanced Cost Management
0101-738	Information Systems Auditing and Assurances Services
	Accounting Information Systems
	Accounting elective

Additional Business Courses:

0106-780	Management Science
0110-730	Business Legal Concepts
0110-731	Commercial Law
0112-760	Integrated Business Systems
or	
0101-737	Accounting and Enterprise Systems
	Finance elective
	Non-accounting professional elective

Master of Science in Finance

Brian F. O'Neil, Ph. D., Associate Dean and Director, Graduate Programs
(585) 475-7784, boneil@cob.rit.edu

The master of science degree in finance is designed to prepare students for managerial careers in corporate finance, investment

analysis and portfolio management, financial consulting, and financial institutions. Courses that closely parallel the education requirements of the Chartered Financial Analyst exam will prepare students who plan to take this exam.

Full-time students must begin studies in the fall or winter quarter to complete the program in one year. Part-time students may enter the program in any quarter.

Admission requirements

Applicants should have baccalaureate degrees from accredited programs. To be considered for admission, it is necessary to file an application, submit official transcripts of all previous undergraduate and graduate work, results of the Graduate Management Admissions Test, and provide an up-to-date résumé. International applicants must submit the results of the Test of English as a Foreign Language (TOEFL) with a minimum score of 580 (paper-based), 237 (computer-based), or 92 (Internet-based) as part of the application. The TOEFL requirement is waived for native speakers of English and for those submitting transcripts and diplomas from American undergraduate schools.

Curriculum

The graduate program of study consists of 12 courses and a comprehensive exam. The courses are:

0103-703	Accounting for Decision Makers
0104-721	Financial Analysis for Managers
0104-722	Financial Management II
0104-725	Securities and Investment Analysis
0104-740	Options and Futures
0104-760	Finance for Global Business
0106-782	Statistical Analysis for Decision Making
	One finance elective
	Two breadth electives

Choose two from the following:*

0103-705	Economics for Managers
0103-711	Microeconomics
0103-712	Macroeconomics

Breadth elective courses may be chosen from the graduate business courses in accounting, international business, management, marketing, management information systems, or technology management.

The candidate must successfully complete a comprehensive field exam based on the required finance courses completed.

**Specific economics courses selected by the finance faculty adviser depend on the student's previous economic course work, if any.*

Master of Science in Management

Brian F. O'Neil, Ph. D., Associate Dean and Director, Graduate Programs
(585) 475-7784, boneil@cob.rit.edu

The master of science in management is a specialized program designed to provide students with the knowledge and problem-solving skills needed to function effectively in a variety of management positions in complex organizations that are impacted by technological change and globalization. Students choose between two tracks: technology management or global management. After taking several courses in research tools, the program culminates with a two course thesis or practicum.

Full-time students must begin the program in the fall quarter in order to complete the program in 12 months.

Admission requirements

Applicants should have baccalaureate degrees from accredited programs. To be considered for admission, it is necessary to file an application, submit official transcripts of all previous undergraduate and graduate work, submit the result of the Graduate Management Admissions Test, and provide an up-to-date résumé. International applicants must submit the results of the Test of English as a Foreign Language (TOEFL) with a minimum score of 580 (paper-based), 237 (computer-based), or 92 (Internet-based) as part of the application. The TOEFL requirement is waived for native speakers of English and for those submitting transcripts and diplomas from American undergraduate schools.

Curriculum

The graduate program of study consists of 12 courses and a thesis or practicum.

Global Management Track

0102-780	Global Business Environments
0102-782	Global Issues and Strategy

Choose two from the following:

0102-760	Managing in a Global Environment
0104-760	Finance in a Global Environment
0105-766	Marketing in a Global Environment
	Two courses in research tools
	Four breadth-of-field courses*
	Two courses in a thesis or practicum

**See graduate adviser before choosing courses*

Technology Management Track

0102-742	Introduction to Technologv Management
0102-762	Managinq New Process and Product Development

Choose two from the following:

0102-741	Managing Organizational Change
0102-761	Managing Research and Innovation
0105-776	Product and Brand Management
0106-744	Project Management
	Two courses in research tools
	Four breadth-of-field courses:
0102-780	Global Business Environments
	Three additional management courses*
	Two courses in a thesis or practicum

**See graduate adviser before choosing these courses*

Graduate Faculty

Wayne J. Morse, BBA, Siena College; MBA, Cornell University; Ph.D., Michigan State University — Interim Dean

Brian F. O'Neil, BS, Syracuse University; MS, Ph.D,, Purdue University — Associate Dean, Director, Graduate Programs

Jerry H. Curnutt, AB, William Jewell College; MS, Ph.D., University of Illinois — Assistant Dean for Student Success

Accounting

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

Khondkar E. Karim, B.Com., M.Com., University of Dhaka; MSA, Eastern Michigan State University; DBA, Mississippi State University; CPA, Mississippi — Associate Professor

Francis E. Kearns, BD, Harvard University; AB, Cornell University; MBA, Ph.D., State University of New York at Buffalo; CPA, New York — Assistant Professor

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

Wayne J. Morse, BBA, Siena College; MBA, Cornell University; Ph.D., Michigan State University; CPA, Illinois — Professor, Interim Dean

Bruce L. Oliver, BBA, MBA, University of Cincinnati; Ph.D., University of Washington — Professor

Daniel D. Tessoni, BSBA, St. John Fisher College; MS, Clarkson University; Ph.D., Syracuse University; CPA, New York — Assistant Professor

Thomas Tribunella, BBA, Niagara University; MBA, Rochester Institute of Technology; Ph.D., State University of New York at Albany; CPA, New York — Assistant Professor

Decision Science

John E. Ettlie, BS, MS, Ph.D., Northwestern University — Director, Technology Management Center, Professor

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

Thomas F. Pray, BS, MS, Clarkson University; Ph.D., Rensselaer Polytechnic Institute — Professor

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

Finance and Economics

Steven C. Gold, BA, BS, Rutgers University; MA, Ph.D., State University of New York at Binghamton-Acting Interim Chair, Accounting and Finance, Professor

Chun-Keung (Stan) Hoi, BS, MS, University of North Texas; Ph.D., Arizona State University — Associate Professor

Jeffrey P. Lessard, BS, BA, University of New Hampshire; MBA, Plymouth State College; MA, Ph.D., University of Arkansas — Professor

Robert Manning, BA, Duke University; MA, Northern Illinois University; Ph.D., Purdue University — Research Professor of Consumer Finance

Melissa Palmer, BBA, St. Bonaventure University; MBA, University of Rochester; CPA, New York — Visiting Lecturer

Ashok J. Robin, MBA, Ph.D., State University of New York at Buffalo — Associate Professor

Patricia L. Wollan, BS, York University; MBA, Old Dominion University; Ph.D., Pennsylvania State University — Assistant Professor

Management

Robert J. Barbato, BA, LeMoyne College; Ph.D., Michigan State University — Professor

Richard DeMartino, BA, Roanoke College; MPA, Ph.D., University of Virginia — Associate Professor

A. Clyde Hull, BA, Yale University; MB, MBA, Ph.D., Indiana University — Assistant Professor

Shalini Khazanchi, BS, South Gujarat University; MBA, University of Pune; Ph.D., University of Cincinnati — Assistant Professor

Martin Lawlor, BS, State University of New York at Buffalo; MBA, Rochester Institute of Technology — Visiting Lecturer

Steven Luxmore, BA MA, University of Guelph; Ph.D.; University of Toronto — Visiting Assistant Professor

David McHardy Reid, BS, University of Salford; MS, University of Manchester; Ph.D., University of Edinburgh — Professor

Sandra L. Rothenberg, BS, Syracuse University; MS, Ph.D., Massachusetts Institute of Technology — Associate Professor

Holly Slay, BS, Wilberfore University; CChE, University of Dayton; MA, Western Michigan University; Ph.D., University of Maryland — Assistant Professor

Zhi Tang, BS, Shandorun University; MS, Fudon University; Ph.D., University of Arizona — Assistant Professor

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

Management Information Systems

James Baroody, BS, University of Richmond; MS, College of William and Mary; Ph.D., University of Wisconsin–Madison — Chair, Decision Sciences and Management Information Systems, Distinguished Lecturer

Jack S. Cook, BS, MA, MBA, University of South Dakota; MS, Ph.D., Washington State University — Associate Professor

Daniel A. Joseph, BS, Niagara University; MA, State University of New York at Albany; MBA, Ph.D., State University of New York at Buffalo — Associate Professor

Koffi N'Da, BS, Inset, Abidjan, Cote d'Ivoire (Ivory Coast); MS, Ph.D., Lava1 University — Assistant Professor

M. Pamela Neely, BS, State University of New York at Buffalo; MS, University of Colorado; Ph.D., State University of New York at Albany — Assistant Professor

Victor J. Perotti, BS, MS, MA, Ph.D., Ohio State University — Associate Professor

Quiang (John) Tu, BS, MS, Xian Jiaotong University; Ph.D., University of Toledo — Associate Professor

Marketing

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

Deborah Colton, BA, State University of New York at Buffalo; MBA, Rochester Institute of Technology; Ph.D., University of South Carolina — Assistant Professor

Eugene H. Fram, BS, ML, University of Pittsburgh; Ed.D., State University of New York at Buffalo — Professor

Neil Hair, BS, University of Wales; MS, Sheffield Hallam University; Ph.D., Cranfield University — Assistant Professor

Kevin Scully, BS, State University of New York at Geneseo; MBA, Rochester Institute of Technology — Lecturer

Philip R. Tyler, BS, Rochester Institute of Technology; MBA, DBA, Michigan State University — Associate Professor

John Ward, BS, Georgia Institute of Technology; MS, Purdue University — Visiting Lecturer

Stanley M. Widrick, BS, Clarkson College of Technology; MBA, State University of New York at Buffalo; Ph.D., Syracuse University — Chair, Management, Marketing and International Business, Professor

Accounting

0101-703 **Accounting for Decision Makers**
An introduction to accounting concepts and the use of accounting information by decision makers. Topics include financial statements; measurement of assets, equities, and income; financial statement analysis, cost behavior and measurement; profitability analysis; relevant costs for special decisions; budgeting; and responsibility accounting. **Credit 4**

0101-704 **Corporate Financial Reporting I**
A comprehensive exposure at an intermediate level to accounting theory and practice. Emphasis is placed on applying underlying accounting theory to complex accounting measurement problems. The effects of alternative methods are considered throughout the entire course. (0101-703) **Credit 4**

0101-705 **Corporate Financial Reporting II**
Continuation of Corporate Financial Reporting I with emphasis on equity and special measurement and reporting problems. Topics include statement of cash flows, pensions, leases, revenue recognition and investments. (0101-704) **Credit 4**

0101-706 **Cost Management**
The development and use of cost data for external reporting and internal cost management (planning and control). Topics include job costing, process costing, joint product costing, cost reassignments, standard costs, activity based costing, decentralization and transfer pricing, and cost variances. Consideration is given to manufacturing, service and retail organizations. (0101-703) **Credit 4**

0101-707 **Advanced Accounting**
The analysis of financial reporting issues encountered in branch operations, business combinations, inter-corporate investments, international business, not-for-profit and government organizations, and partnerships. (0101-705 or equivalent) **Credit 4**

0101-708 **Auditing**
The theory and practice of auditing examined; critical study of auditing procedures and standards in the light of current practice; measurement and reliance of internal control, covered by case studies; modern auditing techniques by statistical sampling and electronic data processing applications; audit reports and the legal liability exposure of auditors. (0101-705) **Credit 4**

0101-709 **Basic Taxation**
A basic introductory course in federal income taxation. Emphasis is on taxation of individuals and sole proprietorships. Topics include income measurement and deductibility of personal and business expenses. (0101-703) **Credit 4**

0101-710 **Advanced Taxation**
A continuation of Basic Taxation. Emphasis is on the tax treatment of property transactions and the taxation of business entities. Also covers the use of technology to prepare complex returns and to research tax issues. (0101-709) **Credit 4**

0101-712 **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 interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit 4**

0101-722 **Advanced Cost Management**
A study of alternative approaches to identifying and proactively managing the costs of providing services and/or manufacturing and distributing products. The focus is on the development of cost data in ambiguous situations to assist managers in decision-making about future activities. Current issues in cost management receive special attention. (0101-706 or permission of instructor) **Credit 4**

0101-737 **Accounting and Enterprise Information Systems**
Planning, designing, acquiring, implementing, using, and managing accounting information systems in complex settings. Emphasis is on accounting applications of enterprise resource planning systems. Students may not receive credit for 010-737 and 0112-760 Integrated Business Systems. (Accounting Information Systems, 0101-345 or equivalent) **Credit 4**

0101-738 **Information Systems Auditing and Assurance Services**
An examination of the unique risks, controls, and assurance services resulting from and related to auditing financial information systems with an emphasis on enterprise resource systems. (1010-708 or equivalent) **Credit 4**

0101-794 **Cost Accounting in Technical Organizations**
A first course in accounting for students in technical disciplines. Topics include the distinction between external and internal accounting, cost behavior, product costing, profitability analysis, performance evaluation, capital budgeting, and transfer pricing. Emphasis is on issues encountered in technology intensive manufacturing organizations. This course is not intended for College of Business students. **Credit 4**

0101-795 **Financial Accounting Theory and Research**
This course examines the theoretical concepts, definitions, and models espoused in the accounting literature and relevant to analyzing various contemporary issues in financial accounting and reporting. (0101-705 or equivalent) **Credit 4**

Management

0102-070 **Professional Skills Seminar I**
This series of workshops and lectures provides students with the tools needed for successful completion of College of Business graduate programs. In Professional Skills Seminar I, students will develop and practice essential skills, including critical thinking, how to analyse a case, oral and written communication, working in a team environment, and academic ethics. This five week course is designed to complement Professional Skills Seminar II. **Credit 0**

0102-071 **Professional Skills Seminar II**
This series of workshops and lectures provides students with the tools needed to prepare them to successfully find a job or co-op. In Professional Skill Seminar II, students become familiar with career management strategies including resume writing, interviewing techniques, career planning, and how to search for a job or co-op. This five week course is required for all full time COB graduate students. This course was designed to complement Professional Skills Seminar I. **Credit 0**

0102-720 **Entrepreneurship and New Venture Creation**
This course studies the process of creating new ventures with an emphasis on understanding the role of the entrepreneur in identifying opportunities, seeking capital and other resources, and managing the formation and growth of a new venture. Students will typically write a business plan in this course. **Credit 4**

0102-740 **Organizational Behavior and Leadership**
This course examines why people behave as they do in organizations and what managers can do to improve organizational performance by influencing people's behavior. Students will be exposed to the ways in which organizations and their members affect one another and to different frameworks for diagnosing and dealing with problems in organizational settings. Topics include motivation, team building, conflict resolution, leadership, organizational change, and managing organizational cultures. **Credit 4**

0102-741 **Managing Organizational Change**
This course examines various theories and approaches currently used to assist organizations in achieving change. The features of successful change in organizations will be discussed, with an emphasis on the structural, motivational, interpersonal, and social aspect of organizational change. Topics include the processes of envisioning and implementing change, as well as, the roles and perspectives of change agents and change recipients. (0102-740) **Credit 4**

0102-742 **Introduction to Technology Management**
This course is an introduction to the technological process in organizations and the factors, both internal and external, that influence the rate, timing and success of industrial innovations. The interrelationship between science and technology and the importance of these two disciplines on 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. (0102-740 or permission of instructor) **Credit 4**

0102-745 **Social and Political Environment of Business**
This class focuses on the interactions among business, government and society. The course illuminates the role of ethics, social ideology and government policy in guiding business decisions and in providing the conditions for successful competitive activity. Attention is given to understanding the reason for government regulation, as well as the pros and cons of various regulatory approaches. The class also looks at current debates on corporate social responsibilities with regard to stakeholders, including government, consumers, employees, communities and the environment. **Credit 4**

0102-750 **Human Resource Management**
This course focuses on the importance of managing human resources with an awareness of the legal and regulatory environment. Attention is given to the increasing importance of cooperation among top management, HR managers, line managers and employees. Students will become familiar with workplace planning and employment, human resource development, compensation and benefits, employment and labor relations, occupational health & safety, and managing diversity. (0102-740) **Credit 4**

0102-753 **Field Experience in Business Consulting**
Students work in consulting teams to assist startup ventures and/or small businesses. Problems are isolated and solutions then developed. Affiliated course projects may focus on a number of areas. For example, they may seek to develop commercialization plans for specific technologies, products or services; focus on unique problems associated with small businesses, developing growth strategies, etc. Recommended for students nearing the completion of their program. (0101-703, 0104-721, 0105-761 for business majors; permission of instructor for other colleges) **Credit 4**

0102-756 **Power and Influence**
Power and influence processes are pervasive and an important part of organizational life. This course has as its objectives enhancing the understanding of these processes and increasing the student's skills in using them. Topics covered include the conditions under which power and politics are more likely to dominate decision processes, assessing the relative power of various actors, understanding the basis for their positions on issues, the sources of both individual and departmental power, power and influence strategies and tactics, and some functional and dysfunctional aspects of organizational politics for both individuals and the organizations involved. (0102-740) **Credit 4**

0102-758 **Seminar in Management**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to management. Specific topics will vary depending upon student and faculty interest and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit *4***

0102-759 **Competitive Strategy**
Strategic management decisions involve cross-functional integration of different management disciplines. As a capstone course, this course integrates and encourages use of what was learned in previous business courses. The objective is to gain insights into developing strategies for sustained competitive advantage. Topics include analysis of mission and visioning, general environmental trends, industry attractiveness, value-chain analysis, core competencies, business and corporate-level strategies, etc. The case method will be used to identify effective business and corporate-level strategies for firms and industries under dynamic competitive conditions. The workload in this capstone course tends to be considerably heavier than average. (All other required core courses) **Credit 4**

0102-760 **Managing in a Global Environment**
An analysis of comparative global business behavior and organization with particular emphasis on values, authority, individual and group relations, labor-management ties, risk tolerance, and motivational techniques. The course will prepare students to recognize different values and cultural factors in the global business community and how these shape and determine appropriate management behavior. The problems and opportunities of transferring management practices from one culture to another will also be examined. (0102-740) **Credit 4**

0102-761 **Managing Research and Innovation**
This course deals with the responsibilities of, and operating problems faced by managers responsible for the research function within high- technology firms. Topics will include: internal technology assessments, the acquisition of technology, domestic and international technology transfer, and the selection and management of R&D projects. Particular attention will be given to motivating and managing creative individuals, organizational alternatives for R&D, and techniques for overcoming barriers to innovation. (0102-742 or permission of instructor) **Credit 4**

0102-762 **Managing New Process and Product Development**
The course deals with the internal organizational challenges faced by managers of technology-intensive companies. Particular attention is given to management techniques for successfully developing and introducing into the marketplace new products and services. Also discussed is the management of technical groups and project teams, cross-functional integration, organizational support of innovation and creativity and organizational alternatives such as matrix management and skunk works. (0102-742 or permission of instructor) **Credit 4**

0102-763 **Behavioral Skills for Managers and Professionals**
This course provides the opportunity to develop individual and interpersonal skills that enhance managerial performance in today's high-performance organization. Each participant is given the opportunity to perform in each of the major skill dimensions, given evaluative feedback and the opportunity to incorporate the implications of that feedback into additional performance opportunities. Course participants are also provided with the opportunity to assess their career work preferences and to compare them with the performance expectations of managerial positions. The management styles of each participant are also assessed, and the impact of the behaviors that flow from each style on the perceptions and performance of others in the organization is clarified. (0102-740) **Credit 4**

0102-765 **Applied Venture Creation**
This project oriented course enables students to gain multi-disciplinary experience in entrepreneurship, venture creation, or product/service commercialization through a number of alternative venues. Student teams gain applied and practical knowledge by participating in an actual entrepreneurial or commercialization project. These projects could include: advancing/maturing a student originated business concept through the RIT Student Business Development Laboratory, developing commercialization plans in partnership with various RIT college product/service development projects, or creating commercial business plans for RIT generated intellectual property. Students meet with supervising faculty on a weekly basis. (Faculty permission is required to enroll in the course. See a COB graduate advisor for details.) **Credit 4**

0102-770 **Business Research Methods**
This course concerns the development, presentation and use of research in managerial decision making. Included are the processes by which meaningful research problems are generated, identification of the relevant literature, 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. (0106-782 or equivalent) **Credit 4**

0102-775 **Business Ethics**
Ethical issues involved in individual and corporate conduct will be examined. Topics include ethical hazards in modern organizations; creating an ethical climate in an organization; honesty; affirmative action; environmental ethics; ethics in advertising and sales, financial management and personnel management; and the role of character and virtues in effective leadership. Special attention is also given to the ethical assumptions of major corporate strategic decisions. **Credit 4**

0102-780 **Global Business Environments**
In this introduction to global business we consider the opportunities and threats posed by global changes, especially those of major market groupings such as NAFTA and EU and the emergence of China as an economic force. In response to these changes, new modes of doing business as well as categories of business are developing and these will be studied, specifically: drivers to globalization, alternative business environments and risk, foreign exchange risk, trade theory, market entry strategies, alliances, foreign direct investment, outsourcing, intellectual property (IP) and its protection. **Credit 4**

0102-782 **Global Issues and Strategies**
This capstone course will focus on either contemporary issues and problems in international business or regional studies analysis (e.g., Europe, Eastern Bloc, Pacific Basin). It will emphasize faculty-directed student research projects. (0102-780) **Credit 4**

0102-891 **Graduate Project**
This course number is used to fulfill the graduate paper requirement under the non-thesis option 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 practitioner-corporate-oriented research project designed by the candidate and his/her adviser to explore a salient management-related issue. **Credit variable 4-8**

0102-892 **Thesis**
The thesis is designed to expose the candidate to procedures of research methodology, data gathering and data analysis. A conceptual and theoretical research project will be designed by the candidate and his/her adviser to explore a salient management-oriented issue. The candidate must obtain the approval of an appropriate faculty member to guide the thesis before registering for the thesis. **Credit variable (4-8 hours)**

Economics

0103-705 **Economics for Managers**

The course focuses on the fundamental economic theories most useful for the management of the firm. Applications drawn from current economic events are utilized to better understand the internal and external environments of the firm and to help managers formulate effective business strategies and policies. Although no prior knowledge of economics is required, this is more than just a survey or principles course. Some important intermediate level economics tools of analysis (both microeconomic and macroeconomic) are introduced to provide managers with the skills necessary to apply economics in a meaningful way to enhance business decision making. (0106-066 algebra or equivalent) **Credit 4**

0103-711 **Microeconomics**

Microeconomics introduces the principles of economic analysis as applied to micro decisions to determine how an organization can achieve its aims most efficiently. This course supplies 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. (0103-705 or two economics courses, one in microeconomics and one in macroeconomics with a grade of B or better.) **Credit 4**

0103-712 **Macroeconomics**

This is an intermediate macroeconomics course with a focus on the global environment. A framework of product and money market equilibrium is developed that recognizes all economies are linked through international markets for goods, services and capital. Open-economy models *are* developed to explain economic growth, inflation, interest rates, foreign exchange rates and trade balances. (0103-705 or two economics courses, one in microeconomics and one in macroeconomics with a grade of B or better) **Credit 4**

0103-716 **Seminar in Economics**

Special topics seminars offer an in-depth examination of current events, issues and problems unique to economics. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit 4**

Finance

0104-721 **Financial Analysis for Managers**

An examination of basic financial theories, techniques, and practices. Topics include: time value of money, valuation, capital asset pricing, risk and diversification, cost of capital, capital budgeting techniques. (0101-703, pre- or corequisite 0106-782) **Credit 4**

0104-722 **Financial Management II**

This advanced course in corporate finance focuses on financing policies, financial planning/control, and other advanced corporate topics. Specific topics include the financing process, alternative financing instruments, restructuring, cost of capital, corporate applications involving options, working capital management and the use of financial budgets/forecasts. (0104-721) **Credit 4**

0104-724 **Problems in Corporate Finance**

This course is designed to give the student greater in-depth understanding of contemporary problems in finance. The focus will be on state-of-the-art techniques of corporate financial management from both a theoretical and practical perspective. Examples of specific topics include: working capital management, capital asset acquisition, capital structure, financial analysis, dividend policy, financial strategy and special topics. The case approach will be the primary method of instruction. The emphasis will be on the analytical and decision making techniques used to develop acceptable solutions. (0104-721, 0101-722) **Credit 4**

0104-725 **Securities and Investment Analysis**

Study of securities and other investment media and their markets. Analysis of investment values based on fundamental analytic procedures, technical analytic procedures, and the impact that modern portfolio theory has on the value of financial assets. Topics include return, growth, risk, accounting procedures, tax considerations and the impact of various institutional arrangements on value determination. (0104-721) **Credit 4**

0104-729 **Seminar in Finance**

Special topics seminars offer an in-depth examination of current events, issues and problems unique to finance. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit 4**

0104-730 **Financial Institutions and Markets**

An examination of the role of financial intermediation in the economy. The existence of regulations and the expanding level of competition among intermediaries are discussed. The importance of interest rate risk and hedging such risk is extensively covered. Topics include regulatory laws, gap analysis, hedging duration gap exposure, bank performance, pension funds, insurance companies and mutual funds. (0104-721) **Credit 4**

0104-732 **Portfolio Management**

This course extends the knowledge of risk and return in a portfolio context to active portfolio management. The measurement and evaluation of portfolio performance are analyzed. The importance of asset allocations, international diversification and pension fund management and the use of a wide range of derivative securities to manage risk are explored. (0104-721) **Credit 4**

0104-734 **Working Capital Management**

This course is an examination of the management of current assets and current liabilities. Emphasis is placed upon cash and marketable securities management, cash budgeting, inventory control, accounts receivable management, and short-term and intermediate-term financing. (0104-721) **Credit 4**

0104-735 **Valuing Private Enterprise**

This course revises and extends valuation models for publicly held firms and applies them, with appropriate modification, to private firms. Such methods are useful for valuing new entrepreneurial ventures as well as subsidiaries of public firms. This is a hands-on course where students perform multiple real-world exercises using Economic Value Added (EVA), Market Value Assets (MVA), and Discounted Cash Flow (DCF) as well as hybrid valuation techniques. (0104-721) **Credit 4**

0104-740 **Options and Futures**

This course focuses on financial derivative securities. Their role in financial management is becoming increasingly important, especially in portfolio management. This course covers valuation of various options and futures as well as their use in risk management. Specific topics include option and futures pricing models, option strategies and contemporary topics such as index arbitraging. (0104-721) **Credit 4**

0104-760 **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. (Corequisite 0104-721) **Credit 4**

Marketing

0105-758 **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 interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. Prerequisites will vary according to topic. **Credit 4**

0105-761 **Marketing Concepts**

A graduate level introduction to the marketing function, its roles in assessing customer satisfaction, its relationship to finance and manufacturing, and its utilization of quantitative and qualitative management tools. Focus is on the strengths and limitations of using the marketing concept in understanding and resolving end user concerns in profit and nonprofit environments. The course is structured around the managerially controllable elements of product, price, promotion and distribution, plus the interrelationships of these elements. **Credit 4**

0105-762 **Advanced Marketing Management**

A course designed to give the student an in-depth knowledge of middle- and upper-level marketing problems and processes. Topics include the tools used by marketing managers in the development, implementation, and control of marketing plans and strategies. (0105-761) **Credit 4**

0105-763 **Buyer Behavior**
The course reviews the major theories that frame the understanding of both consumer (end-user) and business buying behavior. Topics include the buying decision process, the impact of emotion, product knowledge and product involvement on purchasing decisions. In addition, behavioral and social psychology perspectives will be discussed. Ail perspectives will be applied to designing marketing strategy. (0105-761) **Credit 4**

0105-764 **Channel Management**
This course involves a study of the elements and management of marketing channels. A marketing channel is viewed as an interorganizational 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 how institutions can effectively and efficiently transmit things of value from points of conception, extraction and/or production to points of value consumption. (0105-761, corequisite: one advanced marketing course; **Credit 4**

0105-765 **Professional Sales Management**
A critical examination of the activities functions, challenges and opportunities of the sales force manager. The sales management functions will be related to other sectors of the promotion mix as well as the remainder of the marketing mix. An examination of the long term selling process will provide a foundation for this course. (0105-761) **Credit 4**

0105-766 **Marketing in a Global Environment**
This course has a specific focus on the international marketing challenges facing firms operating in developing and developed country markets. Topics will include an examination of the international environment and its impact on marketing decisions, international pricing and promotion, product-market entry and penetration strategies, and how to organize international marketing operations for maximum effectiveness. (0105-761) **Credit 4**

0105-767 **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 pían beginning with the marketing strategy and ending with implementation and evaluation. The project, in which the student plans and prepares a promotion/advertising campaign for a product or service in consultation with the instructor is an integral part of the course. (0105-761) **Credit 4**

0105-771 **Marketing Research Methods**
This course provides an overview of marketing research and 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. (0105-761, 0106-782 or equivalent) **Credit *4***

0105-772 **Internet Marketing: Strategy and Tactics**
This course examines the impact that the Internet has on traditional and contemporary business-to-consumer marketing activities. It explores these implications in both strategic and tactical terms to enhance organizations' levels of competitiveness. The course identifies the use of the Internet in enhancing value for consumers and considers the leverage of: the latest technologies, trends, e-culture and innovation through the medium of the Internet. (0105-761) **Credit 4**

0105-773 **Database Marketing**
This course provides the student with the application of database management to the challenges of relationship marketing. The students will be taught datamining tools which they will use to conduct an analysis of a database and apply it to the design of a relationship marketing plan. (0105-761,0106-782) **Credit 4**

0105-775 **Business-to-Business E-Marketing**
The focus of this course is on the effective integration and coordination of various business to business marketing operations within the realm of e-commerce. The course explores from a marketing perspective factors critical to the success of e-business operations and examines the strategies and tactics that organizations can use to build and/or enhance their business to business relationships using electronic tools. (0105-761) **Credit 4**

0105-776 **Product and Brand Management**
An essential element of corporate success is the management of products and brands. Firms in both consumer and commercial industries often manage their marketing strategies and tactics through the activities of their product and brand managers. This course will examine the role of product and brand managers in the development and execution of strategies that deliver value to targeted customers and grow the business. The role of product and brand managers will be examined through all phases of the firm's product and brand life cycle. The course emphasizes the decisions that firms expect product and brand managers to make .to achieve market share and financial objectives. (0105-761) **Credit 4**

0105-777 **Commercializing 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 firmness 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. (0102-742) **Credit 4**

Decision Science

0106-066 **Graduate Math Review**
Two part graduate math course for students requiring review of basic algebra and statistics. Either or both parts may be required. Part I-Basic review of algebra Part 2-Basic review of statistics. **Credit 0**

0106-743 **Operations Management**
Study of the management of production and operations management. Encompasses both manufacturing and services. Topics include operations strategy; forecasting; work systems; inventory management; capacity and materials planning; JIT; supply chain management; international operations; quality management, quality control, and quality improvement; project management; and current issues. (0106-782 or equivalent) **Credit 4**

0106-744 **Project Management**
A study in the principles of project management and the application of various tools and techniques for project planning and control. This course focuses on the leadership role of the project manager, and the roles and responsibilities of the team members. Considerable emphasis is placed on statements of work and work breakdown structures. The course uses a combination of lecture/discussion, group exercises, and case studies. **Credit 4**

0106-745 **Quality Control and Improvement**
Study of total quality management (TQM), including Deming's philosophy, quality planning, quality cost principles, problem solving methods and tools, the use of statistical methods for quality control and improvement, supplier relations, reliability concepts, and recent developments in quality. The course focus is on the management and continuous improvement of quality and productivity in manufacturing and service organizations. (0106-782 or equivalent) **Credit 4**

0106-747 **Managing Manufacturing Resources**
This course focuses on the effective management of resources in manufacturing companies. Topics focus on: manufacturing strategy from a business perspective; business process improvement and change management; human resource management-current relationships/compensation, diversity, career management; risk management including how to identify and risk mitigation; value/supply chain management with strategic make/buy. (This course for MM&L degree program) **Credit 4**

0106-749 **Manufacturing Strategies and Tactics**
This course integrates the skills learned in operations management with the fundamental disciplines of accounting, financial, and marketing management. Key focuses in the course are manufacturing strategy, the creation and maintenance of a culture for continuous improvement, and the management of change. Manufacturing is investigated in a global context, including the foreign and domestic firms and the strategies and tactics employed by them. The viability of an economy without a manufacturing base is questioned. Teams develop, execute, and report on a manufacturing strategy audit. (0106-743 or equivalent) **Credit 4**

0106-760 **Managing the Supply Chain**
Supply chain management is about the management of material, information and cash flows from raw material to the ultimate customer. Fierce global competition and advanced information technology have forced companies to manage the supply chain to increase responsiveness to market dynamics. The course integrates the fundamental disciplines of operations, purchasing, inventory management, distribution, logistics, and marketing. This course provides students with the knowledge and tools necessary to develop, implement, and sustain strategies for effectively managing supply chain issues. (0106-743) **Credit 4**

0106-780 **Management Science**
This course develops and applies quantitative methods to solve business problems. Tools such as linear and integer programming, sensitivity analysis, simulation and risk analysis are explained. Applications with real and simulated business data are emphasized. (0106-782 or equivalent)

0106-782 **Statistical Analysis for Decision Making**
This is a course in applied statistics emphasizing 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, linear, multiple regression and model building methods. (Grad Math Review 0106-066 or equivalent statistics course) **Credit 4**

0106-795 **Seminar in Decision Science**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to decision sciences. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit 4**

Business Legal Studies

0110-730 **Business Legal Concepts**
This course provides an introduction to legal procedure and the substantive laws that govern businesses. The course explores the background and origin of the US legal system as well as its legal and regulatory agencies. Representative topics will include review of the U.S. Constitution and the U.S. court system, basics of civil and criminal procedures, torts, contracts, criminal law, bankruptcy, antitrust, intellectual property, business and consumer protection. **Credit 4**

O110-731 **Commercial Law**
Explores the impact of the Uniform Commercial Code on business operations. Emphasis on topics included on certified public accounting exam. Topics covered include sales, commercial paper, corporations, partnerships, joint ventures, sole proprietorships, bailment and agency. Topical cases and examples are used to help the student grasp the business implications of the law and its nomenclature. A research project on legal issues is an important aspect of this course. (0110-730 or equivalent) **Credit 4**

0110-740 **Legal Aspects of Electronic Commerce**
This course introduces the student to legal issues unique to electronic commerce. Utilizing legal research, writing and analytical skills, students will examine jurisdiction, e-contracts, forum selection, click on agreements, shrink wrap agreements, electronic transfers, work place privacy, torts and selected statutes such as the Digital Millennium Copyright Act. Students learn how to analyse the information researched; and communicate, in writing, the substantive and analytical findings in the appropriate legal format to advise a fictitious e-commerce business and solve its legal problems. (0110 730 or equivalent) **Credit 4**

0110-745 **Legal and Ethical Issues in Technology Intensive Environments**
The course confronts graduate students with a wide variety of legal and ethical issues in organizational environments that are technologically intensive, such as information technology and the life sciences. Impacts of intellectual property legislation and legal cases in national and international venues are investigated. Legal and social issues involving individual privacy are argued. This exposure to legal and ethical dilemmas is an important tool as the graduates encounter such situation throughout their careers. Coupled with technical proficiency the ability to deal with legal and ethical issues shapes professional successes and failures. Not available to students who have completed 0102-785 **Credit 4**

Management Information Systems

0112-710 **Information Systems Concepts**
This course is an introduction to the conceptual and theoretical foundations of management information systems and their role in modern organizations. The course will provide students with the concepts, tools, and techniques needed to understand and interpret information management issues, such as how to best incorporate information technology into an organization, from a managerial perspective. **Credit 4**

0112-720 **Information Systems Design**
This course provides students with fundamental knowledge and skills required for successful analysis of problems and opportunities and the design and implementation of information systems. Students are provided with knowledge and experience that will be useful in determining systems requirements and developing a logical design. (0112-710) **Credit 4**

0112-725 **Data Management**
This course discusses issues associated with data capture, organization, storage, extraction, and modeling for planned and ad hoc reporting. Enables student to model data by developing conceptual and semantic data models. Techniques taught for managing the design and development of large database systems including logical data models, concurrent processing, data distributions, database administration, data warehousing, data cleansing and data mining. (0112-710) **Credit 4**

0112-730 **Information Systems Consulting**
This course provides students with fundamental knowledge and skills required for information systems consulting. Topics covered include client relationship management, information systems requirements analysis, proposal development, scope negotiation, costing, knowledge acquisition and management, system design, solutions deployment and systems integration, outsourcing and change management. (0112-720) **Credit 4**

0112-735 **Network Technologies**
This course is designed to give students basic knowledge of the networking strategies that are utilized within the corporate IS environment. Emphasis is on the current trends in local area networking as they relate to business needs. Class sessions are composed of lectures and discussions. (0112-710) **Credit 4**

0112-745 **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 4**

0112-755 **Information Systems Management**
This course involves the study of information systems (IS) management and focuses on issues and problems faced by managers of information technology. Topics include information systems planning, computer integrated manufacturing, systems development, establishment of IS standards, e-business, and other management principles relevant to IS. The course utilizes Harvard cases and research papers to illustrate important concepts. 0112-710) **Credit 4**

0112-760 **Integrated Business Systems**
This course focuses on basic concepts and technologies associated with integrated enterprise-wide business information systems. It includes a small amount of hands-on experience with the navigation of the SAP R/3 system. Topics include an overview of Enterprise Resource Planning (ERP) systems, the concepts and technologies required to integrate the systems of large business organizations, and implementation issues associated with integrated business systems. (Familiarity with MS Office Suite and Internet browsers) **Credit *4***

0112-761 **Business Process Analysis and Workflow Design**
Everyone who works in any organization is involved in a process. This course is about the evaluation, design, and, where possible and useful, automation of processes in organizations. Approaches to analyzing and designing processes are covered as well as the use of graphic modeling techniques that will allow for clear and simple definition of processes. Systems used for automating process workflow will be introduced and hands-on use of *SAP's* R/3 workflow application will be introduced. (Familiarity with MS Office Suite and Internet browsers) **Credit 4**

0112-795 **Seminar in Management Information System**
Special topics seminars offer an in-depth examination of current events, issues and problems unique to MIS. Specific topics will vary depending upon student and faculty interests and on recent events in the business world. Seminar topics for a specific quarter will be announced prior to the course offering. These seminars may be repeated for credit since topics will normally vary from quarter to quarter. **Credit 4**

B. Thomas Golisano College of Computing and Information Sciences

www.rit.edu/~gccis/

Jorge L. Diaz-Herrera, Ph.D., Dean

Established in the summer of 2001, the B. Thomas Golisano College of Computing and Information Sciences is the newest college at RIT. Included in the college are the departments of computer science; information technology; software engineering; networking, security, and systems administration; and the Center for Advancing the Study of Cyber-infrastructure. With its focus on both interdepartmental and inter-college cooperation the college addresses computing in the broadest sense. GCCIS has 90 faculty, 2,700 students, more than 40 technical and support staff, and extensive facilities dedicated to teaching, research, and development.

The college offers master of science degrees in computer science, information technology, software development and management, computer security and information assurance as well as an advanced certificate in interactive multimedia development. In addition, several new and innovative programs have recently been added: a master of science in learning and knowledge management systems, an advanced certificate in learning and knowledge management, and a doctor of philosophy in computing and information sciences. These programs offer the most current computing technologies and are supported by extensive laboratory facilities. Courses are available during the day and evening, allowing full-or part-time study. The MS degrees in software development and management, learning and knowledge management, and portions of the information technology program are also offered in online learning format. The advanced certificate in learning and knowledge management is offered online.

With degree programs in computing at the doctoral-, masters- and bachelors-level, GCCIS is one of the most comprehensive computing colleges in the United States. The Center for Advancing the Study of Cyberinfrastructure is a creative facility in which students and faculty can collaborate on inter-disciplinary research that investigates the role of computing in the advancement of science and engineering. With comprehensive programs across the computing and information science spectrum, we are addressing the need for inter-disciplinary computing experts in today's society.

The recent additions of MS degrees in computer security and information assurance and in learning and knowledge management along with the new doctorate in computing and information sciences position GCCIS to become a national leader in the computing disciplines. These programs address the growing need for experts in the fields of knowledge asset creation, computer security, and network management.

Programs

Master of Science degrees in:

Advanced Certificates in:

Doctor of Philosophy degree in:

**This program is pending approval by the New York State Department of Education*

= Online learning option available

Several other graduate degree programs are under development at this time. Software engineering, game design and development, and networking and systems administration are pending approval with a projected start date of fall, 2006. *Please note these are projected start dates only and pending approval by the New York State Department of Education. Information regarding these programs is subject to change without notice.*

Faculty

Any academic department or program can be only as strong as its faculty. The GCCIS faculty is dedicated to teaching, applied research, and professional development, with an emphasis on student involvement and career preparation. Most have significant industrial experience in addition to outstanding academic credentials. Faculty members provide leadership in implementing innovative teaching techniques and in anticipating and meeting the needs of students and our industrial partners.

Resources

The highly technical nature of the GCCIS programs demands excellent facilities and equipment. Each department has extensive laboratories containing powerful PCs and workstations and appropriate, up-to-date software. Labs are available to students 16–18 hours a day, except when being used for designated courses. Network, wireless, and high speed internet access are also available, insuring that our students have the tools necessary to complete their assignments and projects.

To provide space for this equipment, a 126,000 square-foot building was completed in 2003. This allows for both general-use and specialized labs, such as networking, security, entertainment technology, human-computer interaction, and computer vision. The close proximity of the academic departments in the college encourages joint projects as well as interaction among students in different programs. Equipped with over 1,500 computer work stations, and over 50 classrooms, labs, and studio labs, all with the latest technology, the college prides itself on having the very best for its students.

Financial aid

Scholarships and graduate assistantships are available in each department. Details can be obtained from the departmental graduate program coordinator.

Cooperative education

An optional cooperative educational experience (co-op) is available for those MS students who wish to participate, in order to gain industrial experience. Students register for a zero-credit graduate cooperative education course at no cost. The Office of Cooperative Education and Career Services will help students find a co-op position, but students may find positions on their own. Normally, students should have completed at least two-thirds of the course work before finding a co-op position.

Additional information

Additional information may be obtained by contacting:

B. Thomas Golisano College of Computing and Information Sciences
Rochester Institute of Technology
20 Lomb Memorial Drive
Rochester, NY 14623-5608
(585) 475-7203
http://www.rit.edu/~gccis

College-Wide Programs

Our college-wide programs are intradisciplinary in nature, encompassing fundamental concepts across the entire discipline of computing and information sciences. The curriculums in these programs require the expertise and collaboration of all departments in GCCIS, enabling students to consult and engage with faculty from the entire college.

Master of Science in Computer Security and Information Assurance

Hans-Peter Bischof, Ph. D., Coordinator
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www.rit.edu/~gccis/graduate/security

Developers and practitioners need to understand the importance of building security and survivability into systems, rather than trying to add it once systems are installed. This curriculum addresses these concerns by drawing on the expertise of the faculty from the four departments that make up the B. Thomas Golisano College of Computing and Information Sciences: computer science; information technology; networks, security and system administration; and software engineering.

The MS in computing security and information assurance contains a group of seven core courses that provide a common foundation. The core courses are designed to give students a better understanding of the technological as well as the ethical role of computer security in society. Students then develop a specialization in one of several areas by selecting four related elective courses under the guidance of a faculty adviser. Students conclude their program of study through the successful completion of a thesis under the guidance of a faculty mentor. This cross-disciplinary program enables graduates to develop a strong foundation preparing them for leadership positions in both the private and public sectors in the computer security industry or for an advanced degree. Students can also prepare for academic or research careers in computer security and information assurance as well as further academic study.

Faculty members in the department are actively engaged in consulting and research in the information assurance areas, including cryptography, databases, networking, and software engineering. There are many opportunities for graduate

students to participate in these research activities for thesis or independent study work.

Computing facilities

The computing facilities of GCCIS are driven by curricular and research based needs. The college computing facilities are connected to the gigabit RIT campus backbone with an OC3 connection to the Internet. Students have access to our facilities from off-campus locations. Institutional facilities provide a location for students to develop their own presence on the Web. In national surveys, RIT's has consistently ranked among the top 20 most wired colleges campuses.

The following computing laboratories are available to support students pursuing this degree. They are equipped with the latest hardware and software technology.

- Sixteen studio laboratories designed to increase student-instructor interaction. These labs support formal, closed lecture/laboratory instruction and can accommodate 16 to 40 students in a class. Five of these are equipped with heavy-duty Sun Blade workstations while the rest are equipped with up-to-date, high-capacity PCs.
- A networking and distributing systems laboratory focuses on the study of data communications and networking strategies, utilizing a variety of Sun workstations and file servers as networking tools.
- A network laboratory focuses on the physical set-up, configuration, and analysis of various internetworking devices, including the Internet. There are 60 computers organized into 20 work areas.
- A systems administration laboratory focuses on the installation, configuration, and management of various network services and resources. It includes 80 computers organized into 20 work areas.
- Two security laboratories support all topics in networking and systems security. One is equipped with 48 PCs, organized into 25 work areas, and the other is equipped with a variety of minicomputer workstations, organized into 10 areas.
- A projects lab supports all wireless, network trouble-shooting, and network management curriculum with a wide variety of equipment. There are 54 computers organized into 18 work areas.
- A network programming and scripting lab supports all programming and scripting requirements of the security and network curricula. The lab accommodates up to 32 students.
- Three general-purpose laboratories are open daily, including weekends, and are available to all GCCIS majors, as well as those from other programs who are registered in one of our courses. One is a mini-computer Sun work-station lab with 28 stations while the other two are micro-computer laboratories with 40 stations and 116 respectively.
- A graduate laboratory for use by students in graduate programs.
- Eleven student team rooms equipped with generous white-board space, a meeting table, and comfortable seating for six. Each team room has one workstation plus six Ethernet connections. Six of the rooms are equipped with computer-ready ceiling-mounted projectors that can be used to rehearse presentations or increase team productivity during meetings.
- A lab for real-time and embedded systems. Computing today is not restricted to devices that look like computers. Printers and fax machines, cellular phones, and life-support systems are examples of systems that could not operate without reliable software. A $250,000 NSF grant was awarded to equip this lab with the latest technology. This lab has capacity for 25 students.
- Three research laboratories dedicated to the areas of artificial intelligence, computational vision and acustics, data mining, robotics, and wireless networks. They range in size from 12 to 15 stations.
- Three database studio laboratories are equipped with VMware and special database software and servers to support database curricula and research. The largest has 60 computers organized into 20 to 35 areas, depending on purpose. The other two laboratories have approximately 40 computers and can seat from 24 to 35 students.

Computer security and information assurance students also have access to computers, relevant information technology labs (PCs and Macs), and RIT's main Information Technology Services facilities, as listed in the Student Services section of this bulletin.

These graduate networks are also available to support departmental research, theses, projects, and course work. All students have full access to the Internet and the World Wide Web.

General information

The MS in computing security and information assurance is designed for students who have an undergraduate degree in computer science, information technology, or software engineering, as well as those who have a strong background in a field in which computers are applied, such as computer or electrical engineering.

Computing security and information assurance graduate courses are generally offered in the afternoon and evening. Some of our graduate students are employed and are pursuing the degree on a part-time basis. **A** full-time student, one who takes three courses per quarter, may be able to complete the course work in five quarters; part-time students can finish in two to four years. The time required to complete a master's thesis varies according to the student and the scope of the thesis; two quarters is typical.

Admission requirements

Because the program encompasses a wide variety of technical disciplines, students with diverse backgrounds are encouraged

to apply. Undergraduate preparation leading to a bachelor of science degree in computer science, software engineering, information technology, computer engineering, electrical engineering, applied mathematics, or computer engineering technology is usually required. However, exceptional students from other fields may be admitted on a contingent basis. Applicants should have a minimum grade point average of 3.0.

Applicants must have a strong record of academic achievement from their undergraduate institution, as indicated by official transcripts, proficiency on the Graduate Record Examination (GRE), and strong recommendations from at least two well-qualified individuals who are able to assess the student's potential for success in the program. It is expected that applicants will achieve at least the following scores on the GRE: 650 (quantitative), 500 (verbal), and 650 (analytical).

Applicants from foreign universities will be required to submit results of the Test of English as a Foreign Language (TOEFL). A minimum score of at least 570 (paper-based), or 230 (computer-based) is required.

Applicants must satisfy prerequisite requirements in mathematics and computing (listed below). If an applicant lacks any of these prerequisites, bridge program courses are available to allow students to achieve the required knowledge and skills. Generally, formal acceptance into the master's program is deferred until the applicant has made significant progress through these necessary courses.

Prerequisites

Mathematics

Integral Calculus
Discrete Mathematics

Computing

Experience with a modern high-level language (e.g., C++, Java)
Operating Systems
OS Scripting
Software Engineering

The bridge program

Students whose undergraduate preparation or industrial experience does not satisfy the above content may make up these deficiencies through up to a year of study, taking one or more of the following RIT courses, as prescribed by the graduate coordinator.

Mathematics

1016-281, 282	Calculus
1016-265	Discrete Math I

Computing

4003-707	Advanced Programming
4003-713	Operating Systems
4002-402	OS Scripting
4010-361	Software Engineering

If any bridge courses are indicated in a student's plan of study, the student may be admitted on the condition that he or she will successfully complete the bridge program courses with a grade of "B" or better in order to be fully accepted into the program. All remaining bridge program courses must be completed with a grade of at least "B"; courses with lower grades must be repeated. Bridge program courses are not part of the 49 credits required for the master's degree. These grades are not included in a student's graduate grade point average.

A bridge program can be designed in ways different from that described above. Often, other courses can be substituted, and courses at other colleges can be applied. (See the Computing Security and Information Assurance Graduate Studies Handbook for more details.) All programs must be approved in advance by the program chair.

Curriculum

The graduate program of study is composed of core courses, electives, and a thesis, for a total of 49 credits. The thesis track consists of:

- Seven required "core" courses (26 credits)
- Electives (16 credits)
- Master's thesis (7 credits)

The computing security and information assurance core consists of seven courses:

4005-755	Secure Wireless and Wired Data Networks
4002-780	Computer System Security
4005-705	Cryptography I
4005-779	Secure Database Systems Seminar
4010-710	Research Methods
4010-748	Secure Software Engineering: Requirements and Design
4005-893	Ethics in Technology or
4002-890	Information Security Law, Ethics and Policy

A subset of electives is shown below:

4002-760	Computer Viruses and Malicious Software
4002-841	Advanced Forensics
4002-877	Secure e-Commerce
4002-882	Enterprise Security
4005-709	Cryptography II Seminar
4005-740	Data Communications and Networks I
4005-741	Data Communication and Networks II
4005-743	Secure Operating Systems and Networks
4005-749	Server-less Network Security Seminar
4005-759	Information Assurance Seminar
4005-759	Data Mining Seminar
4005-800	Theory of Computer Algorithms
4010-758	Secure Software Engineering: Verification and Validation Seminar
4005-774	Secure Database Systems
4005-784	Privacy and Security Seminar
	Special Topics
	Independent Study

Students also may include elective courses from other RIT departments' graduate offerings. Other departments' courses are primarily for their own majors and may have prerequisites that will not be approved for degree credit.

Electives provide breadth of experience in security-related areas within computer science, information technology, and software engineering. Students who wish to include courses

from departments outside of the list of electives need prior approval of the graduate coordinator.

A program of study must be designed in cooperation with the graduate coordinator.

The master's thesis

A thesis paper forms the capstone of this MS program. In order to register, a student must complete Research Methods and submit an acceptable proposal to the computing security and information assurance faculty.

Requirements for the degree must be completed within seven years of the date of the oldest course counted toward the student's program. Bridge courses are excluded.

Master of Science in Game Design and Development*

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The master of science in game design and development defines a program of study that allows students to explore the entertainment technology landscape as well as other related areas. The program focuses its technical roots in the computing and information sciences disciplines, while simultaneously covering the breadth of the development landscape through involvement in topics such as computer graphics design, human-computer interaction, interactive narrative, and game world design. The degree is intended specifically for students that aspire to hold careers within the professional games industry or a related field such as simulation, edutainment, or visualization.

The program is a two year, cohort-based program in which students are admitted through a portfolio review process and subsequently pursue a "major" sequence of six courses to guarantee depth within a specialization area relative to game development, and a "minor" of three courses specifically outside their major area of study. In addition, all students will complete a seminar track of five courses within the program that ties students specializing in various majors together, and explores the overlap and interconnection of their work as well as providing a framework of understanding for the professional industry as a whole.

Upon completion of their coursework, students are organized into development teams that will construct a working game engine and software title as a capstone experience, with both individual and group requirements. The capstone experience culminates in a private defense before program faculty as well as a public exhibition. The capstone project, the focus on team-based collaborative development, the seminar track on industry issues, and the applied nature of the coursework all work together to provide a comprehensive treatment of the subject.

Admission requirements

Admission to the program is highly competitive. In addition, students are only admitted to the fall quarter, due to the cohort nature of the program. Prospective students will be expected to have an undergraduate degree in a relevant field, such as computer science, software engineering, information technology, or computer graphics. Students with undergraduate degrees in related disciplines such as computer animation or human computer interaction may also be considered. Admissions will be based on their performance in their undergraduate degree program as well as by portfolio examination. The portfolio will include both individual and group projects in the area in which they wish to study within the degree program. Prospective students are encouraged to include examples of game construction activities as part of their portfolios. Applicants to the program are required to take the GRE exam if their undergraduate or highest related graduate degree is under a 3.00 GPA on a 4.00 scale. Applicants will be selected in a manner to ensure balance among the various tracks and specialties.

For international students who have not received an undergraduate degree at an English-speaking institution, the TOEFL test is required. For applicants submitting the TOEFL exam, students must have a minimum score of 230 (computer-based), 570 (paper-based), or 88 (Internet-based).

Prerequisites

Admission to the program is considered to be the prerequisite for the first quarter coursework.

Curriculum

All students will choose to complete a major of six courses for depth, in either game engine development or artificial intelligence and simulation:

Game Engine Development Major Sequence	Qtr. Cr. Hrs.
4005-761 Computer Graphics I	4
4005-762 Computer Graphics II	4
4002-734 2D Graphics Programming	4
4002-735 3D Graphics Programming	4
4005-763 Computer Animation: Algorithms and Techniques	4
4002-836 Game Engine Design and Development	4

Artificial Intelligence and Simulation Major Sequence	Qtr. Cr. Hrs.
4005-750 Introduction to Artificial Intelligence	4
4002-791 Artificial Life and Evolutionary Simulation	4
4005-752 Artificial Intelligence for Interactive Environments	4
4005-759 Topics in Artificial Intelligence	4
4005-756 Genetic Algorithms	4
4005-855 Neural Networks and Machine Learning	4

All students are required to complete a minor of three courses for breadth, in one of: Asset Creation and Management, Content Authoring for Games, Human Computer Interaction, Database Architecture and Design, by choosing a minor out of a major above, or through a request for special topics approved by the program faculty.

Asset Creation and Management	Qtr. Cr. Hrs.
(Student must take 2001-721 3DCG Modeling + any two additional courses from the remaining six)	
2001-721 3DCG Modeling	4
2001-722 3DCG Interactive Animation	4
2001-732 3DCG Shading	4
2001-747 3DCG Rendering, Output and Prototyping	4
2001-731 3DCG Lighting	4
2001-743 3DCG Character Design	4
2001-787 3DCG Production Pipeline	4

Content Authoring For Games	Qtr. Cr. Hrs.
4004-728 Interactive Narrative for Games	4
4004-732 Game World Design	4
4004-744 Building Online Communities	4

Human Computer Interaction	Qtr. Cr. Hrs.
4004-745 Foundations of HCI	4
4004-748 Usability Engineering	4
4004-749 Usability Testing	4

Database Architecture and Design	Qtr. Cr. Hrs.
4004-720 Data Object Development	4
4004-784 Multi-Client Database Implementation	4
4004-785 Fundamentals of DBMS Architecture and Implementation	4

All students are required to complete the game design and development seminar sequence - a series of five courses designed to bring students of various cohorts together to identify overlap around industry issues:

Game Design and Development Seminar Sequence	Qtr. Cr. Hrs.
4004-731 History and Critical Analysis of Computer Games and Interactive Entertainment	4
4004-734 Online Identity, Social and Community Behavior	4
4002-790 Emerging Themes in Entertainment Technology	4
4002-792 Development Processes in the Games Industry	4
4002-793 Business and Legal Aspects of Game Development	4

Finally, all students in the program are required to complete a 20-week capstone experience in the second year of the program, during the winter and spring quarters. Students are expected to work full-time on this activity during the spring. At the end of the spring quarter, all students undertaking such activity are required to present at the end-of-quarter show. This show has two distinct components: a private faculty review, which should be regarded as a thesis defense, and a public demonstration and presentation.

Game Design and Development Capstone Experience	Qtr. Cr. Hrs.
4002-887 Capstone Design	4
4002-888 Capstone Development	2

This program is pending approval by the New York State Department of Education.

Doctor of Philosophy in Computing and Information Sciences

Evelyn Rozanski, Ph. D., Interim Associate Dean for Graduate Studies and Research
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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 B. Thomas Golisano College of Computing and Information Sciences: the breadth of its program offerings and its scholarly focus on discovering solutions to real-world problems by balancing theory and practice. The doctoral curriculum facilitates and maintains intra- and inter-disciplinary collaboration among students and faculty across various disciplines within the college and RIT.

The intradisciplinary scope encompasses fundamental concepts across the entire discipline of computing and information sciences. These components are grouped into three knowledge specialty areas: *interaction, infrastructure,* and *informatics.*

Interaction is the combined action of two or more entities (human or computational) that both affect one another and work together when facilitated by technology. Interaction in turn encompasses several subtopics relating to how people and technology interact and interface. There are several common threads that weave through all of the areas, many of them relying heavily and building upon foundations in the social, cognitive, and behavioral sciences with an emphasis on understanding human phenomena and social/organizational phenomena. To some extent, these fields follow an engineering approach to the design of interactions in which solutions are based on rules and principles derived from research and practice. 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, and creative design and sensitivity to human needs and aesthetics are critical.

Infrastructure is 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. It includes, on the hardware side, system-level design (e.g., for system-on-a-chip solutions) and their building block components. One perspective 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 project estimation, tracking, and oversight. The communications perspective includes sensor networks and protocols, as well as active networks, wireless networks, mobile networks, configurable networks, and high speed networks; as well as, network security and privacy, quality of service, reliability, service discovery, and integration and interworking across heterogeneous networks. At the system level there are issues related to conformance and certification; system dependability, fault tolerance, verifiable adaptability, and reconfigurable systems; and real-time, self-adaptive, self-organizing, autonomic systems.

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 primarily 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.

The **interdisciplinary** context means that the doctoral program also focuses on the interaction between computing and non-computing disciplines, or areas of *domain-specific computing,* in science, engineering, arts, humanities, and business. By incorporating *domain-specific computing,* following the philosophy of use-inspired research, the research conducted in this program will apply computing and information science principles to the solution of multidisciplinary problems in application domains that lie outside of the scope of the traditional computing discipline. A major focus of this research will be the development of coherent, domain-specific computing environments collectively known as cyberinfrastructure. The research requirement will incorporate fundamental concepts in cyberinfrastructure necessary for understanding the problems commonly encountered in advancing scientific discovery and product development in cross-disciplinary domains.

Admission requirements

Admission to the doctoral program in computing and information sciences is highly competitive and successful applicants will, in general, have records considerably stronger in breadth or quality than the minimum standards suggest. Applicants should also be aware that meeting the requirements does not guarantee admission.

Applicants will be evaluated on the basis of their prior academic record and their potential for creative research. Admissions decisions are made by the program's admissions committee, which is comprised of the faculty members of the program. Decisions will generally be made in the winter for admission to the fall quarter.

Minimum requirements for consideration include:

- A baccalaureate degree or its recognized equivalent. Since the doctoral program in computing and information sciences encompasses a wide variety of disciplines, RIT seeks students with diverse backgrounds. While most students will come from a computing-related discipline, students in engineering, science, the humanities, fine arts, business, and other disciplines along with computing backgrounds are encouraged to apply.
- A strong record of academic achievement as indicated by official transcripts.
- One full year of study in programming and computing concepts. More advanced computing courses are desirable.
- Mathematical skills equivalent to college-level courses in discrete mathematics, and probability and statistics.
- Recent results (within five years) of the Graduate Record Examination (GRE).
- Recommendations from at least two individuals who are well-qualified to assess the student's potential for success in a doctoral program.
- Writing samples, preferably professional writing or research papers, if available.
- A written statement defining the student's research interests.
- A current resume, if applicable.
- An optional portfolio of previous work.
- Results of the Test of English as a Foreign Language (TOEFL) for students for whom English is not their native language. Paper-, computer-, Internet-based tests are acceptable.

In addition, an interview by one or more of the doctoral program faculty and/or admissions committee will be required for candidates considered for admission prior to final selection. This interview may be via telephone.

Assistantships, including tuition and stipend, are available and awarded on a competitive basis.

Students transferring into the program from a masters program in a computing and information sciences discipline, or in a related domain-specific discipline, may be granted up to 28 quarter-based credit hours towards the doctoral degree requirements. However, students are not eligible to earn an additional master's degree if the student already holds an MS degree in a computing and information sciences or related field from RIT or another university.

Curriculum

The program requires a minimum of 106 quarter-credit hours beyond the baccalaureate level. These credit hours are comprised of graduate-level coursework, including seminar attendance and research credits.

Core courses (20 quarter credit hours):

4040-810	Research Methods
4040-820	Discovery
4040-830	Connectivity
4040-840	Security and Trust
4040-850	Design

Specialization courses (20 quarter credit hours) in two of the three specialty areas (interaction, infrastructure, informatics).

The interaction sub-core courses are grouped into the following topic areas:

Human-Computer Interaction - Courses in this area will allow students to conduct research into the cognitive and

behavioral aspects of human interactions with computers, devices, and environments.

4004-745 Foundations of Human-computer Interaction
4004-748 Usability Engineering
4004-749 Usability Testing
4004-755 Advanced Topics in HCI
4002-765 User-centered Design Methods
4002-892 CSCW and Groupware

Computer-Based Instructional Systems - Courses in this area will allow students to conduct research on the effectiveness of instructional systems and be involved in the development and evaluation of new instructional tools.

4002-723 Interactive Courseware
4002-820 Simulations and Learning Environments
4002-828 Intelligent Computer Based Instruction
4002-812 Knowledge and Content Obiects
4002-728 Models of Human Performance
4002-845 Economics of Human Performance

The infrastructure sub-core courses are grouped into the following topic areas:

Networks and Security - Courses in this area provide in-depth study in design, modeling, and implementation in the security-related and performance analysis aspects of data and communication networks.

0306-710 Network Design, Modeling and Simulation
4002-817 Emerging Network Technologies
4005-742 Ad-hoc Networks
4002-755 Secure Wireless and Wired Data Networks
4005-743 Secure Operating Systems and Networks
0306-772 Wireless Networks
4002-760 Computer Viruses and Malicious Software
4002-780 Computer System Security
4002-841 Advanced Computer Forensics
4002-882 Enterprise Security

Digital Systems and VLSI - Courses in this area cover the design, modeling, and evaluation of modern computing systems, including hardware, software, and their integration.

0306-756 Multiple Processor Systems
0306-722 Advanced Computer Architecture
0306-772 Embedded and Real-time Systems
0306-731 VLSl Design Projects
0306-772 Advanced Digital Modeling
0301-730 Advanced Analog IC Design
0301-726 Mixed Signal IC Design
4005-730 Distributed Systems I

The informatics sub-core courses are grouped into the following topic areas:

Core Informatics - Courses in this area cover the increased complexity of managing vast amounts of data.

4005-700 Foundations of Computing Theory
4005-709 Combinatorial Computing
0301-794 Information Theory
4005-704 Complexity Theory
4005-705 Cryptography
4005-780 Computer System Security
4005-735 Parallel Computing
4010-750 Software Modeling
4005-800 Theory of Computer Algorithms

Discovery Informatics - Course in this area study the closely related problems of data management, knowledge discovery, and pattern recognition.

4005-771 Database Systems
4005-759 Data Mining
4005-759 Database Management Concepts
4005-772 Database Systems Implementation
4005-779 Secure Database Systems

Intelligent Systems - Courses in this area focus on developing models that are biologically inspired and that leverage current knowledge in cognitive science, neuroscience, computer science, and engineering with the goal of developing systems that understand a given environment.

4005-750 Introduction to Artificial Intelligence
4005-759 Biologically Inspired Intelligent Systems
4005-755 Neural Networks and Machine Learning
0301-770 Pattern Recognition
4005-757 Introduction to Computer Vision
4005-759 Advanced Computer Vision

Cross-disciplinary domain course (12 quarter credit hours) in an area directly related to the student's research project.

Collaborative Practicum (eight quarter credit hours) is a collaborative, multidisciplinary team project where students will be able to demonstrate their problem-solving abilities and their capabilities to apply knowledge and technology in innovative ways.

Advanced Electives (eight quarter credit hours), with adviser approval, are designed to further a specialty or cross-disciplinary domain area.

Student Research Seminar (one quarter credit hour for *6* quarters) where research and communication skills will be further cultivated.

Dissertation (32 quarter credit hours) where students will be required to conduct original, use-inspired research involving two of the three knowledge areas of interaction, informatics, and infrastructure, and applied them to a domain.

Additional program requirements

- Participation in the cyberinfrastructure colloquium. Best practices in collaborative cross-disciplinary research and in communications will be developed and exemplified in a cyberinfrastructure colloquium, which will be open to all students and faculty.
- Each student must pass four examinations in the following order:
  - Breadth assessment after the core coursework
  - Depth assessment after the specialization coursework
  - Thesis proposal defense (committee approval) after the thesis proposal is written
- Dissertation defense after all coursework, research, and the first three assessments have been successfully completed and the dissertation written

- Two years of full-time residency (minimum of nine quarter credit hours per quarter for six consecutive quarters, not including the summer quarter) and registration each quarter of their residency for the research seminar course.
- Teaching requirement, supported by a teaching mentorship.
- Students working on funded research projects will be required to be available during the day for project commitments.

Requirements for the degree must be completed within seven years of the date of the oldest course counted toward the student's program.

Networking, Security and Systems Administration Department

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The MS in networking and systems administration recognizes two potentially opposing trends currently at work in industry. One trend is for a reduction in staffing levels and increased calls for efficiency and management oversight in the provision of IT services. The opposing trend is for increasingly complex network environments, and a greater recognition of the power of IT to be a strategic enabler of corporate adaptation. These trends can only co-exist through a reliance on a highly educated and technologically proficient networking, security and system administration staff that understands both the technology and the application of that technology to business issues and opportunities. The proposed MS program is designed to provide students with the educational background and skills to compete successfully in this environment. Additionally, two graduate certificates, one in networking and system administration and the other in computer and network system security, are under development.

Laboratory facilities

Most NSSA courses are laboratory-based. The computing facilities of the networking, security and systems administration department are driven solely by curricular needs. We focus the computers and networks in our labs around the needs of our students, who use these facilities to investigate concepts, and to design and develop systems to meet the needs of the ever-evolving information age. Many of our students also work as lab assistants or graduate assistants, adding an additional practical dimension to their educational experiences.

The five labs supporting NSSA curriculum are:

- Projects Lab
- NetLab
- SysLab
- Telephony Integration and Real Time Data Lad
- Security Lab

Master of Science in Networking and Systems Administration*

Luther Troell, Chair
(585) 475-6479, Luther.Troell@rit.edu

The master of science degree in networking and systems administration enables the matriculated student to study, develop, and become proficient in the practices, methodologies, and techniques in the management of a modern IT infrastructure. The focus is on enterprise-level problems and solutions, addressing the needs of a medium- to large-scale organization.

The underlying principle of this program is that effective technical leadership in modern enterprises relies on a combination of technical knowledge with an understanding of basic business concepts. This program is designed for part-time study at a distance (online learning), as well as full-time on campus education.

Admission requirements

Applicants should have a baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 3.0 (a "B" average). Applicants must submit two professional recommendations.

Applicants from foreign universities must submit Graduate Record Examination (GRE) scores. The GRE score is also recommended for those whose undergraduate grade point average is less than 3.0. Visa forms cannot be issued by RIT for part-time or distance education.

Applicants whose native language is not English must take the TOEFL examination; a minimum score of 570 (paper-based) or 230 (computer-based) is 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.

Prerequisites

Students wishing to enter the master's program must have a solid educational or employment record in networking, security and systems administration. If a student does not have the necessary background, bridge courses are provided to allow students to meet these prerequisites. Formal acceptance into the master's program may be possible even though the applicant must complete bridge program courses.

The bridge program

Students whose undergraduate preparation or industrial experience does not satisfy the technical prerequisites of this degree can make up this deficiency through study, taking one or more of the following RIT courses, as prescribed by the graduate program coordinator.

Technical prerequisites

4055-716	C++ for System Administration
4055-721	PERL for System Administration
4055-761	Principles of System Administration
4055-746	Telecommunications Network Protocols

The bridge program courses are not part of the 48 quarter credits required for the master's degree. Grades for bridge courses are not included in a student's graduate GPA if the courses are taken before matriculation; courses are included if that are competed after matriculation.

A bridge program 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 coordinator for approval.

The curriculum

The graduate program of study consists of 12 courses (48 quarter credit hours), which include eight courses (32 quarter credit hours) of required core courses, plus another four courses (16 quarter credit hours) as electives from an approved set. Two quarters of optional cooperative work experience are possible.

The NSSA core:

0102-740	Organizational Behavior and Leadership
0106-744	Proiect Management
4055-726	Research Methods
4055-817	Emerging Network Technologies
4055-850	Network Design and Performance
4055-863	Protocol Design and Implementation
4055-882	Enterprise Security
4055-897	MS Thesis

Electives must be chosen from the following set of courses:

0101-703	Accounting for Decision Makers
4055-755	Secured Wireless and Wired Networks
4055-760	Computer Viruses and Malicious Software
4055-780	Computer System Security
4055-818	Network Management
4055-841	Advanced Computer Forensics
4055-862	Advanced Routing Protocols
4055-883	Enterprise Networking
4055-884	Enterprise Service Provisioning

**This program is pending approval by the New York State Department of Education.*

Computer Science Department

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The MS program in computer science at RIT consists of a core curriculum, a wide variety of clusters, and many additional electives. The core provides students with a solid background in the theoretical principles underlying computer science, which ensures that graduates acquire the intellectual tools necessary to keep up-to-date in this rapidly evolving discipline. The clusters provide students with the opportunity to obtain depth in a computer science discipline. The electives add the necessary breadth of knowledge required by industry. This combination prepares our graduates to engineer modern computing systems and contribute in all aspects of the systems' life cycles. They can also prepare students for academic or research careers in computer science or a related discipline, as well as further academic study.

Clusters are offered in a variety of areas, such as computer graphics and visualization, database systems/data mining, distributed systems, intelligent systems, languages and tools, security, and theory. Certain pre-approved courses from other departments may also be counted toward the degree.

Faculty members in the department are actively engaged in consulting or research in the area of artificial intelligence, wireless networks, computer vision, computational combinatorics, and distributed computing systems. There are many opportunities for graduate students to participate in these activities for thesis or project work and independent study.

Related MS programs at RIT are computer engineering (College of Engineering) as well as information technology and software development and management (both in the department of information technology).

Computer facilities

The computer science department provides extensive facilities for students and faculty. The hardware associated with these facilities represents current technology, including:

- a graduate lab with 17 Sun Blade 150 workstations and a graduate library,
- more than 100 Sun Blade 150 workstations,
- a networking/distributed systems lab with 10 dual processor Pentiums and its own internal network, and
- specialized labs in vision, security, wireless networks, and artificial intelligence.

Computer science students also have access to the computers in the information technology labs (PCs and Macs) and RIT's main Information and Technology Services facilities, as listed in the Student Services section of this catalog.

Graduate students have Internet access and are encouraged to use home computers. (The RIT bookstore carries computer equipment and software, and provides discounts to RIT students.)

Master of Science in Computer Science

http://www.cs.rit.edu/masters/index.php

The MS in computer science is designed for students who have an undergraduate major 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. Students can concentrate in intelligent systems, languages and tools, distributed systems, security, theory, databases/data mining, or graphics.

Computer science graduate courses are generally offered in the afternoon and evening. Some of our graduate students are employed and are pursuing the degree on a part-time basis. A full-time student, one who takes three courses per quarter, may be able to complete the course work in one year; part-time students can finish in two to four years. The time required to complete a master's thesis or project varies according to the student and the scope of the project; two quarters is typical.

Admission requirements

Applicants should have a baccalaureate or an equivalent degree from an accredited institution and a minimum grade point average of 3.0 (B). RIT undergraduate students in computer science, computational math, biomedical computing, or computer 'engineering technology may study for both their BS and MS degrees through accelerated programs.

Applicants from foreign universities must submit TOEFL and Graduate Record Exam (GRE) score. (GRE scores also can be considered for applicants whose undergraduate grade point average is lower than 3.0.)

Applicants must satisfy prerequisite requirements in mathematics and computer science. If an applicant lacks any of these prerequisites, bridge program courses are available to allow students to achieve the required knowledge and skills. Generally, formal acceptance into the master's program is deferred until the applicant has made significant progress through these necessary courses.

Prerequisites

Mathematics

Differential and Integral Calculus
Probability and Statistics
Discrete Mathematics

Computing

Experience with a modern high-level language (e.g., C++, Java)
Data Structures
Assembly Language Programming
Software Design Methodology
Introductory Computer Architecture and Digital Logic
Operating Systems
Programming Language Concepts (including Lisp)

The bridge program

Students whose undergraduate preparation or industrial experience does not satisfy the above content or grade point requirements may make up these deficiencies through up to a year of study, taking one or more of the following RIT courses, as prescribed by the graduate coordinator.

Mathematics

1016-281, 282, 283	Calculus
1016-351	Probability and Statistics (Calculus-based)
1006-265	Discrete Mathematics

Computing

4003-231	Computer Science I
4003-232	Computer Science II
4003-233	Computer Science III
4003-334	Computer Science IV
or	
4003-236	Accelerated Computer Science I
4003-233	Computer Science III
4003-334	Computer Science IV
or	
4003-707	Advanced Programming
4003-334	Computer Science IV
and	
4003-710	Computer Organization
4003-709	Programming Language Concepts
4003-713	Operating Systems

If any bridge courses are indicated in a student's plan of study, the student may be admitted on the condition that he or she will successfully complete the bridge program courses with a grade of "B" or better in order to be fully accepted into the program. All remaining bridge program courses must be completed with a grade of at least "B"; courses with lower grades must be repeated. Although bridge program courses are not part of the 45 credits required for the master's degree, their grades are included in a student's graduate grade-point average unless the courses were taken before matriculation.

A bridge program can be designed in ways different from that described above. Often, other courses can be substituted, and courses at other colleges can be applied. (See the Computer Science Graduate Studies Handbook for more details.) All programs must be approved in advance by the graduate coordinator.

The curriculum

The graduate program of study consists of 45 credits. There are two tracks to the degree, the thesis track and the project track. The computer science core consists of three courses:

4005-700	Foundations of Computing Theory
4005-800	Theory of Computer Algorithms
4005-893	Graduate Seminar

The thesis track

- Four courses from a cluster (16 credits)
- Three electives (12 credits)
- Master's thesis (seven credits)

The project track

- Four courses from a cluster (16 credits)
- Four electives (16 credits)
- Master's project (three credits)

The topic of the project must be in the cluster domain. Only the graduate coordinator can approve an exception to this rule.

For either program, students with a strong background in a core area may receive permission from the graduate coordinator to replace a core course with another course, generally in the same area. Only the graduate coordinator can approve changes to a student's program of study.

Clusters and electives

The following clusters are available:

- Computer Graphics and Visualization
- Database Systems/Data Mining
- Distributed Systems
- Intelligent Systems
- Languages and Tools
- Security
- Theory

In addition, a student is allowed to design his or her own cluster, with the consent of an adviser and the graduate coordinator. A subset of electives and advanced electives is shown below; advanced electives are indicated by "†"

4005-704	Complexity and Computability
4005-705	Cryptography
4005-709	Combinatorial Computing
4005-709	Crytography II
4005-710	Programming Language Theory
4005-711	Compiler Construction †
4005-713	XML-Arch, Tools and Techniques
4005-714	Programming Skills
4005-719	Topics in Programming Languages
4005-720	Computer Architecture
4005-729	Topics in Computer Architecture †
4005-730	Distributed Operating Systems I
4005-731	Distributed Operating Systems II †
4005-735	Parallel Computing I
4005-736	Parallel Computing II †
4005-739	Topics in Operating Systems †
4005-740	Data Communications and Networks I
4005-741	Data Communication and Networks II
4005-742	Ad-Hoc Networks
4005-743	Secure Operating Systems Networks
4005-749	Enterprise Computing
4005-750	Introduction to Artificial Intelligence
4005-751	Knowledge-Based Systems †
4005-755	Neural Networks and Machine Learning †
4005-756	Genetic Alqorithms †
4005-757	Introduction to Computer Vision †
4005-759	Artificial Intelligence for Games
4005-761	Computer Graphics I
4005-762	Computer Graphics II
4005-769	Topics in Computer Graphics
4005-771	Database Systems
4005-772	Database System Implementation
4005-774	Secure Database Data Mining
4005-779	Advanced Data Mining
4005-784	Privacy and Security

Students also may include elective courses from other RIT departments' graduate offerings. See www.cs.rit.edu/~csdoc/graduate for a list of approved courses. Other departments' courses are primarily for their own majors and may have prerequisites that are not approved for degree credit.

Electives provide breadth of experience in computer science and applications areas. Students who wish to include courses from departments outside of computer science need prior approval of the graduate coordinator. Refer to the course descriptions in the departments of computer science, engineering, and business for possible elective courses.

A program of study must be designed in cooperation with the graduate coordinator.

The master's thesis or project

A thesis paper or project forms the capstone of the MS program. In order to register for either, a student must complete the graduate seminar and submit an acceptable proposal to the computer science faculty.

Requirements for the degree must be completed within seven years of the date of the oldest course counted toward the student's program. Bridge courses are excluded.

Information Technology Department

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The information technology (IT) department offers master of science degrees in information technology, software development and management, learning and knowledge management systems, and programs of study leading to advanced certificates in interactive multimedia development, and learning and knowledge management. Pending final approvals, an MS degree in game design and development is expected for the 2006-07 academic year. Graduate courses are given at times of the day convenient to both part-time and full-time graduate students — usually late afternoon and evening. MS degree programs typically take at least one and a half to two years to complete. The advanced certificates may be accomplished in one calendar year or less.

The master of science degree in information technology enables graduates to contribute to the emerging interdisciplinary field of information technology in a variety of capacities. Students will learn a systematic approach to the design of information technology solutions for contemporary problems, including those found in business and education. All students develop a plan of study that focuses on specific areas of interest within the IT discipline. For example, students could develop skills in interface design and user task analysis; design and develop interactive web-based or multimedia-based applications with backend database technologies; or develop a strategic and technical understanding of networks and communication systems. Alternately, students could apply cognitive and organizational theories to the design of information technology applications and systems. The curriculum for this program is offered on-campus; portions are available through online learning.

The master of science degree in software development and management prepares students for a broad spectrum of information technology careers in the field of software development. Graduates acquire a solid base of technical and design skills along with insights into the importance of project management for software development. This program is offered entirely in online learning format.

The master of science in learning and knowledge management systems addresses the need for business and industry to create corporate learning resources and to manage both the learning process and corporation knowledge assets. The program covers the knowledge and skills necessary for the planning, creation, and implementation of innovative instructional, performance support, and knowledge-sharing environments with a strong social science emphasis. An advanced certificate, based on the first four courses in the MS degree program, is also available. These programs are offered in online-learning format.

The advanced certificate in interactive multimedia development provides an opportunity for students to gain firsthand knowledge and expertise in the art and science of interactive

multimedia design. As interactive technologies advance, the content and form of projects change, but the focus of this certificate is the enhancement of human communication in electronic environments. Students explore related issues through a series of six core courses in interactive multimedia development. This certificate program is only available on-campus.

An anticipated master of science degree in game design and development will prepare students for employment in the game and entertainment industries as well as in other related fields.

Laboratory facilities

The computing facilities of the information technology department are driven solely by curricular needs. Our focus for the computers and networks that we provide is the needs of our students, who use our labs to investigate concepts, and to design and develop content for either stand-alone computers or network delivery. Many of our students also work as lab assistants, adding an additional practical dimension to their educational experiences.

Many IT courses are laboratory-based. Some courses have separately scheduled laboratory sessions in which an instructor provides a structured learning experience that reinforces lecture concepts. Other courses are taught in specially designed "active learning labs" in which each student has a computer. These courses use alternating lecture and hands-on sessions to facilitate student learning. The IT active learning labs also have display facilities with one or more large screens located at the front of the room, so students may see demonstrations of work and immediately apply them.

Our open labs provide students with access to computing resources outside of scheduled lab and class times. In addition to general laboratory facilities, the IT department has specialized laboratories that support curriculum in the areas of website design, streaming media, computer games, human-computer interaction, programming, and database implementation and administration. Our curriculum is further supported by the laboratory facilities in the networking, security, and systems administration department (NSSA). Due to our cross-platform commitment, many of our computing labs also contain Windows and Macintosh platforms. UNIX is used in several specialized labs.

The IT database labs are designed to facilitate experimentation with database administration and client/server database concepts. The labs have benches consisting of a mix of Linux and Windows-based machines that can be configured as either servers or clients. Students can begin by configuring single-user, one-tier environments and progress to multi-tier networked configurations, where multiple clients interact with typical database management software, such as Oracle, through middle-tier or Web server environments.

The IT streaming-media lab houses the department's video and audio studios, which support sound and video content creation for digital video and animation courses. The digital video production studio has a "talk show style" set for streaming video productions, SDI cameras, and a chroma key screen. The lab's audio studio is designed for both voiceover/narration work and for groups of three or four performers to do dialog work or record music. In addition to supporting class work, this lab is a creative environment available for student and faculty use. The two studios are linked by a professional, digital control room complete with soundboard, professional-quality microphones, and industry-standard sound editing equipment, as well as video switchers, encoders, and media servers.

The IT entertainment technology laboratory is a unique lab designed for small-group study. The lab contains high-end PC and Macintosh computers outfitted with state-of-the-art graphic cards and dual monitors on a gigabit network. This lab is primarily used to develop multi-user gaming and social environments. Students in this lab have access to a variety of digital cameras, camcorders, scanners, console video game systems, an HDTV, and an overhead projection unit. Students studying interface design can also take advantage of heads-up displays, wearable computing components, and other futuristic technologies housed in this lab.

The IT usability testing laboratory consists of two components: testing rooms and an observation area. Each testing room has a state-of-the-art networked PC and Mac with touch-screen monitors, along with several input devices (such as joysticks, haptic mice, track balls, etc.). The testing room has a video camcorder on a robotic arm that sends the video feed to the observation area. An intercom system is set up between the two areas to allow for communication. The observation side has a monitor for displaying the user's screen, headsets for the observers, a PC for note taking, a microphone to the testing room, and video and audio recorders. A one-way mirror separates the testing rooms from the observation area.

The NSSA networking lab is designed to facilitate network exploration. The lab consists of individual work stations that include several PCs, three hubs, routers, and a layer-2 switch. Each of the PCs can run "sniffer" software, making each a network analyzer. Additional equipment, such as cable testers, breakout boxes, more hubs, crimping tools, V.35 cables for serial routing, is available from an equipment cage as needed. In addition, each station is cabled to the lab infrastructure to allow it to be its own sub-network in the lab network or to be directly connected to the lab network, which provides many topology options.

The NSSA projects lab is designed to facilitate learning about hardware, and wireless and wired networking topics that exceed those covered in the usability testing or the networking labs. Each station contains multiple PCs and an infrastructure similar to the usability testing and networking labs. A collection of roll-around racks with a variety of networking appliances make the construction of special projects possible and aids in the pursuit of graduate theses.

The NSSA systems administration lab is designed to facilitate experimentation in network management and system administration. The lab consists of computer stations with four

PC-compatible computers each. Normally, these are configured as a Windows Server, a Windows workstation, and two UNIX platforms. However, students can reconfigure these machines as required and save their configurations using disk-imaging software on the lab image server, making this an extremely flexible lab. There are lab-wide servers and a networking infrastructure to enrich the computing environment. The main switch/router in this lab affords six sub-networks per station. Additional hardware and software is available from the equipment cage to allow students to configure more complex topologies.

The NSSA security lab is designed to facilitate student experimentation in the growing field of information security. Each student station consists of multiple PCs capable of running any number of operating systems. This lab is totally isolated from the rest of the campus to allow for in-depth exploration of viruses, firewalls, and other security topics. Additional computer equipment such as routers, switches, hubs, testers, firewalls, IDS, or IPS, may be checked out from an equipment cage.

Our computing facilities are connected to the gigabit RIT campus backbone, which has OC3 connections to the Internet. Students have access to our computer facilities via an Ethernet connection from their residence halls or via dial-up PPP or other connections from off-campus locations. Institutional facilities provide a location for students to develop their own presence on the Web. The overall RIT campus facilities have consistently been rated in the top 20 by national surveys.

RIT's general and specialized IT laboratories make our facilities one of the most up-to-date in the nation for undergraduate and graduate exploration of information technology concepts.

Master of Science in Software Development and Management

http://www.it.rit.edu/it/grad/sdm/index.maml

The master of science degree in software development and management (SD&M) enables the matriculated student to study, develop, and become proficient in the practices, methodologies, and techniques at all levels in the software development process. The program is designed for students whose undergraduate majors were in a computing discipline. Students must have a background in software development before entering the program.

The underlying principle of this curriculum is that software development is a manageable process — that the problems encountered now and in the future will be amenable to solutions based on sound managerial methodology and reasoned application of technology. This program is delivered online and designed for part-time study.

Admission requirements

Applicants should have a baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 3.0 (a "B" average). Applicants must submit two professional recommendations.

Applicants from foreign universities must submit Graduate Record Examination (GRE) scores. The GRE is also recommended for those applicants whose undergraduate grade point average is less than 3.0. Since this is a part-time program, visa forms cannot be issued by RIT.

Applicants whose native language is not English must take the TOEFL examination; a minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required.

Prerequisites

Individuals wishing to enter the master's program must have at least two years of full-time employment experience in the software development process and a solid background in object-oriented programming (Java). If a student does not have the necessary programming background, bridge courses are provided to allow students to meet these prerequisites. Formal acceptance into the master's program may be possible even though the applicant must complete bridge program courses.

The bridge program

Students whose undergraduate preparation or industrial experience does not satisfy the Java prerequisite can make up this deficiency by completing one or more of the following RIT courses, as prescribed by the graduate program coordinator.

Java programming language

4002-217	Programming for Information Technolow I*
4002-218	Programming for Information Technology II*
(or)	
4002-414	Java for Programmers*(requires prior programming experience)
(or)	
4002-714	Java Programming (requires prior programming experience)

** This course is not available through online learning. Please contact the graduate program coordinator for an appropriate substitution.*

The bridge program courses are not part of the 48 credits required for the master's degree. Grades for bridge courses are not included in a student's graduate grade point average if taken before matriculation; they are included if taken after matriculation.

A bridge program 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 coordinator for approval.

The curriculum

The graduate program of study consists of 12 courses (48 quarter credit hours), which include a foundation course, a business elective, three course concentrations, and the capstone experience. Two quarters of optional cooperative work experience are possible. Course numbers in parenthesis indicate required prerequisite (s).

The SD&M core:	**Qtr. Cr. Hrs.**
4002-752 Themes in Software Development and Management I	4

The software development concentration consists of three courses:

4002-710 Object Technologies	4
4002-720 Data Object Development	4
4002-775 Component Development (4002-710)	4

The project mangement concentration consists of three course:

4002-830 Project Management	4
4002-831 Process Management	4
4002-820 Economics of Software Development (4002-830 and 4002-831 recommended)	4

One business elective selected from:

0102-740 Organizational Behavior
0102-763 Behavior Skill for Managers and Professionals

Upper-level concentration selected from the following options:

Enterprise Architecture

4002-819 Integration Technologies (4002-725)	4
4002-821 Data Architecture and Management (4002-710 & 4002-720)	4
4002-825 System Architectures (4002-725; 4002-819 recommended)	4

E-Commerce Management

4002-871 IT and Organizational Process	4
4002-872 Inter-enterprise Computing	4
4002-873 IT and Strategic Opportunity	4

Human Computer Interaction (HCI)

4004-745 Foundations of HCI	4
4004-755 Advanced Topics in HCI (4004-745)	4
4002-892 CSCW and Groupware (4004-745)	4

Architecture Fundamentals

4002-821 Data Architecture and Management (4002-710)	4
4004-745 Foundations of HCI	4
4002-872 Inter-enterprise Computing	4

Special Topics: Three courses on advanced topics related to software development, with prior approval of the SD&M faculty.

The SD&M capstone

4002-895 Software Development and Management	4

Students with a business degree or prior academic study that included the required business elective may replace that course with another graduate-level course with the approval of the graduate program coordinator.

Master of Science in Information Technology

http://www.it.rit.edu/it/grad/msit.maml

The master of science degree in information technology (MS/IT) is a unique and flexible program that allows the student to craft his or her own program of study within the broad range of the IT computing discipline. Students build upon a core requirement in current information technology themes. The specialty areas include website design and multimedia development, game programming, application development, software project management, electronic comerce, learning and performance technology, human-computer interaction, database theory and practic, and computer networking. In addition, students have the option f chooing courses from among the wide variety of fields offerd within RIT, such as copmuter animation, computer graphics design, telecommunications technology, and business. The degree, with the core course and selected concentrations, is also available in the distance delivery format.

Admission requirements

Applicants should have a baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 3.0/4.0 (a "B" average). Applicants must submit a resume and two professional recommendations.

Applicatns from foreign universities must submit Graduate Record Examination (GRE) scores. These scores may be required for those applicants whose undergraduate grade point average is less than 3.0. Applicants whose native language is not English must take the TOEFL examination; a minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required. Applicants with a lower TOEFL score may be admitted conditionally and will be required to compete a prescribed program in English, along with a reduced program course load.

Prerequisites

It is expected that students wishing to enter the MS/IT program will have a background in fundamental information technology concepts, including object-oriented programming, computer hardware and software architecture, networking, and website design and multimedia concepts.

Students without the necessary background should complete the prerequisites before applying to the program. 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 through study, taking one or more of the following RIT courses, as prescribed by the graduate program coordinator.

Object-Oriented Programming

4002-217	Programming for Information Technology I*, and
4002-218	Programming for Information Technology II*
(or)	
4002-414	Java for Programmers* (requires prior programming experience)
(or)	
4002-714	Java Programming (requires prior programming experience)
(or)	
4002-716	C++ Programming Workshop (requires prior programming experience)

Hardware

4050-340 Computer Platform Fundamentals

Networking

4050-341	Foundations of Data Communications
(or)	
4055-746	Telecommunications Network Protocols

Multimedia and Website Design

4002-320	Introduction to multimedia: Internet and Web
(or)	
4004-741	Fundamentals of Web-Based Multimedia*

** This course is not available through online learning. Please contact the graduate program coordinator for an appropriate substitution.*

With the possible exceptions of 4002-714 or 4002-716, the bridge program's courses are not part of the 48 quarter credit hours required for the master's degree. Grades for bridge courses are not included in a student's graduate GPA if the courses are taken before matriculation; courses are included if they are taken after matriculation.

A bridge program 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 coordinator for approval.

The curriculum

The master of science in information technology consists of 48 quarter credit hours of graduate study. The curriculum consists of a core course, a choice of concentrations, and an elective.

Core course (available in distance format) **Qtr. Cr. Hrs.**

4002-718 Current Themes in Information Technology 4

Concentrations (36 credits)

Parenthesis material indicates required prerequisites.

Interactive Multimedia Development (on-campus format only)

4004-745 Foundations of Human-Computer Interaction 4
4004-737 Website Design and Technology (4004-741) 4
4004-730 Interactive Media Implementation
(4004-741 and a two-course programming sequence) 4

Prerequisites: 4004-741, a prerequisite course. This is the introductory/foundation concentration for this curricular area. It is intended for students who do not have prior background in website design and interactive media development but would like to either do a three-course overview concentration or prepare for more in-depth study in this area in one of the other concentrations below.

Multimedia Application Development (on-campus format only)

4004-746 Programming for Interactive Multimedia (4004-730) 4
4004-729 Introduction to VRML (4004-737 and 4004-746) 4
4004-738 Multi-User Media Spaces (4004-746) 4

Prerequisites: 4004-730 and 4004-737 from the introductory concentration above.

Web Application Development (on-campus format only)

4004-739 Programming for the World Wide Web 4
(4004-737 and a two-course programming sequence)
4004-751 Web-Database Integration (4004-739 and a database course) 4
4004-xxx An advanced elective in Web development 4

Prerequisite: Completion of a two-course programming sequence (program prerequisite), 4004-737, from the introductory concentration above, an introductory or higher database course and any other prerequisites as appropriate for the chosen elective.

XML Data Management (on-campus format only)

4002-770 Introduction to XML (4004-737 and 4004-739) 4
4002-771 XML Programming (4002-770 and 4002-714) 4
4002-772 XML Transformation and Presentation (4002-770) 4

Prerequisites: Completion of a two-course programming sequence or 4002-714,4004-737 from the introductory concentration, and 4004-739.

Interface Architecture (on-campus format only)

4004-757 Graphical Elements of the User Experience (4004-730) 4
4004-802 Perspectives on Computer Mediation (4004-730, 745) 4
4004-804 Building Tools for Creative Practice (4004-730, 745) 4
4004-806 Innovation, Invention, and Computer-Mediated Experience (4004-730 and 4004-748 or 4004-775) 4

Prerequisites: 4004-730 and 4004-745 from the introductory concentration above. This concentration focuses on the visual perception, interaction style, and sensory aspects of creating functional user interfaces for computer-mediated experiences.

Game Programming (on-campus format only)

Students without extensive formal multimedia programming must take:
4004-746 Programming for Interactive Multimedia (4004-730) 4
The concentration consists of 4004-746, if needed,
and two or all three of the following:
4002-734 2D Graphics Programming (4002-714 or 4004-746) 4
4002-735 3D Graphics Programming (4002-734) 4
4002-836 Game Engine Design and Development
(4002-734 and 4002-735) 4

Prerequisites: Completion of a two-course programming sequence, and 4004-730 from the IMD introductory concentration or equivalent programming experience.

Game Design (on-campus format only)

4004-731 History and Critical Analysis of Comp. Games and Interactive Entertainment 4
(MSIT graduate student status in computer game content.)
4004-728 Interactive Narrative (4002-731 and (4004-737 or 4004-746)) 4
4004-732 Game World Design (4002-728) 4

Prerequisites: Completion of 4004-741 which is a prerequisite the MS/IT program.

Application Development (distance and on-campus formats)

4002-714 Java Programming (a two-course programming sequence in a language other than Java) 4
4002-710 Object Technologies (4002-714 or knowledge of Java) 4
4002-725 Component Development (4002-710) 4

Prerequisite: This concentration requires a minimum two-course, object-oriented programming sequence or equivalent pre-approved background/experience. If the student has solid experience in Java programming (equivalent to 4002-714), the following may be substituted, with prior approval, as the third course:

4002-819 Integration Technologies 4

Human-Computer Interaction (distance format)**

4004-745** Foundations of Human-Computer Interaction	4
And two of the following courses:	
4004-748 Usability Engineering (4004-745 and 4004-730)	4
4002-749 Usability Testing (4004-748 and a statistics course)	4
4004-755** Advanced Topics in HCI (4002-745)	4
4002-765** User-Centered Design Methods (4004-745)	4
4002-892** CSCW and GroupWare (4004-745)	4

Prerequistes: This concentration requires completion of the core course or equivalent pre-approved background/experience Students also need a solid background in Web technology, including 4004-730, or equivalent pre-approved background/experience

Leaning and Performance Technology (distance and on-campus)

4002-722 Fundamentals of Instructional Technology	4
4002-723 Interactive Courseware (4002-722)	4
4002-724 Performance Support Systems Design	4

Project Management (Distance format only)

4002-830 Project Management	4
4002-831 Process Management	4
4002-820 Econmoics of Software Developemnt	4

Prerequistes: This concentration requires at least two yesrs of full-time employment in the software development process plus programming experience. The faculty recommends that 4002-820 be taken after the other two courses.

Electronic Commerce Management (distance format only)

4002-871 Information Technology and Organizational Process	4
4002-872 Inter-Enterprise Computing	4
4002-873 IT and Strategic Opportunity	4

Technical E-Commerce (distance format only)

4002-872 Inter-Enterprise Computing	
4002-875 E-Commerce Implementation (4004-741, 4002-720)	4
4002-876 Secure E-Commerce (4002-875)	4

Prerequisites: These concentrations require completion of all pre-requisite and core courses or equivalent pre-approved background experience. Students need a solid background in programming, Web technology, and data communications as well as experience in issues relevant to the field of information technology.

Database (distance format)**

4002-720** Data Obiect Development (two-course OOP sequence)	4
4002-785 Fundamentals of DBMS Architecture and Implementation (4002-360/720)	4
4002-784 Fundamentals of Database Client/Server Connectivity (4002-360/720)	4
4002-787 Database Performance and Tuning (4002-784 and 4002-785)	4
4002-789 Data Warehousing (4002-785)	4

Prerequisites: This concentration requires background in object-oriented programming, a program prerequisite. If an undergraduate DBMS theory course, such as 4002-360, has been taken, 4002-720 is not needed.

Bioinformatics (on-campus format only)

4002-762 Introduction to Bioinformatics Computing	4
(4002-714 and a discrete math course)	4
4002-763 Advanced Bioinformatics Computing (4002-762)	4

Prerequisites: This concentration area is under development. It requires background in discrete math (1016-265) and programming. Background in biology is helpful.

Networking (distance format)**

4055-815 Introduction to Routing and Switching (4050-342)	4
4055-761**Principles of System Admin (4055-746and 4050-402 or 4055-721)	4
4055-755**Secure Wireless andWired Data Newworks (4055-746)	4

Prerequisites: This concentration requires Telecommunications Network Protocols (4055-746) as a prerequisite. Students without scripting background will also need to take OS Scripting (4050-402) or Perl for System Adminstration (4055-721) Depending upon the plan of study it may be possible that one of these courses could be used as the MS/IT electives or part of a special topics concentration. Addtional courses may also ber included to create a 4-or-5 course concentration.

System Survivability (distance format)**

4055-761** Principles of System Administration (4055-746 and (4050-402 or 4055-721)	4
4055-780 Computer System Security (4055-761 or (4050-421 and 0501-507))	4

And one of the following:

4055-755** Secure Wireless and Wired Data Networks (4055-746)	4
4055-760** Computer Viruses and Malicious Software (4002-716)	4
4055-882** Enterprise Security (4002-746)	4

Prerequisite: This concentration requires Telecommunications Network Protocols (4002-746) as a prerequisite. Students without scripting background will also need to take OS Scripting (4050-402) or Perl for System Administration (4055-721). Depending upon the plan of study it may be possible that one of these courses could be used as the MS/IT elective or part of a special-topics concentration.

Concentrations offered by other RIT departments

With the permission of the graduate program coordinator, students are permitted to complete one concentration (a maximum of 12 graduate credits) from another department at RIT. Concentrations in the following areas are available:

- Technology management (College of Business)
- Information systems (College of Business)
- Telecommunications technology (engineering technology department)
- Automated manufacturing (department of manufacturing and mechanical engineering technology)
- Health systems administration (department of hospitality and service management)
- Computer Graphics (department of interactive media design and animation)

Contact the IT graduate coordinator for more information.

Special Topics
Students can use the special topics option to design a concentration with approval from the graduate program coordinator. Undergraduate information technology courses at the 400-level or above may be acceptable with prior approval.

Electives (zero or four credits)
The electives may be chosen from information technology, computer science, computer engineering, electrical engineering, or business. Graduate courses from other departments also may be appropriate with the approval of the graduate program coordinator.

Capstone experience (four or eight credits)
A master's project or thesis is required to meet graduation requirements. The capstone experience should build upon the student's concentrations and electives. It is important that students plan their course work toward completing the project or thesis in their intended area of interest. Each student will assemble a capstone experience committee consisting of two (project) or three (thesis) faculty members who will evaluate the project or thesis. Students will register for 4 or 8 credits for their capstone experience depending on the scope of the work. Students who choose the 8-credit capstone will not take the elective. All requirements for the degree must be completed within seven years of the date of the oldest course counted toward the student's program. Bridge courses are excluded.

Master of Science in Learning and Knowledge Management Systems

http://www.it.rit.edu/it/grad/lkms.maml

The master of science degree program in learning and knowledge management systems (MS/LKMS) addresses the knowledge and skills necessary for the planning, creation, and implementation of innovative instructional, performance support, and knowledge-sharing environments. Developing these environments requires an understanding of instruction, knowledge assets, and human performance along with skills in current and emerging networked multimedia technologies. Students in this program investigate a variety of strategies for providing education, training, and performance support to learning populations that are separated by distance, time, or other constraints. Students learn how to capture, store, evaluate, and distribute knowledge assets and to design technical and organizational systems for knowledge management. Students learn to select and implement the best tools and methods to allow their population to achieve its knowledge-based objectives. The program integrates aspects of performance technology, instructional design and technology, information technology, and knowledge management.

The program is delivered completely at a distance (online learning) and attempts to "practice what it preaches" with a variety of online course formats and approaches.

Admission requirements
Applicants should have a baccalaureate or equivalent degree from an accredited four-year institution and a minimum cumulative grade point average of 3.0 (a "B" average). Applicants must submit two professional recommendations and a resume. Submission of either a portfolio of relevant work or Graduate Record Examination (GRE) scores is recommended.

Applicants from foreign universities must submit GRE scores, as well as those applicants whose undergraduate grade point average is less than 3.0. Applicants whose native language is not English must submit TOEFL scores; a minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required. Since this program is only offered for part-time study, an I-20 for full-time study in the United States is not available to international students.

Prerequisites

It is expected that individuals wishing to enter the master's program will have previous experience in the field of instructional design, training, or knowledge management. Individuals with this experience should submit a portfolio of their work that demonstrates their familiarity with Internet tools and educational technology. In lieu of this portfolio, GRE scores should be submitted. For detailed information on submitting a portfolio, contact the IT graduate program coordinator.

Applicants must have at least introductory programming skills. This can be demonstrated through a standard two-course object-oriented computer programming sequence or equivalent work experience. Any object-oriented programming language is acceptable. All prerequisite study must be completed with a grade of "B" or better.

The following introductory programming courses, in the C++ programming language, are available in distance-learning format from RIT (prerequisites are shown in parenthesis):

4002-208	Introduction to Programming	(none)
4002-210	Programming with Classes	(4002-208)

The curriculum

The MS/LKMS is a 45 quarter-credit MS degree and it is composed of ten required courses plus a 5-credit MS capstone. The capstone is a single-term, course-based experience.

		Qtr. Cr. Hrs.
4002-722	Fundamentals of Instructional Technology	4
4002-723	Interactive Courseware	4
4002-724	Performance Support Systems	4
4002-728	Models of Human Performance	4
4002-729	Media Asset Creation	4
4002-731	LKM Application Development	4
4002-810	Simulations and Learning Environments	4
4002-812	Knowledge and Content Objects	4
4002-828	Intelligent Computer-Based Instruction	4
4002-845	Economics of Human Performance	4

The LKMS capstone

4002-865	Project and Program Evaluation	5

Advanced Certificate in Interactive Multimedia Development

http://www.it.rit.edu/it/grad/imdCert.maml

As interactive technologies advance, the forms and approaches to human communication change — and the importance of enhancing the communication experience within electronic environments increases. This certificate provides an opportunity for students to gain firsthand knowledge and expertise in the art and science of interactive multimedia design. In this program, students explore the theories of interactive computing, the fundamentals of interactive multimedia, programming in an authoring language, multimedia design, and the impact of networked technologies in such areas as the Internet.

Admission requirements

Undergraduate degree applicants should have a baccalaureate or equivalent four-year degree from an accredited institution and a minimum cumulative grade point average of 3.0 (a "B" average). Two professional recommendations must be submitted. Applicants whose native language is not English must submit TOEFL scores; a minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required. Applicants with a lower TOEFL score may be admitted conditionally and will take a prescribed program in English, along with a reduced program course load. Since this is a part-time program, I20 forms cannot be issued by RIT.

Prerequisites

Due to continuing advances in the field of interactive multimedia, knowledge of programming has become necessary to complete all of the courses. Students must have object-oriented programming skills equivalent to one undergraduate course. Either of the following bridge courses is available to complete this requirement. Neither requires any prerequisites.

4002-217	Proqramming for Information Technology I (Java; on-campus only)
4002-208	Introduction to Programming (C++; on-camp us and distance formats)

The curriculum

Projects include the development of websites and interactive multimedia applications. The curriculum consists of six courses:

	Qtr. Cr. Hrs.
4004-741 Fundamentals of Web-based Multimedia	4
4004-730 Interactive Media Implementation	4
4004-737 Website Design and Technology	4
4004-745 Foundations of Human-Computer Interaction	4
Two Web or multimedia electives	8

The curriculum can be completed in as few as three quarters. Students have at their disposal a variety of computer, video, and digitizing equipment in our state-of-the-art interactive multimedia laboratory facilities.

Advanced Certificate in Learning and Knowledge Management Systems

This innovative certificate program is designed with a strong social science emphasis and focuses on the growing need for business and industry to address corporate learning and knowledge management. The four courses that comprise the certificate develop knowledge and skills in the area of planning, creating, and implementing media-based instructional systems. Creating these systems requires knowledge of instructional design and development along with skills in current and emerging networked multimedia technologies. Students in this certificate learn a variety of techniques for providing media-based training to learning populations that are separated by distance, time, or other constraints. Graduates of the certificate program can work as instructional designers or educational multimedia specialists among other job titles and responsibilities. The certificate is also an option for students enrolled in the master of science degree program in learning and knowledge management systems (MS/LKMS).

The curriculum is completely distance delivered and attempts to "practice what it preaches" with a variety of online course formats and approaches intended to both support learning and build community.

Admission requirements

Applicants should have a baccalaureate or equivalent four-year degree from an accredited institution with a minimum cumulative grade point average of 3.0 (a "B" average). A resume and two professional recommendations must be submitted. Applicants whose native language is not English must submit TOEFL scores; a minimum score of 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required. Since this is a part-time program, I20 forms cannot be issued by RIT.

Prerequisites

The program requires a mix of technical and social science skills. Students, who have experience in the field, are more likely to succeed. However, a student may use this certificate program to build a portfolio of work, which could be used for admission to the MS/LKMS program. Because computer programming is done in almost every course in the certificate, applicants must have a programming background equivalent to a two-course programming sequence in a current object-oriented programming language before admission. The following bridge courses are available to complete this requirement:

4002-217	Programming for Information Technology I (Java) (on-campus only) and
4002-218	Programming for Information Technology II (Java) (on-campus only)
or	
4002-208	Introduction to Programming (C++) (on-campus and distance formats) and
4002-210	Programming with Classes (C++) (on-campus and distance formats)

The curriculum

The advanced certificate in learning and knowledge management systems consists of four courses, which are a sub-set of the requirements for the master of science degree.

		Qtr. Cr. Hrs.
4002-722	Fundamentals of Instructional Technology	4
4002-729	Media Asset Creation	4
4002-723	Interactive Courseware	4
4002-731	LKM Application Development	4

With the appropriate background, the certificate can be completed in either two or four quarters depending upon the number of courses taken.

Software Engineering Department

J. Fernando Naveda, Chair
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The department of software engineering is developing a master of science degree in software engineering, which is currently awaiting final approval by the New York State Department of Education. It is projected that the program will be ready to accept students for admission in the fall of 2006. *Please note that this is a projected date only and is pending approval of the program by the New York State Department of Education. The information regarding this program is subject to change without notice.*

Demand for quality software delivered on time and within budget has never been higher and, according to recent studies, it will continue to increase for years to come. In 1996, RIT became the first university in the United States, and one of the first in the world, to offer a baccalaureate degree in software engineering. Many schools are following our leadership, as undergraduate software engineering degrees are increasingly featured in university portfolios.

Laboratory facilities

The great majority of the courses offered by this department require team projects. In addition, an increasing number of courses are being taught using the studio format, which gives students the opportunity to capitalize on interactive instruction. The facilities that support the department's curriculum are:

- Three studio labs
- One real-time and embedded systems lab
- Eleven team rooms
- One open lab
- One mentoring lab (primarily designed in support of the undergraduate curriculum)
- One senior projects lab

Master of Science in Software Engineering*

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Building on our leadership position in undergraduate software engineering education, the master of science in software engineering (MSSWE) is designed to attract software professionals with a formal undergraduate background in software engineering, computer science, or computer engineering and at least one year of professional experience. The program's core content ensures that graduates will possess both breadth and depth of knowledge in software engineering. Specialization tracks in software quality and software design provide the student with the opportunity to match their graduate education with their professional goals.

Admission requirements

There are two large groups of individuals who may be interested in an advanced software engineering degree. The first group comprises professionals without a formal baccalaureate degree in computing, but who may otherwise have sufficient experience developing software professionally. The second group includes recent graduates from accredited baccalaureate computing degree programs. The program's admission requirements are as follows:

- Prospective students with a baccalaureate degree from an accredited institution must have a cumulative grade point average (GPA) 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.
- Prospective students without a bachelor's degree in software engineering, computer science, or computer engineering are expected to submit evidence of professional experience developing software. For these individuals, a minimum of three years of professional experience developing software is required.
- GRE test scores are required from applicants whose undergraduate degrees are from foreign colleges. Applicants whose undergraduate GPA is under 3.0 are also encouraged to submit their GRE score to enhance their application.
- A Test of English as a Foreign Language (TOEFL) score of at least 570 (paper-based), 230 (computer-based), or 88 (Internet-based) is required for all applicants for whom English is not their native language.
- All applicants must submit a professional essay describing their current job (if applicable), relevant experience, and career plans.
- All applicants must submit a document describing significant software projects in which they have participated.

Prerequisites

Based on evaluation of academic and relevant experience, some applicants may be required to successfully complete (with a grade of "B" or better) some or all of the following bridge courses. Successful completion of bridge courses is necessary for registration in graduate-level courses.

4010-361	Introduction to Software Engineering
4010-362	Engineering of Software Subsystems
4010-555	Software Requirements and Specification
Plus one of the following	
4010-441	Principles of Concurrent Software Systems
4010-442	Principles of Distributed Software Systems
4010-443	Principles of Information Systems Design
4010-549	Software Design Seminar (topics may vary)

The curriculum

The program comprises 52 quarter credit hours, anchored by a three quarter (12 credit hour) practicum where students work with peers and faculty on a long-term, moderately complex software development project. Initially students will serve in basic support and developer roles, but as they progress through the practicum and accompanying coursework they will be assigned correspondingly greater responsibilities. As a consequence, the program combines fundamental and theoretical concepts taught in courses with their application in a constrained but realistic setting. This is in the best tradition of RIT's historic commitment to "learning through doing."

The MSSWE core

4010-720	Software Evolution and Re-engineering
4010-710	Research Methods
4010-730	Process Engineering and Environments
4010-700	Practicum I
4010-701	Practicum II
4010-702	Practicum III
4010-740	Empirical Software Engineering
4010-750	Software Modeling
4010-780	Experience and Research Report

Electives

Though significant learning specific to the student's specialization track will be learned through the three practicum courses, students in the quality and design tracks are required to take one of the following two courses depending in their choice of specialization track.

4010-760	Software Quality Engineering (quality track)
4010-770	Software Architectures and Product Lines (design track)

In addition to the specialization track elective, the curriculum includes three technical electives can be chosen from graduate offerings in computer science, computer engineering, and software development and management.

**This program is pending approval by the New York State Department of Education.*

Graduate Faculty

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Department of Computer Science

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Sidney Marshall, Ph.D., Dartmouth College — AssociateProfessor

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

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Department of Information Technology

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Networking, Security, and Systems Administration

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Software Engineering

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Center for Advancing the Study of CyberInfrastructure (CASCI)

Guy Johnson, BS, Pennsylvania State University; MS, Syracuse University — Executive Director and Professor

Peter G. Anderson, BS, Ph.D., Massachusetts Institute of Technology — Professor Emeritus

Newton Howard, BA, Concordia University; MT, Eastern Michigan University; Ph. D., University of Oxford — AssociateProfessor

Information Technology

4002-710 **Object Technologies**
This is a course in the principles and techniques of designing and implementing software objects. Current software environments are used to explore effective design methods and concepts. Topics include basic object design, class definition and syntax, object-oriented design, software quality and object evaluation. Software design and programming projects are required. (Completion of SD&M bridge or permission) **Class 4, Distance Format, Credit 4**

4002-714 **Java for Programmers**
An intensive survey of the Java programming language for experienced programmers. This course covers the creation of application programs. Topics include: basic language concepts (declaring and evaluation of data, statements, expressions, control flow, and input/output), object-oriented fundamentals, GUI interfaces, exception handling, debugging, threads, and the client/server environment. Programming projects will be required. (A two-course object-oriented programming sequence in a language other than Java) **Active Learning 5, Credit 4**

4002-716 **C++ Programming Workshop**
A workshop in the Ct+ programming language intended for students to gain programming experience. This course will focus on modern programming concepts such as reusability, data abstraction, information hiding, exception handling and object-oriented design. Programming projects will be required. (4002-710 or permission of instructor) **Class 4, Distance Format, Credit 4**

4002-718 **Current Themes in Information Technology**
This course provides entering graduate students in Information Technology with an overview of current theory and issues in the field. Topics covered would include social and cultural impacts of technology, virtuality digital communication, and online communities. Using reading from a variety of books and periodicals, students will be presented with views on Information Technology in a socioeconomic context. (MS-IT Bridge) **Class 4, Distance Format, Credit 4**

4002-720 **Data Object Development**
Introduction to analysis and design of data representations and data object implementation. Current software environments are used to explore effective database design and implementation concepts. Topics include conceptual modeling, methodologies, logical/physical database design, data query and manipulation, and transaction design. Database design and implementation projects are required. (Completion of SD&M Bridge) **Class 4, Distance Format, Credit 4**

4002-722 **Fundamentals of Instructional Technology**
The world of information technology offers the possibility of transforming the way that instruction is designed and delivered. However, few information technology professionals understand the methods and materials of instructional design. As a professional in information technology, a student may be responsible for designing instruction either in a business or an educational context. This course enables the student to be able to plan, organize, and systematically develop instructional materials. The course uses an Instructional Systems Design (ISD) model to analyse, design, deliver, and evaluate instruction. **Class 4, Credit 4**

4002-723 **Interactive Courseware**
Computer software that teaches is referred to as courseware. This course was designed to help you make the transition from "general" Instructional Design (4002-722/510) into the actual application of these principles in a computer-based environment. Although the basic principles of instructional design hold true in all media environment, using these teaching and learning principles is somewhat different when developing instruction that will be delivered by computer. This course teaches procedures that have already been successful in the design and development of courseware. (4002-722) **Class 4, Credit 4**

4002-724 **Performance Support Systems Design**
An electronic performance support system (EPSS) is a software technology, designed to give each user what he or she needs when he or she needs it. It is designed to enable skilled performance without training. An EPSS can be defined functionally, by what it does. The job of an EPSS is to help a worker perform his or her job better. Typical components of an EPSS encompass tutorials, drills, simulations, and hypertexts, but often include expert systems, help systems, and intelligent job aids. This course examines some of the relevant literature supporting EPSS and provides students with the opportunity to design and develop several different components of a performance support system. (4002-722 and a two course programming sequence) **Class 4, Credit 4**

4002-725 **Component Development**
A programming course focused on the use, design and implementation of reusable software components. Students create and test components based on current technology. Issues of reusable design, quality, component libraries, and interoperability are included. Design and programming project is required. (4002-710) **Class 4, Distance Format, Credit 4**

4002-726 **Research Methods**
This course will prepare students to conduct research and to design experiments and analyze data for empirical studies in Information Technology. Students will explore qualitative and quantitative research methods, experimental and non-experimental design, theoretical framework development, statistical data analysis, sampling and data collection methods within the context of information technology research. Case studies, mini-research projects and scholarly writing assignments will be required. (0307-712 or equivalent) **Class 4, Lab 0, Credit 4**

4002-727 **Digital Audio and Computer Music**
Technologies and techniques for producing and manipulating digital audio and computer music are explored. Topics include digital representation of sound, synthesis techniques, digital audio recording and processing, MIDI and real-time performance issues, algorithmic composition, and application of digital audio to multimedia and Web production. Students also are required to pursue a related research topic that could lead to a Masters project or thesis. (4002-730) **Class 4, Credit 4**

4002-728 **Models of Human Performance**
This course focuses on the theoretical underpinnings of effective distributed learning and knowledge management. The course focuses on surveying general models of distributed learning in both industry and education, then relates the design of these systems to relevant theory, from the fields of psychology, education, sociology and other areas. (4002-722) **Distance Learning 4**

4002-729 **Media Asset Creation**
Media assets are knowledge-based components that have broadband, multimedia elements. Students will learn how to create and work with broadband interactive media such as streamed audio and video, animation, and to program graphical user interfaces. This course is intended as a hands-on introduction to the creation and implementation of these components. **Distance Learning 4**

4002-731 **LKM Application Development**
This course is an introduction to the development of several client server technologies. Students will learn to create server-side scripts and programs that can process information. They will also use a variety of client-side scripting languages. The course will show students how to analyse the distributed programming needs for a given problem. (4002-217, 4002-218, or a two-course programming sequence)

4002-734 **2D Graphics Programming**
Use of an advanced graphics API to access hardware accelerated graphics. Discussion of scene graphs, optimizations, and integration with the API object structure. Advanced use of the API calls in production code, to construct environments capable of real-time performance. (4002-714 and 4004-746) **Class 4, Credit 4**

4002-735 **3D Graphics Programming**
Use of a graphics API to access hardware accelerated graphics. Discussion of the API scene graph, 3D optimizations, and integration between the 2D graphics mode and a 3D immediate mode implementation. This course builds upon students' previous work and extends it in the construction of a fully functional 3D Engine, with library construction for game development. (4002-734) **Class 4, Credit 4**

4002-752 **Themes in Software Development and Management**
This course will present prominent and emerging views of technologies, approaches, and issues in application development to entering graduate students in the Software Development and Management Program. The range of topics will encompass a. broad spectrum of the software development lifecycle using readings from a variety of books and periodicals, independent research, and presentations by leading experts on application development. **Class 4, Distance Format, Credit 4**

4002-762 **Introduction to Bioinformatics Computing**
This course will provide a theoretical and practical (lab-based) study of computational genomics. Techniques will be studied for quickly and effectively commandeering computing resources to the solution of problems raised in biology. Course topics include an express tour of bioinformatics resources, exact and approximate pattern matching, sequence alignment, gene prediction, fragment assembly, multiple alignment, statistical and machine learning approaches. (Programming for IT 3 (4002-219) or Computer Science 3 (0603-233) or Java for Programmers (4002-318 or 4002-714) Discrete Math I (1016-265) Biology for Computing (4002-xxx) or Equivalent) **Class 3, Lab 2, Credit 4**

4002-763 **Advanced Bioinformatics Computing**
This course will provide an in-depth exposure to advanced techniques in computational genomics. Topics may include: gene finding, genetic algorithms, hidden markov models, neural networks, gene expression analysis, clustering algorithms, probabilistic models of evolution, phylogenetic trees, simple and complex diseases: gene mapping, SNP analysis, machine learning, molecular network analysis, probabilistic framework for modeling and interference, systems biology. (4002-762) **Class 3, Lab 3, Credit 4**

4002-765 **User-Centered Design Methods**
This course will focus on the major user centered design methodologies used in the development of applications and environments. Topics include: evolution of software design methods, emergence of user centered design, and key concepts and attributes of contextual, scenario-based, and performance-centered design. Case studies will be used to illustrate the different design methods. Software design projects will be required. (4004-745 or by instructor approval) **Class 4, Distance Format, Credit 4**

4002-770 **Introduction to XML**
This course will focus on the development and use of the extensible markup language (XML) to create structured data. Emphasis will be placed on the conceptual framework of XML, key components and practices of XML design, XML standards and methods of creating structured data and metadata, research issues in XML development and use. *(4004-737* and 4004-739) **Active Learning Format 4, Credit 4**

4002-771 **XML Programming**
Exchange of information between disparate programs is a significant problem in industry. Students will learn how to leverage XML to achieve interoperability between programs. Topics covered in this hands-on course include parsing and generating XML, and web services. (4002-770 and 4002-714) **Active Learning Format 4, Credit 4**

4002-772 **XML Transformation and Presentation**
This course will explore techniques and technologies for transforming XML documents using XSLT and XSL-FO. The emphasis will be on transformation of XML data into human-readable documents, such as HTML pages and PDF files. Topics covered will include XSLT syntax and processing, XPath and XPointer. Students will implement projects to present XML data using a variety of transformation tools and technologies. (4002-770) **Active Learning Format 4, Credit 4**

4002-784 **Fundamentals of Database Client/Server Connectivity**
Students will investigate strategies for client-server and server server communication against single or multiple database servers. Specifically, students will configure, test, and demonstrate successful communication between multiple database servers and multiple clients. Similarities and differences between commercially available connectivity packages, and issues impacting performance will be explored. Programming exercises are required. (4002-360 or 4002-720 and 4002-219 or 4002-714) **Active Learning Format 5, Credit 4**

4002-785 **Fundamentals of DBMS Architecture and Implementation**
Students will be introduced to issues in client/server database implementation and administration. Topics such as schema implementation, storage allocation and management, user creation and access security, transaction management, data backup and recovery, and performance measurement and enhancement will be presented in lecture and investigated laboratory environment. Students will configure and demonstrate successful management of a database server for client access. (4002-360 or 4002-720) **Class 3, Lab 2, Credit 4**

4002-787 **Database Performance and Tuning**
Students will explore database theory as it applies to the performance and tuning of database systems. Topics in database performance will be explored including: physical and logical design issues, the hardware and software environment, SQL statement execution and front end application issues. Techniques in performance monitoring and tuning will be investigated. (4002-484 and 4002-485 or 4002-784 and 4002-785) **Active Learning Format 5, Credit 4**

4002-789 **Data Warehousing**
This course covers the purpose, scope, capabilities, and processes used in data warehousing technologies for the management and analysis of data. Students will be introduced to the theory of data warehousing, dimensional data modeling, the extract/transform/load process, warehouse implementation, dimensional-data 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. (4002-485, 785) **Class 4, Credit *4***

4002-790 **Emerging Themes in Entertainment Technology**
This course examines current technologies as well as future trends that will impact the direction of technology development within the gaming industry. Topics of study may include, but are not limited to; graphics hardware, graphics algorithms, content creation tools, content organization tools, artificial intelligence techniques, machine learning techniques, game play networking, audio and video hardware and algorithms, user interface development, control and feedback systems, simulation systems, console game systems, as well as game engine technology and corresponding development MPI's. (Graduate standing in Information Technology and enrollment in the game programming concentration or permission of the instructor) **Class 4, Credit 4**

4002-791 **Artificial Life and Evolutionary Simulation**
This course will provide students with theory and practical skills in Artificial Life (A-Life). Topics areas include the history and evolution of Artificial Life algorithms to applied domains such as game artificial intelligence, computer music, simulation, and visualization. Software and toolsets that assist Artificial Life programmers will be examined. Students will be expected to design and implement a simulation in teams as well as properly document their design and development strategy. *(4004-746* Programming of Interactive Media or *4005-750* Introduction to Artificial Intelligence)

4002-792 **Development Processes in the Game Industry**
This course examines the individual and group roles of the development process model within game design and development industry. Students will transform design document specifications into software and hardware needs for developers, testers and end users. Students will examine team dynamics and processes for programming, content development, testing, deployment, and maintenance. Students will explore design process through the deconstruction of the game industry's software lifecycle model. (Enrollment in the game design and development graduate program)

4002-793 **Business and Legal Aspects of Game Development**
This course will provides students with a practical background in business and legal practices specific to the gaming industry. Students will be introduced to entrepreneurship in the gaming industry, confidentiality rules, game developer rights and responsibilities, the developer/publishing/retailer relationship, contact development, intellectual property rules and regulations, royalties, licensing, and legal responsibilities for content and consumer impact. Projects may include individual and group research, examination of case studies, and written and oral reports on current industry practice. (Enrollment in the Game Design and Development Masters or permission of instructor) **Credit 4, Class 4, Lab 0**

4002-810 **Simulations and Learning Environments**
A learning environment is an electronic environment in which students are provided resources from which to learn. These resources may include tutorials, but are generally far more experimental in nature. A valuable component within a learning environment is an instructional simulation, which provides an opportunity for learners to interact with a safe, virtual world. Kolb's experiential learning theory is a theoretical framework that can be used for designing learning environments. This course provides theoretical background along with hands-on development. (4002-722 and 4002-216 or equivalent programming experience) **Class 4, Lab 0, Credit 4**

4002-812 **Knowledge and Content Objects**
Students will develop instructional content for reuse using current technologies. Learners study issues relating to current and emerging standards for reuse and interoperability. Activities include translating instructional material into standard design models, evaluating examples of knowledge representation, creating knowledge objects, and creating new content modules out of existing knowledge objects. (4002-723 and 4002-730) **Distance Learning 4**

4002-819 **Integration Technologies**
This course is an in-depth study of the major interoperability technologies. Exercises are used to illustrate how modern integration technologies address the economic and technical issues related to the development of integrated systems. Programming projects are required. (4002-710,4002-725) **Class 4, Distance Format, Credit 4**

4002-820 **Economics of Software Development**
This course is an analysis of the factors that determine software cost, quality, and time to delivery. Topics include fundamentals of software development, identification of cost drivers, and analysis of productivity and quality data. Students use models to estimate software cost, delivery time, and operational reliability. (2 + years of sohare development experience and SD&M bridge) **Class 4, Distance Format, Credit 4**

4002-821 **Data Architecture and Management**
This course will focus on data architectures, issues, and strategies for managing enterprise data as an organizational information asset. The fundamental meaning and management of data is emphasized as an enabler to enterprise data integrity, enterprise data architecture, and satisfaction of enterprise business requirements. Topics include metadata management, business process integration, data and process governance, repository management, data quality, data architectures, and current technologies in information exchange. Data integration and programming projects are required. (4002-710, 4002-720) **Class 4, Distance Format, Credit 4**

4002-825 **Systems Architectures**
A programming course focused on the application of interoperability technologies. Students develop integrated systems based on software components, applications, databases, web sites, heterogeneous operating systems and networks. *(4002-8* **19) Class 4, Distance Format, Credit 4**

4002-828 **Intelligent Computer-Based Instruction**
Intelligent Computer Based Instruction (ICBI) uses the ideas of individualization and adaptation in the process of computer-based instruction. As such, ICBI pushes the limit of computer-based instruction. Using the computer as an intelligent system requires the computer to have a more sophisticated student model and content model, and a set of rules for resolving gaps between the two. Students will use emerging ICBI shells and will design and implement web-based components and modules that adjust to learner's skills and abilities. (4002-723) **Distance Learning 4**

4002-830 **Project Management**
This is a course in the methods and techniques of managing a software development project. Topics include defining project goals, work breakdown structure, defining tasks, project plans, estimation and scheduling techniques, work monitoring and measurements. (Twot years of software development experience and SD&M bridge) **Class *4,* Distance Format, Credit 4**

4002-831 **Process Management**
This is a course in the methods and techniques of managing a software development environment. Topics include development organization structure, team management, staff development, project selection and prioritization, cost/benefit analysis, role of standards, and organization communication. (2+ years of software development experience and SD&M bridge) **Class 4, Distance Format, Credit 4**

4002-836 **Game Engine Design and Development**
This course will provide students with theory and practical skills in game engine design topic areas such as understanding the graphics pipeline as it influences engine design, hardware principles and the relationship to game engine design construction, mathematical principles, scene graph construction and maintenance, advanced scenegraph manipulation, textures, materials, and lighting, collision systems, physics, particle systems, and control systems. Furthermore, this course will examine software and toolsets that assist game engine designers in their tasks. Students will be expected to design and implement a game engine in teams as well as properly document their design and development strategy. **Class 4, Credit 4, Lab 0 (4002-735)**

4002-045 **Economics of Human Performance**
This course studies the economics of human performance within organizations. Topics include community costs in information work, productivity measurement of knowledge related work, long-term value of service, and related economic topics. **Distance Learning 4**

4002-865 **Program Evaluation**
This course provides the structure for a graduate capstone experience. Students learn fundamental evaluation terminology and frameworks for program evaluation, such as the CIPP model. Designs for evaluating projects are discussed. Students will design and conduct a full scale evaluation of an online learning or knowledge management system, and will produce a formal, written document that functions as the capstone experience for the degree. (4002-810 and 4002-845) **Distance Learning 4**

4002-871 **IT and Organizational Process**
The topic of process cserver-side has become an intriguing issue as it places Information Technology as a key enabler within organizations. Information Technology offers new opportunities to integrate and improve the effectiveness of an organization's processes; both internal and customer facing. It also places a new value on information. This course will explore the importance of information, the importance of sound digital processes to the organization, and the design of a digital business (MSIT core or equivalent background/ experience) **Class 4, Distance Format, Credit 4**

4002-872 **Inter-enterprise Computing**
Managers and technologists both need to be aware of the variety of new means of doing business. Information Technology has made it possible for multiple businesses to work together as an extended enterprise, sharing full access to vital information that enables them to do business more effectively. This course presents an in-depth study of alternative ways for organizations to conduct business electronically. Additionally, business can take advantage of current means of sharing information, via Internet and functioning as extended enterprises, and ways in which they are using Internet for commercial advantage. (MSIT core or equivalent background/experience) **Class 4, Distance Format, Credit 4**

4002-873 **IT and Strategic Opportunities**
Using a variety of futuring techniques and exercises, this course prepares students to identify new strategic opportunities created by advances in information technology. The course looks at service organizations, manufacturing organizations, and also information organizations as described by Drucker. The course attempts to predict trends in technology within these types of environments, by looking for parallels in history, by mapping trends, and by examining the characteristics of new technologies according to their innovative characteristics. (MSIT core or equivalent background/lexperience) **Class 4, Distance Format, Credit 4**

4002-875 **E-commerce Implementation**
This course focuses on building and integrating the back-end components required to build a scalable e-commerce site. The course will address the concepts, issues, and programming skills specific to building components for enterprise-level e-commerce systems. Topics include search engines and inventory, ordering, and profile management systems. Programming projects required. (4004-741, 4002-720, 4002-872) **Class 4, Distance Format, Credit 4**

4002-076 **Secure E-commerce**
This course covers the concepts required to implement a secure e commerce site. Topics include the assessment of security in a proposed or an existing site, the implications of decisions impacting security and the implementation considerations needed to establish a secure site. (4002-875) **Class 4, Distance Format, Credit 4**

4002-807 **Capstone Design — MS Game Design and Development**
This course allows students within the game design and developer program to develop a capstone proposal and design document. The capstone design document specifies the scope and depth of the capstone project as well as defines the group and individual responsibilities for the cohort capstone project experience (Permission of MS Game Design and Development faculty)

4002-888 **Capstone Development — MS Game Design and 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. (4002-887 Capstone Design — MSGame Design and Development and permission of MS Game Design and Development faculty adviser)

4002-890 **Graduate Seminar in IT**
This is the IT seminar course to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given special-topics offering. Prerequisites: as appropriate for topic proposed Co-requisites: as appropriate for topic proposed **Credit 2-8**

4002-092 **CSCW and Groupware**
This course will examine the role of information technology in collaborative work settings. An overview of relevant theory, technologies, and standards will provide the context for examining the integration and strategic use of e-mail distributed networking, the Web, conferencing and enhanced messaging. (4004-745) **Class 4, Distance Format, Credit 4**

4002-893 **Seminar in Thesis and Project Preparation**
This course provides a structure, methodology and forum for the capstone experience proposal development and committee selection. (2/3 of graduate course work not including prerequisite courses) **Class 2, Distance Format, Credit 2**

4002-895 **Software Development and Management Capstone**
A presentation demonstrating current awareness and understanding of trends impacting the software development and management field. Students prepare a portfolio summarizing their course work in the SD&M program and discuss the relationship of their course work to advances in software development technology and practice. (Enrollment in last quarter of study) **Class 4, Distance Format, Credit 4**

4002-897 **MS Thesis**
Capstone experience for the Master of Science in Information Technology degree program. Students must submit an accepted thesis proposal in order to enroll. (Permission of graduate studies committee) **Credit 0-8**

4002-898 **MS Project**
Capstone experience for the Master of Science in Information Technology. Student must submit an accepted proposal in order to enroll. (Permission of the graduate studies committee) **Credit 0–8**

4002-899 **Independent Study**
The student will work independently under the supervision of a faculty advisor on a topic not covered in other courses.

4002-999 **Graduate Co-op Education**
An optional cooperative educational experience is available for those students who wish to participate in order to gain industrial experience. (Completion of bridge program and 5 core courses) **Credit 0**

4004-728 **Interactive Narrative**
This course will examine elements of narrative and storytelling within computer games. Students will learn how narrative works within these environments and how it differs from standard narrative whether the digital creation is original or derived from a traditional narrative source. Students will lek to apply different theories of Ludology (theory and critical analysis of computer games) to analysis and critique of computer games. Students will write treatments, flowcharts, storyboards and scripts for their own games and then implement prototypes based on those documents. Students will complete written assignments. (4004-731 and either 4004-737 or 4004-746 or equivalent) **Active Learning 4, Credit 4**

4004-729 **Introduction to VRML**
This course will focus on basic and advanced concepts of 3D environment creation and implementation within the Virtual Reality Markup Language (VRML) specification implemented on the World Wide Web. Students will work individually in groups to create VRML environments on their own home pages and in a larger scale group environment. *(4004-737* and 4004-742) **Class 4, Credit 4**

4004-730 **Interactive Media Development**
Students will build on their understanding of basic media types to develop interactive user interfaces to rich-media content, such as video, audio, graphics, and text. They will learn to control and synchronize multiple media assets in a variety of environments utilizing authoring tools such as Macromedia Director. Students will design and implement applications that support a high level of interactivity and develop strategies for delivering these programs via CD-ROM and the World Wide Web. Programming will be required. (4004-741 or equivalent, and 4002-231 or 4002-218, or a two-course programming sequence) Active **Learning 4, Credit 4**

4004-731 **History and Critical Analysis of Computer Games**
This course provides a historical perspective on the evolution of computer and video game design, development and production. Related interactive digital entertainment will also be investigated to provide an understanding of historical issues related to games, computer games, and interactive media. Topics include analysis and critique of analog and interactive television technology, the application of computing and technology to the arts and literature, the business of computer games and cultural responses to computer games. Students will critique computer games and other interactive entertainment products in the context of these topics, the trade press, and personal experience. **Active Learning 4, Credit 4**

4004-732 **Game World Design**
In this course, students will examine technical requirements for the creation of computer games based on previously developed design artifacts. They will create a design document consistent with current industry practices, building upon a written script, related materials and prototype and will present the draft design documents for critique. (4004-728) **Active Learning 4, Credit 4**

4004-734 **Online Identity, Social and Community Behavior**
This course introduces students to the expanding body of research and popular writing on online identity, social and community behavior and its application to the development of new online communities and social software tools. Students will create their own prototypes for online communities and/or software tools, will participate in and evaluate existing online environments. **Active Learning 4, Distance Format, Credit 4**

4004-737 **Website Design and Technologies**
Assuming a basic knowledge of HTML coding and web page design, this class moves into large-scale site development, and an introduction to advanced web technologies. Building on the web page design concepts introduced in 4004-741, this course focuses on site design issues, including scalability, maintenance, and integration of web technologies into the business or organizational context. Technologies introduced include cascading style sheets, dynamic HTML, basic JavaScript, and streaming media. (4004-741) **Active Learning 4, Credit 4**

4004-738 **Multi-User Media Spaces**
This course will focus on the development of interactive applications that use network connectivity to allow multiple users to interact with each other in real time and in a persistent virtual community. The course will integrate multiple technologies dealing with connectivity, database access, server-side logic and object-oriented programming environments. Important human-computer interaction issues will be raised around the design and processing of messages and the traffic patterns generated by multi-user messaging. *(4004-746)* **Active Learning 4, Credit 4**

4004-739 **Programming for the World Wide Web**
The World-wide Web is no longer just linked as static HTML documents. Web pages can be generated dynamically and can interact with a user to modify pages on-the-fly, validate user inputs and entertain. This course is an overview of several forms of programming that are used in the creation of interactive and dynamic web content. This course provides *a* practical overview of programming in the context of the World-wide Web. It will enable students to develop web pages and web sites that incorporate both client-side and server-side programming by installing and modifying existing scripts as well as writing new scripts. (4004-737 and a two-course programming sequence) **Class 4, Credit 4**

4004-741 **Fundamentals of Web Based Multimedia**
This class provides an introduction to web-based multimedia development and implementation. Topics covered include uses of web based multimedia in business and historical contexts, differences between web-based and stand-alone multimedia, basic HTML and web page design, digital image creation and manipulation, and the incorporation of audio, video, and animated components in web-based multimedia. Students will learn to use computer-mediated communication and Internet utilities in support of multimedia development. (Computer literacy) **Class 4, Credit 4**

4004-742 **Interactive Multimedia Development**
The development of interactive multimedia requires principles garnered from a variety of disciplines. Through readings, critiques, exercises and discussions, students will explore what makes an interactive multimedia application (or component of an application) successful and what types of applications are best suited to interactive multimedia. This course provides an introduction to the design of interactive multimedia drawing upon user interface design, task analysis, analysis of audience characteristics, and usability testing as well as design and editing principles from animation and video production. Using the hardware and software tools learned in the Fundamentals course, students will implement and test designs as individual components and as integrated elements of interactive multimedia for interactive and instructional applications. (4004-741 and 4004-745) **Class 4, Credit 4**

4004-743 **Interactive Multimedia Project**
This project-based course provides a culminating multimedia experience. Having achieved some proficiency with the tools and concepts of interactive multimedia, students are expected to produce significant work that can be used as a portfolio piece. Examples of interactive multimedia are examined and discussed. As CD-ROM is increasingly the medium of choice for distribution of interactive multimedia, design constraints for using read-only media are discussed. Techniques and principles for managing larger and more complex projects involving teams are examined. *(4004-746)* **Class 4, Credit 4**

4004-744 **Building Online Communities**
Students design and then work in teams to implement fully-functional on-line communities and/or social software tools to support on-line communities. This includes attracting members, promoting and managing their communities. Students will also evaluate the performance of their designs, their community members and their own management skills. (4004-737 and either 4004-734 or 4002-892) **Credit 4, Active Learning 4**

4004-745 **Foundations of Human-Computer Interaction**
Human-computer interaction (HCI) is a field of study concerned with the design, evaluation and implementation of interactive computing systems for effective human use and with the study of major phenomena surrounding them. This course surveys the foundation concepts and major issues of the HCI field including: cognitive psychology, human factors, interaction styles, user analysis, task analysis, interaction design methods and techniques, and evaluation. The primary focus of this course will be on the users and their tasks. **Class 4, Distance Format, Credit 4**

4004-746 **Programming for Interactive Multimedia**
The goal of this course is to advance the student's programming skills for implementing multimedia. This course will include programming the computer to control graphics, text, audio and video images as well as implement navigational strategies, indexing of information, import and export of data. This course will look at both event-driven and time-driven models of interaction. Upon completion of the course, students will achieve an understanding of basic programming concepts such as control structures, variables and procedures as well as design strategies such as defining requirements, top-down and bottom up design using applicable software engineering principles and interactive design involving users. Learning will be project-based and, whenever possible, directly related to ongoing projects. (4004-730) **Class 4, Credit 4**

4004-747 **Topics in Interactive Multimedia**
Interactive multimedia is a rapidly evolving field that is significantly influenced by changes in theory, storage media, computing hardware, authoring/presentation software and communication capabilities such as local and wide-area networks. In this course, students will be exposed to recent trends by hands-on development of interactive media projects. These will include development of interactive multimedia for use on multiple platforms, developing multimedia that can be accessed via the Internet, real-time interaction between users using networked multimedia and development of interactive CD-ROM-based multimedia. *(4004-746)* **Class 4, Credit 4**

4004-748 **Usability Engineering**
This team project oriented course stresses the importance of good software interfaces and the relationship of user interface design to human computer interaction. Topics include: the usability engineering lifecycle, effective system design and development, usability heuristics, testing, assessment methods, and international user interfaces. This course focuses on the design, testing, and development of effective user interfaces. (4004-745 and 4004-730) **Class 4, Credit 4**

4004-749 **Usability Testing**
This project-based course will focus on the formal evaluation of user interfaces. Topics include: usability test goal setting, recruitment of appropriate users, design of test tasks, design of the test environment, test plan development and implementation, analysis and interpretation of the results, and documentation and presentation of results and recommendations. (4004-748 and a statistics course) **Class 4, Credit 4**

4004-751 **Web Database Integration**
An introduction to technologies, techniques, and contexts for developing dynamic web sites that are driven by back-end databases. Builds on the concepts of web programming and multi-user relational databases introduced in prerequisite classes. (4004-737, 4004-739 and 4002-360 or 4002-720) **Class 4, Credit 4**

4004-755 **Advanced Topics in HCI**
Human-computer interface (HCI) is an evolving field. This course is designed to study the current themes and advanced issues of HCI. Topics will vary depending upon current research and developments in the field. (4004-745*)* **Class 4, Distance Format, Credit 4**

4004-757 **Graphical Elements of the User Experience**
This course provides a theoretical framework covering principles of GUI and its effect upon the user experience. Emphasis will be upon principles that guide the user toward certain behaviors and elicit a sense of identity. This course is designed to articulate methods used to manipulate visual perceptions of space and surface. Students will apply these methods to create user interfaces that reflect the utility and character appropriate for specific projects. (4004-730) **Credit 4**

4004-774 **Eye Tracking: Theory, Methodology, and Applications**
This course will provide a theoretical and practical study of eye movements and eye tracking, and will focus on the application of eye tracking to usability testing. Course topics include: eye movements and visual perception; types of eye trackers and theory of operations; data analysis; and the application of eye tracking to various domains. Laboratory projects will be required. (4004-745 and Statistics) **Class 4, Lab 0, Credit** *4*

4004-775 **Remote Usability Development and Testing**
This course will discuss the tools and procedures of remote usability testing and apply them to the development of an effective user interface. Topics include: the software development lifecycle, design and development of effective interfaces, heuristic evaluations, assessment methods, usability testing procedures and protocols, remote testing tools and procedures, and analyse testing results and propose recommendations. (4004-745, 4002-730 and Statistics, not intended for students taking 4004-748 and 4004-749) **Credit 4**

4004-780 **Application Domain in HCI**
This course will provide a theoretical and case-based study of several areas of HCI, all considered within an application domain of information technology. Application domains may include medical informatics, bioinformatics, game design, and entertainment. Course topics include: a scientific approach to ui design (usability engineering), domain-specific user analysis & user profiles, social and cultural influences, general and domain-specific design issues, information visualization, data integration, mobile devices, security, privacy and ethics. (4004-745) **Class 4, Lab 0, Credit 4**

4004-781 **Usability Economics**
User-centered design methodologies are proven enablers for developing successful systems and are important to realizing enterprise benefits. An understanding of usability economics is needed to effectively integrate usability engineering into the systems development process. This course provides students with the necessary background and methods to prepare cost-benefit analysis of applying usability engineering in a variety of system development domains. Other topics include: strategies for introducing usability engineering lifecycle into an organization; developing a usability culture; and developing enterprise usability standards. (4004-745, and 4004-748 or 4004-775) **Class 4, Lab 0, Credit 4**

4004-802 **Perspectives on Computer Mediation**
This course examines the design and implementation of software for computer mediation from several perspectives: the computer support for cooperative work (CSCW) perspective addresses activity and organization management, the computer-mediated collaboration (CMC) perspective addresses social systems for computing, and the computer supported collaborative learning (CSCL) perspective addresses collaborative and constructivist learning systems. Students will investigate the design and implementation of computer mediated experiences across several domains, including, but not limited to: social computing, pervasive and ubiquitous computing, Computer-based learning environments, entertainment and gaming systems, as well as visualization and simulation systems. Students will be required to work in teams to create a large-scale computer mediated project. (4004-730 and 4004-745) **Credit 4, Active Learning 4**

4004-804 **Building Tools for Creative Practice**
Students will be introduced to many of the patterns defining modern computer interfaces and will use them to implement a novel interface of their own design. Students will develop implementation skills for prototyping traditional and experimental interfaces for computing devices. Design patterns and classes will be used to implement components of a typical graphical user interface. Students will then apply these programming strategies to build a toolkit for a new, less conventional interaction style of their own design. Programming projects will be required. (4004-730 and 4004-745) **Credit 4, Active Learning 4**

4004-806 **Innovation, Invention, and Computer Mediated Experience**
This course considers the process and products of invention in information technology, past, present, and future. Each term we will conceive and develop a different "outside the box" project in a "tinkerer's lab". Readings, lectures, student presentations and discussions will deal with the interplay of technology, human nature and a human environment in which information technology is pervasive, ubiquitous, and (perhaps) implanted. The instructor will also guide students through a series of collaborative experiences inventing, designing, implementing and studying past and future IT. Presentations and projects are required. (4004-730 and (4004-748 or 4004-775) **Class 4, Credit 4**

4004-897 **MS HCI Thesis**
Capstone experience for the Master of Science in Human-Computer Interaction. Student must submit an accepted proposal in order to enroll. (Permission of the HCI Graduate Studies Committee)

4004-898 **MS HCI Project**
Capstone experience for the Master of Science in Human-Computer Interaction. Student must submit an accepted proposal in order to enroll. (Permission of the HCI Graduate Studies Committee)

Computer Science

4003-705 **Discrete Mathematics**
The fundamental concepts of discrete mathematics which are necessary for understanding further mathematical foundations of computer science. Topics include: structures defined on finite sets, elementary symbolic logic, patterns of mathematical proof, vectors and matrics, graphs, combinatorics, formal languages, abstract mathematical systems. The relevance of the chosen topics to computer science and the applications of computers to these topics will be stressed. (College algebra, computer literacy) **Class 4, Credit 4**

4003-707 **Advanced Programming**
The goal of this course is to introduce the language Java. Topics include class design and implementation, inheritance, exceptions, files, threads, swing, network programming, and remote method invocation. We will use object-oriented technology as a means to an end to design and implement software solutions. Programming assignments are an integral part of the course. (Object-oriented Programming + C) **Credit 4**

4003-709 **Programming Language Concepts**
A study of the syntax and semantics of a diverse set of high-level programming languages. The languages chosen are compared and contrasted in order to demonstrate general principles of programming language design. This course emphasizes the concepts underpinning modern languages rather than the mastery of particular language details. Programming projects will be required. Alternative RIT offering: 4003-450 (4003-263 or 334, Algorithms and Data Structures, 4003-705 or 1016-265) **Class 4, Credit 4**

4003-710 **Computer Organization**
An introduction to computer architecture and assembly language programming concepts and techniques. Topics include Boolean algebra, combinational and sequential circuit design, storage mechanisms and their organization, the instruction cycle in a simple CPU, assembly language programming, programming at the device level, and the role of assembly language in understanding the hardware/software interface. Digital logic and software projects will be required. (4003-334, 1016-265) **Class 4, Credit 4**

4003-713 **Operating Systems**
A general survey of operating system concepts. Topics include process synchronization, interprocess communication, deadlock, multiprogramming and multiprocessing, processor scheduling and resource management, memory management, overlays, static and dynamic relocation, virtual memory file systems, logical and physical I/O, device allocation, I/O processor scheduling, process and resource protection. Programming projects will be required. Alternative RIT Offering: 4003-440. (4003-707 or 334) **Class 4, Credit 4**

4005-700 **Foundations of Computer Theory**
Introduction to the classical and contemporary theory of computation covering regular, context-free, and computable (recursive) languages with finite state machines, pushdown automata, and Turing machines. Basic concepts of computability theory. (Algorithms and Data Structures, 1016-265, 4003-232) **Class 4, Credit 4**

4005-701 **Computability**
Computability is the heart of theoretical computer science for it is the theory which attempts to formalize the notion of computation. Topics include computation by while-programs, Turing machines, recursive function theory, symbol manipulation systems, program methodology, the limitation of the concept of effective computability. (4005-700) **Credit 4**

4005-702 **Computational Complexity**
This course is concerned with the mathematical analysis of computer algorithms. Topics include matrii operations, combinatorial algorithms, integer and polynomial arithmetic, NP-completeness, and lower bounds on algorithms involving arithmetic operations. (4005-700) **Credit 4**

4005-704 **Complexity and Computability**
This course provides an introduction to complexity theory and computability theory. It starts with an overview of basic complexity classes, with special focus on NP-theory. This is followed by a study of problems complete for NP and PSPACE, the Church-Turing thesis, and undecidability of a selection of classical problems. Some advanced topics in computability, like degrees of unsolvability, the recursion theorem, or Godel's incompleteness theorem will be discussed. (4005-700) **Class 4, Credit 4**

4005-705 **Cryptography**
The course is devoted to the review of basic cryptographic algorithms, their implementation and usage. Classical encryption techniques and those of Rivest-Shamir-Adleman and EL Gamal will be seen in depth, and an overview of several others will be presented. This course also presents authentication schemes and interactive proof protocols. Students will write a term paper, either theoretical based on literature or reporting a student's own implementation or experiments with a chosen cryptographic scheme. Depending on the size of the group, some or all students will give a presentation to the class. (4003-263 or 4003-334; 1016-265*;* set by instructor) **Class 4, Credit 4**

4005-706 **Cryptography II**
This course investigates advanced topics in cryptography, Topics include an overview of necessary background in algebra and number theory, private and public key cryptosystems, and basic signature schemes. Additional topics include number theory and basic theory of Galois fields used in cryptography; history of primality algorithms and the polynomial time test of primality; discrete logarithm based cryptosystems including those based on elliptic curves; interactive protocols including the role of zero-knowledge proofs in authentication; construction of untraceable electronic cash on the net; and quantum cryptography. Other topics may include digital watermarking, fingerprinting, and steganography. Programming will be required. (4005-705 Cryptography I or 4003-482 and permission of instructor)

4005-709 **Topics in Computer Science Theory**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: arithmetic algorithms, data encryption, the Fast Frontier Transform, combinatorial optimization, logic. Programming projects may be required. (Set by instructor) **Credit 1-4**

4005-710 **Programming Language Theory**
An introduction to the basic concepts of programming language design. It begins with a survey of the issues that are involved in the design and implementation of languages. Specific tools for the description of syntactic and semantic structure are introduced. The balance of the course is an analysis of programming language structure, using these descriptive tools to give precise form to the discussion. Programming assignments will be required. (1016-265, 4003-709) **Class 4, Credit 4**

4005-711 **Compiler Construction**
The structure of language translators, lexical and syntactic analysis, storage allocation and management, code generation, optimization, error recovery. Programming projects will be required. *(*4005-700*)* **Class 4, Credit 4**

4005-713 **XML-Architectures, Tools and Techniques**
This course is a critical review of the XML standard and its major applications for data description, transformation, storage, and transport, and in its role as a meta language for little languages used within software development and network communication. XML as a tool for language design is compared to a parser-generator based approach. The implementation of XML parsing is compared to other forms of language recognition. Students are expected to complete programming assignments, some involving Java, and give a team presentation (which includes a demonstration and online presence) about an XML-based technology available from the Internet. (4003-707 or 4003-233 or permission of instructor) **Class 4, Credit 4**

4005-714 **Programming Skills**
The goal of this course is to introduce the student to a programming paradigm and an appropriate programming language chosen from those that are currently important in industry or that show high promise of becoming important. A significant portion of the learning curve occurs through programming assignments with exemplary solutions discussed later in class. Students must complete a separate term project which will require some skills not discussed in class. The instructor will post specifics prior to registration. With the approval of the program coordinator, this course can be taken for credit more than once, provided each instance deals with a different paradigm and language. (4003-707 or 4003-233 or permission of instructor) **Credit 4**

4005-715 **Language Based Security**
This course explores the two major roles played by programming language-based mechanisms in developing secure systems that share mobile data or code. First, the course covers principles and practice of secure coding including topics such as good versus bad code, design, and implementation; security principles and architectures; and automation and testing. Second, the course examines techniques based on language design and implementation including topics such as secure operating system structures; software based fault isolation; reference monitors; type-safe languages; certifying compilers; proof-carrying code; automated program analysis and program rewriting. Computing projects are required. (4003-440, 713 and 4003-709 or permission of instructor) **Class 4, Credit 4**

4005-719 **Topics in Programming Languages**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: logic programming, data flow, functional or applicative, and object oriented languages, programming language semantics, formal verification. Programming projects will be required. (Permission of the instructor, completion of the bridge program) **Class 1-4, Credit 1-4**

4005-720 **Computer Architecture**
Review of commercially available computer systems, including classical CPU and control unit design, register organization, primary memory organization and access, internal and external bus structures, and virtual memory schemes. Alternatives to classical machine architecture such as the stack machine and the associative processor are defined and compared. Parallel processors and distributed systems are also presented, along with an analysis of their performance relative to nonparallel machines. Programming projects are required. (4003-710, 4003-707, 4003-713) **Class 4, Credit 4**

4005-729 **Topics in Computer Architecture**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Programming projects will be required. (Permission of the instructor, completion of the bridge program) **Class 1-4, Credit 1-4**

4005-730 **Distributed Operating Systems I**
An introduction to the study of the hardware and sohare issues affecting the design of a distributed operating system. This course begins with an overview of processor networks and network protocols. It continues with a discussion of the issues that must be addressed in the design of a distributed operating system. The remainder of the course focuses an protocols and algorithms for handling process communication, synchronization, and coordination. (4003-709 and 4003-713) **Class 4, Credit 4**

4005-731 **Distributed Operating Systems II**
This course addresses the practical issues involved in the design of a distributed operating system. The following topics are discussed: implementations of the process environment, processor scheduling, file systems, and the management of distributed memory. Examples of specific implementations will be discussed. Other topics (e.g., security) may be covered, at the discretion of the instructor. A group or individual project, involving the design and implementation of one or more components of a distributed operating system, will be a major component of this course. (4005-730) **Class 4, Credit 4**

4005-735 **Parallel Computing I**
A study of the hardware and software issues in parallel computing. Topics include an introduction to the basic concepts, parallel architectures and network topologies,. parallel algorithms, parallel metria, parallel languages, network topology, granularity, applications, parallel programming design and debugging. Programming projects will be required. (4003-713) **Class 4, Credit 4**

4005-736 **Parallel Computing II**
A study of selected topics in parallel algorithm design through the analysis of algorithms used in various areas of application. This course will investigate the interplay between architecture and algorithmic structure and will discuss the effect that these issues have on the complexity and efficiency of parallel algorithms. Programming projects are required. (4005-735) **Class 4, Credit 4**

4005-739 **Topics in Operating Systems**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: Unix internals, concurrency methods, Petri Nets, parallel programming and algorithms, security, operating systems performance, software environments, communicating sequential processes ("CSP"). Programming projects will be required. (Permission of the instructor, completion of the bridge program) **Credit 1-4**

4005-740 **Data Communication and Networks I**
This course is an introduction to the concepts and principles of computer networks. Students will design and implement projects using application protocols, and will study transport, network, and data link protocols and algorithms. This course also includes an introduction to local area networks, data transmission fundamentals, and network security. Programming projects will be required. (Probability, 4003-707) **Class 4, Credit 4**

4005-741 **Data Communication and Networks II**
This course continues the study of computer networks begun in 4005-740 Data Communications and Networks I, emphasizing design principals and theoretical aspects of networks. Topics include the nature of communications media and signaling methods, analog and digital transmission, data link protocols, protocol proof techniques, routing, broadcasting, and multicasting, connection, disconnection and crash recovery protocols, internetworking and security, network analysis and design using graph theory and queueing theory. (4005-740*)* **Class 4, Credit 4**

4005-742 **Ad-hoc Networks**
This course explores serverless ad-hoc networks. Topics include authentication, confidentiality, routing, service discovery, middleware and key generation and key distribution. Programming projects are required. (CSI-CS3 or 4003-707, 4003-420 Data Communications and Networking) **Class 4, Credit 4**

4005-743 **Secure Operating Systems Network**
This course provides students with an introduction to the issues surrounding security aspects in operating systems and networks. Case studies will be used to illustrate security issues in operating systems and networks, Topics include but are not limited to the orange book, access control, firewalls, and an evaluation of the security aspects in a distributed system. Where appropriate, programming exercises will be used to improve understanding of security issues. Exercises may involve group as well as individual projects. It is expected that student presentations will be given during the quarter. (4005-740 and 4003-440 or permission of instructor) **Class 4, Credit 4**

4005-749 **Topics in Data Communication**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: network reliability, special-purpose protocols, error-correcting codes. Programming projects will be required. (Permission of the instructor, completion of the bridge program) **Class *1-4,* Credit *1-4***

4005-750 **Introduction to Artificial Intelligence**
An introduction to the field of artificial intelligence, including both theory and applications. A programming language that allows effective symbolic manipulation (PROLOG) is used to demonstrate the capabilities and limitations of the material presented in class. Topics include search strategies and their implementation, logic, networks, frames and scripts, production, symbolic manipulation and list processing, problem-solving methods, expert systems, natural language understanding, and selections from vision, robotics, planning and learning. Programming assignments are an integral part of the course. (4003-709) **Class 4, Credit 4**

4005-751 **Knowledge Based Systems**
An introduction to the issues and techniques of building knowledge based systems. Topics will include a survey of existing expert system architectures and implementations, knowledge representation techniques, expert system building tools, and knowledge acquisition. In addition to examining existing expert systems, students will implement expert systems. Programming projects will be required. (4005-750) **Class 4, Credit 4**

4005-752 **Artificial Intelligence for Interactive Environments**
This course delves into the use of artificial intelligence in interactive environments. These environments range from the entertaining nature of role-playing games to more serious military simulations. In all these environments, agents and groups of agents must interact in an intelligent manner. Topics will include advanced pathfinding algorithms, sensory systems, group tactical strategies, and learning algorithms. Projects are an inherent part of the course. (4003-455, 4005-750 or permission of instructor) **Class 4, Credit 4, Lab 1**

4005-753 **Biologically Inspired Intelligent System**
This course examines contemporary topics in artificial intelligence in neuroscience, cognitive science and physiology. Students will focus on developing computer models that are biologically inspired and leverage current knowledge in these areas with the goal to develop systems that understand their environment. An in-depth research paper on a relevant topic, a programming project, and a presentation will be required. A background in biology is not required. (Graduate standing in CS or permission of instructor) **Credit**

4005-755 **Neural Networks and Machine Learning**
Neural networks, systems with massively connected parallel primitive computing elements, are, metaphorically, computers structured after natural brains. Such systems promise much better performance than classical computers at pattern recognition and related areas. In this seminar, we will present several neural network models, introduce the current research activity, and develop some underlying mathematics. Students will have the opportunity to develop and present models, both paper and software simulated, and to utilize canned simulators. Students will be exposed to the current research literature. Programming projects will be required. (4005-700 and completion of bridge) **Class 4, Credit 4**

4005-756 **Genetic Algorithms**
Genetic algorithms provide a powerful approach for searching large, ill-behaved problem spaces. In this course, we will study the theoretical foundations of genetic algorithms as well as their application to a variety of search and optimization problems. This course will cover topics from the current research literature, and students will be expected to do a library research review and perform an experimental project. Programming projects will be required. (4005-700,4005-710) **Class 4, Credit 4**

4005-757 **Introduction to Computer Vision**
An introduction to the underlying concepts of computer vision and image understanding. The course will consider fundamental topics, including image formation, edge detection, texture analysis, color, segmentation, shape analysis, detection of objects in images and high level image representation. Depending on the interest of the class, more advanced topics will be covered, such as image database retrieval or robotic vision. Programming assignments are an integral part of the course. (Completion of bridge) **Class 4, Credit 4**

4005-758 **Advanced Computer Vision**
This course examines advanced topics of current research interest in computer vision including motion analysis, video processing and model based object recognition. The topics will be studied with reference to specific applications, for example video interpretation, robot control, road traffic monitoring, and industrial inspection. A research paper, an advanced programming project, and a presentation will be required. (4005-757 or permission of instructor) **Credit 4**

4005-759 **Topics in Artificial Intelligence**
Current topics in the field. The format of this course is a combination lecture and seminar. Students may register for this course more than once. Topics covered in the past include: logic programming, natural language processing, pattern recognition, specialized AI languages and programming paradigms, robotics. Programming projects will be required. (Permission of the instructor, completion of the bridge program) **Class 1-4, Credit 1-4**

4005-761 **Computer Graphics I**
A study of the hardware and software principles of computer graphics. Topics include an introduction to the basic concepts: 2-D transformations, viewing transformations, display file structure, geometric models, picture structure, interactive and noninteractive techniques, raster graphics fundamentals, 3-D fundamentals, graphics packages and graphics systems. Students use and develop a graphic software system based on an accepted graphics standard. Programming projects are required. (4003-707 or 4003-234) **Class 4, Credit 4**

4005-762 **Computer Graphics I1**
This course will investigate the theory of computer image synthesis. Seminal computer graphics will be used to describe the various components of the image synthesis pipeline and explain, just as in photography, how the path of lights in a virtual scene can be simulated and used to create photorealistic imagery. The course will emphasize the theory behind rendering tools and libraries available for image synthesis. The student will put theory into practice via programming assignments and a capstone project. (Computer Graphics I) **Class 4, Credit 4**

4005-763 **Computer Animation-Algorithms and Techniques**
This course takes a look at Computer Animation from a programmer's perspective. It will investigate the theory, algorithms and techniques for describing and programming motion for virtual 3D worlds. Approaches that will be explored include keyframing systems; kinematics, motion of articulated figures, procedural and behavioral systems, and the use of motion capture data. This course is a programming-oriented course with major deliverables including the implementation of techniques presented in lecture as well as a final project concentrating on an area of a student's choice. Students enrolling in this course are expected to have proficiency in the use of a 3D API (e.g. OpenGL, DirectX, Java3D). The course will additionally prepare graduate students to do research in this area through reading, summary, and survey of papers from the animation literature. (4005-761 or 4002-735 or permission of instructor)

4005-769 **Topics in Computer Graphics**
This project-oriented course builds on topics developed in 4005-761, Computer Graphics I. Expanded topics include standard graphics software, animation techniques, 3-D modeling methods, hidden surface and line algorithms, shading, antialiasing, color models and design of the user interface. Students will be required to design and implement an interactive system for an application that incorporates several of the above areas. Programming projects will be required. (4005-761 or permission of the instructor) **Class 4, Credit 4**

4005-771 **Database Systems**
Broad introduction to database management systems (DBMS) and the design, implementation, and applications of databases. Topics include an overview of DBMS architectures, concepts and implementations of the relational model, SQL, database design and modeling techniques, and issues such as recovery, concurrency, physical implementation concerns and performance and management aspects. Optimal topics include: alternative approaches to designing database systems (for example, object-oriented or extended relational systems), distributed databases, database machines, and database interfaces and languages. A programming project is required. (4003-334) **Class 4, Credit 4**

4005-772 **Database Systems Implementation**
This course covers data structures and algorithms used to implement database management systems. Topics include physical data organizations, indexing and hashing, query processing and optimization, database recovery techniques, transaction management, concurrency control, and database performance evaluation. Current research topics in database system implementation are explored. Programming projects will be required. (4003-771) **Class 4, Credit 4**

4005-774 **Secure Database Systems**
This course explores policies, methods and mechanisms for protecting enterprise data. Topics include data reliability, integrity, and confidentiality; discretionary and mandatory access controls; secure database architectures; secure transaction processing; information flow, aggregations, and inference controls, and auditing; security models for relational, object-oriented, statistical, XML, and real time database systems. Programming projects are required. (4002-484, or 4003-485, or 4010-443 or equivalent) **Class 4, Credit *4***

4005-775 **Introduction to Data Mining**
This course provides an introduction to the concepts and techniques used in the field of data mining. The course covers the knowledge discovery process that includes data selection, cleaning, coding; different statistical, pattern recognition and machine learning techniques; and reporting and visualization of generated structures. Computing projects, a term paper and presentations are required. (4005-771) **Class 4, Credit 4**

4005-779 **Computer Science Seminar**
This course explores policies, methods and mechanisms for protecting enterprise data. Topics include data reliability, integrity, and confidentiality; discretionary and mandatory access controls; secure database architectures; secure transaction processing; information flow, aggregation and inference controls, auditing; security models for relational, object-oriented, statistical, XML, and real-time database systems. Programming projects are required. (4002-484 or 4003-485 or 4010-443 or 4005-771 or permission of instructor)

4005-784 **Privacy and Security**
This course provides students with an introduction to the issues surrounding security of computer systems and privacy concerns in an increasingly information-based society. This class will consider numerous social issues in computing, including risks and liability involved in using information as well as ethical concerns. Case studies will be used to illustrate both common and historic problems in computer security. Group and individual programming projects will be used to improve understanding of security issues. Students will research specific areas of interest and report their results to the class. (4003-420 and 4003-713) **Class 4, Credit 4**

4005-800 **Theory of Computer Algorithms**
A study of techniques to design and analyse the complexity of algorithms. This course will make students aware of a large number of classical algorithms and their complexity and will introduce the area of NP-completeness. Programming projects will be required. (Algorithms and Data Structures and 4003-705 or 1016-265) **Class 4, Credit 4**

4005-890 **MS Thesis**
Capstone of the Master's Degree Program. Students must submit an acceptable thesis proposal in order to enroll. (Permission of the graduate studies committee; 4005-893) **Credit 0-9**

4005-891 **MS Project**
Alternative capstone of the Master's Degree Program. Student must submit an acceptable project proposal in order to enroll. (Permission of the graduate studies committee. (4005-893) **Credit variable 2–5**

4005-893 **MS Project/thesis Seminar**
In this course the student will develop a Master's Project or Thesis topic. It will be necessary for the student to make presentations in the class, form a committee and write a Master's Proposal. This course must be completed prior to registering for 4005-891. (Complete 16 graduate hours with a minimum 3.0 GPA) **Class 2, Credit 2**

4005-898 **Independent Study**
A supervised investigation of selected topics within computer science. Consent of the sponsor and departmental approval are required. **Credit 1-4**

4005-899 **Seminar**
Current advances in computer science (set by instructor). **Credit 4**

4005-999 **Graduate Co-op Education**
Six months of full-time, paid employment in the computing field. See the CS graduate program coordinator or RIT's Office of Cooperative Education for further details. (Good standing, completion of bridge and 16 graduate credits) **Credit 0**

Software Engineering

4010-710 **Research Methods**
Overview of the academic research methodologies used in graduate level work. Topics include: writing style, audience analysis, research planning, experimental design, document structure, research validation, and the process for submission and review to conferences and journals.

4010-748 **Secure Software Engineering: Requirement**
Overview of the secure software issues and principles that should be addressed during requirements of engineering and design. Topics include: risk management and software requirement specification. Designing for security and security in implementation.

4010-758 **Secure Software Engineering: Verification**
Overview of the secure software issues and principles that should be addressed during testing. Topics include: test planning, security goal test planning, testing tools, testing security requirements, testing the security of a design, grey box testing techniques, acceptance testing techniques, and contemporary issues regarding testing for security.

Computing and Information Sciences

4040-810 **Research Methods**
This is a core course of the Ph.D. in the computing and information sciences program. 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 the literature review, and provides initial study in correlational and experimental research methods and design. Students will analyse several existing research studies, and design and conduct studies.

4040-820 **Discovery**
This is a core course of the Ph.D. in the computing and information sciences program. This course explores the theory and practice of discovering information from large data sets. Topics include data informatics, knowledge discovery, data visualization, information sharing and presentation, and ethical issues underlying access and interpretation of large datasets.

4040-830 **Connectivity**
This is a core course of the Ph.D. in the computing and information sciences program. This course provides coverage of connectivity in communication, computing, and naturally-occurring networks. Topics include fundamental and emerging concepts in networking, and the analytical and heuristic tools that people use to develop and analyse networks.

4040-840 **Security and Trust**
This is a core course of the Ph.D. in the computing and information sciences program. This course discusses theoretical, social, policy and procedural, and human factors aspects that effect general security in a computing environment. Course topics are: cryptography, network security, policies and procedures, access control, secure software engineering, and human factors of security.

4040-850 **Design**
This is a core course of the Ph.D. in the computing and information sciences program. This team and project oriented course stresses the systems approach to problem solving in the context of "use-inspired basic research." The course provides an overview of design processes, methods and tools. Topics include various types of systems and their lifecycles and process frameworks; effective system design representations and development methods; usability heuristics, testing, and assessment methods, product line domain engineering concepts; project planning and oversight tools.

Networking, Security & Systems Administration

4055-721 **Perl for System Administration**
This course will provide students with an introduction to the Perl programming language, with examples and problems drawn from the system administration arena. In addition to the essentials of the language, students will be taught how to locate and install Perl Modules for use on a computing system. Toward the end of the course, OOPerl (Object Oriented Ped) will be introduced, as an extension to modules. Application areas discussed will include programs for walking the files system, user account creation and manipulation, and the processing of log files. (Completion of a two-course object oriented programming sequence) **Class 4, Credit 4**

4055-726 **Research Methods NSSA**
This seminar introduces students to the MS in Networking, Security, and System Administration by providing an opportunity to meet the faculty involved in the program and their fellow students. Students will learn about current areas of research in networking, security, and system administration and the areas of research interest of the faculty. To encourage students to begin thinking about their final thesis, students will develop a research proposal that may serve as the basis for their later thesis proposal. In addition, this course provides an overview of the academic research methodologies used in graduate level work. Topics include: experimental research, correlation, experiment observation, surveys, and case studies. Also included will be document structure, validation, and the process for submission and review to conferences and journals. **Class 4, Credit 4**

4055-746 **Telecommunications Network Protocols**
Network topologies are discussed, with coverage of layers, 1, 2, 3, and 4. Access control, framing, network protocols, (IP) transport protocols (TCP and UDP), session initiation protocols (SIP), subnetting, port numbers, hubs, switches, routers, and other topics are covered. (No prerequisites) **Class 4, Credit 4**

4055-755 **Secure Wireless Networks**
Providing security in today's complex networks is a difficult subject and requires network managers to be well versed in the many aspects comprising network security. In order to accommodate the rapid expansion of networks and the alarming rate in which network security is breached, there is a need for more and better educated people who understand the basics of security in a networked world. This course is designed to provide students with the foundation needed to understand the problems of network security, perform a risk analysis to ascertain the threats and cost of an attack, and design and implement security strategies to effectively build a defense to minimize the effects of these attacks. (4050-413 and 4050-515 or 4055-815 or matriculation into the masters in security program) **Class 4, Credit 4**

4055-760 **Computer Viruses and Malicious Software**
This course involves the study of malicious software (Malware) including computer viruses, worms, and Trojan horses. Topics include the various mechanisms used in the construction of malicious software; existing commercial anti-virus software; preventative and reactive means for dealing with malicious software on workstations, servers and in networks; training and education of users; and reliable sources to monitor for alerts as well as the prevention of hoaxes. (4055-716 or equivalent) **Class 3, Lab 2, Credit 4**

4055-761 **Principles of System Administration**
Students are introduced to fundamental system administration topics and technologies that serve as the basis for later course work in system administration. Topics covered include; ethics and system administration, the law and system administration, and the role of the system administrator in organizations. Technologies covered include: computing resource management, the TCP/IP protocol suite, the Domain name Service (DNS), the Dynamic Host Configuration Protocol (DHCP), and the Lightweight Directory Access Protocol (LDAP). Students will use the Remote Laboratory Emulation System (RLES) to complete laboratory exercises. (4050-340 and 4050-341 or equivalent) **Class 4, Credit 4**

4055 -780 **Computer System Security**
This course provides an introduction to computer system and network security. The areas covered will include the liability, exposure, opportunity, and ability to exploit various weaknesses in a networked computer environment. The forms of the attacks and the detection and defense of the attacks will be discussed. The techniques and facilities available to both the intruder and administrator will be examined and evaluated with illustrative laboratory exercises. (4055-761 or equivalent, corequisite: 4055-780 lab) **Class 3, Lab 2, Credit 4**

4055-782 **Wireless Adhoc/Sensor Networks**
This course will introduce students to the diverse literature on ad hoc/sensor networks, and expose them to the fundamental issues in designing and analyzing ad-hoc/sensor network systems. Students will study related technologies and standards ranging from networking, OS support and algorithms, to security. Of primary concern will be protocol design, communication and computational challenges posed by these systems. Activities will include constructing ad-hoc/sensor networks, programming on the sensor hardware, and studying the performance of various protocols. (4055-746 and a two-course sequence in object-oriented programming) **Class 3, Lab 2, Credit 4**

4055-815 **Introduction to Routing and Switching**
This course is a laboratory-based course on the establishment of a data stream across the Internet. The focus is on providing a TCP/IP data stream for higher level services to operate over. It is primarily concerned with the network layer and below. Protocol suites other than TCP/IP may be studied. Students will learn how to connect together computers in a network, and then how to connect the separate networks together to form an internetwork. Bridging and switching concepts are investigated (such as the resolution of bridging loops through the appropriate algorithms). Routed and routing protocols and algorithms are studied and implemented. (4050-342; corequisite: 4050-815 lab) **Class 3, Lab *2,* Credit *4***

4055-816 **Introduction to Network Administration**
This course investigates the key components of network services. Topics include DHCP, DNS, LDM, NetBIOS and SNMP As time allows, other related topics such as finger, ph, who is will be explored. This course involves significant laboratory work. (4050-342 and 4050-402, corequisite: 4055-816 lab) **Class 3, Lab 2, Credit 4**

4055-817 **Emerging Network Technologies**
The Internet has experienced profound growing pains in the last several years that have called into question the adequacy of some of the underlying technologies upon which it has been based. In response to this there are a substantial number of emerging network technologies that if widely adopted may allow the Internet to continue to grow and develop. This course is designed to provide students with an overview of several of these emerging network technologies. The course will consist of a combination of lectures, independent labs and simulation and modeling exercises. **Class 4, Credit 4**

4055-818 **Network Management**
This course will introduce students to the advanced concepts related to the development and implementation of network management tools utilizing a scripting language and the simple network management protocol (SNMP). Theoretical concepts related to network management and tool development will be discussed as well as the requirements of tool use in an enterprise scale network environment. Scripting and programming projects required. (4055-817) **Class 3, Lab 2, Credit 4**

4055-822 **Introduction to Network Programming**
Network Programming is a course in the writing of simple client/server programs, using the TCP/IP network protocol stack. It works through the establishment of simple connectionless communications, through connection-oriented communications, to multi-client connection oriented communications. The objective is to expose the workings of TCP/IP at the transport layer, and provide the student with experience in writing simple network applications. (4002-216 or 4002-218 and 4055-815; co-requisite: 4055-822 lab) **Class 4, Lab 2, Credit 4**

4055-841 **Advanced Computer Forensics**
This course provides students with knowledge and understanding of computer forensics. It will also provide a theoretical foundation for the techniques and methods needed for the extraction of information from digital devices. Students will gain exposure to the spectrum of available computer forensics tools along with developing their own tools for "special needs" situations. The core forensics procedures necessary for ensuring the admissibility of evidence in court, as well as the legal and ethical implications of the process, will be covered on both Unix and Windows under multiple file systems. (4055-716 (or equivalent) and 4055-761 (or equivalent) **Class 4, Credit 4**

4055-850 **Network Design and Performance**
This course will examine the factors that impact the design and performance of computer networks. Students will use simulation tools to design networks based on identified needs, analyse the performance of these networks, and investigate the impact of design alternatives. Designs for site, campus, and enterprise networks, which combine WAN and LAN technologies, will be investigated. Consideration will also be given to the incorporation and impact of business goals and security needs. (4055-746) **Class 4, Credit 4**

4055-862 **Advanced Routing Protocols**
Managing complex network environments requires an understanding of the sophisticated routing protocols necessary for controlling information flow. This course will examine the routing protocols in standard use and their application in typical enterprise and large Internet service provider (ISP) environments. The advantages and disadvantages of each protocol will be investigated. In addition, emerging networking technologies and the protocols needed to facilitate their implementation will also be discussed. *(4*055-746 or equivalent) **Class 4, Credit 4**

4055-863 **Protocol Design and Implementation**
Students will use a package that provides them access to the lowest layers of the OSI model available to software. Employing this package, students will write programs to interact with established protocols, and to implement their own protocols. What a protocol is will be discussed and what makes a protocol good or bad will also be explored. (4055-746 and 4055-716) **Class *5,* Credit 4**

4055-882 **Enterprise Security**
This course is designed to provide students with the advanced concepts needed to establish network security strategies to ensure adequate protection for the corporate environment and yet provide accessibility for the corporate community. (4055-815, 4055-816 or 4055-761) **Class 4, Credit 4**

4055-883 **Enterprise Networking**
This course will provide students with the knowledge and understanding to apply modeling and simulation techniques to predict throughput in large-scale enterprise networks. Theoretical concepts of large-scale networks will be discussed and students will create software models based on this theory. This course will provide students with the knowledge needed to apply available tools for modeling network functionality to determine the impact of network infrastructure modification, device reconfiguration, and the impact of new application rollout. Modelin/simulation project required. (4055-850) **Class 4, Credit 4**

4055-884 **Enterprise Service Provisioning**
Advances in server sohare and hardware have made it possible for large organizations to consolidate software services onto fewer, higher powered servers while at the same time enhancing reliability and availability. This course will explore available technologies such as cluster computing and server virtualization as they can be used to deploy software services in enterprise environments. (4055-818) **Class 4, Credit 4**

4055-890 **Graduate Seminar in NSSA**
This is the NSSA seminar course to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given special-topics offering. (As appropriate for topic proposed) **Credit 2–8**

4055-896 **Proposal Development**
This course will guide students in the development of a proposal for the completion of a thesis in networking and system administration. As part of this course, students will learn about the different parts of a proposal and the relationship of a proposal to a completed thesis. As part of this course, students will meet with potential thesis advisors in their area of concentration and discuss with them potential thesis topics.

4055-897 **MS NSSA Thesis**
This is the capstone experience for the Master of Science in networking and system administration. Students must submit an accepted proposal in order to enroll. (Permission of instructor) **Credit 4**

4055-899 **Graduate Independent Study in NSSA**
Graduate students will work with a supervising faculty member on a project of mutual interest. Project design and evaluation will be determined through discussion with the supervising faculty member and documented through completion of an independent study form to be filed with the Department of NSSA.

Kate Gleason College of Engineering

www.rit.edu/~6430www

Programs

= *Online learning option available*

Harvey J. Palmer, Dean

The Kate Gleason College of Engineering offers comprehensive, innovative graduate programs in a range of engineering disciplines. Programs include traditional master of science degrees, master of engineering degrees, and a broad-based, cross-disciplinary Ph.D. in microsystems engineering. The College of Engineering, in conjunction with the College of Science, also offers an interdisciplinary MS degree in materials science and engineering.

The master of science degree is research based and leads to either employment in an industrial environment or to further graduate study at the doctoral level. The master of engineering degree is primarily a terminal master's program leading to industrial employment. An industrial internship, engineering case study, or opportunity for substantial cross-disciplinary studies replaces the traditional thesis requirement.

Day, late afternoon, and evening classes were designed to meet the needs of both working professionals and full-time students.

Details of specific programs, including courses, research activities, thesis requirements, and assistantships are outlined on the following pages. For information about the interdisciplinary master of science degree in materials science and engineering, offered jointly with the College of Science, please visit the department website at www.rit.edu/~670www/CMSE/.

Study options

Full-time study

The large variety of graduate programs in engineering allows students to matriculate on either a full-time or part-time basis. A full-time student will generally take between 12 and 18 credits per quarter, depending upon their research or graduate project activity. A full-time student in a master of engineering degree program may choose to alternate academic quarters with an internship. A full-time student can normally complete the degree requirements in one calendar year.

Part-time study

The Kate Gleason College of Engineering encourages practicing engineers in the greater Rochester industrial community to pursue a program of study leading to the master of science or master of engineering degree without interrupting their employment. Consequently, many of the courses in the graduate programs in engineering are normally scheduled in the late afternoon or early evening.

Students employed full time in industry are limited to a maximum of two courses or 8 credits each quarter. A student who wishes to register for more than 8 credits while employed full time must obtain the approval of his or her adviser and the department head.

It is possible for a student to obtain the MS or ME degree in two academic years (or six academic quarters) by taking courses in late afternoons or early evenings only.

Admission requirements

Any student who wishes to become a candidate for the master's degree must first be formally admitted to the appropriate graduate program. Formal admission to a graduate program gives matriculated status to a student.

An applicant may be considered for admission as a graduate student if he or she has received a bachelor's degree in engineering, or a closely related field, from an approved undergraduate school. Graduate applicants who do not fully satisfy all admission criteria, such as appropriate baccalaureate degree, grades, and other credentials, may be considered for admission with the condition that they take the appropriate bridge courses to make up their deficiencies. Such courses will not normally count toward the graduate credits required for the master's degree. All applicants who are admitted prior to the conclusion of their baccalaureate program are required to submit their final transcript by the end of the first quarter of graduate work.

To be considered for admission it is necessary to file an Application for Admission to Graduate Study accompanied by the appropriate transcripts of previous undergraduate and graduate study, and two letters of recommendation.

Nonmatriculated status

An individual may take graduate courses as a nonmatriculated student if he or she has a bachelor's degree from an approved undergraduate school and the necessary background for the specific courses in which he or she wishes to enroll. The courses taken for credit can usually be applied toward the master's degree when the student is formally admitted to the graduate program at a later date. However, the number of credits that will be transferred to the degree program from courses taken at RIT as a nonmatriculated student is normally limited to a maximum of 12 credits.

Those who wish to enroll in a graduate course as a nonmatriculated student must obtain permission from the graduate program coordinator in the department and the course instructor.

In general, applicants are required to submit scores from the Graduate Record Examination (GRE) for admission into the master's degree programs. Please contact each individual department for more information. The exam is also required for admission into the Ph.D. program in microsystems engineering.

Plan of study

The programs are flexible and afford students an opportunity to plan a course of study suited to their interests and educational objectives. Each graduate student should submit a plan of study to the department office within the first year after admission as a graduate student. To assure a coherent program, and one which reflects the student's maturing capacities and aims, the plan may be revised on request.

Transfer credits

A maximum of nine quarter credits in a 45 credit hour program or 12 quarter credits in a 48 credit hour program can be transferred from graduate courses taken outside the university. To be considered for transfer credit, the courses must have been taken within a five-year period prior to the date of the student's initial entry into a graduate program in engineering at RIT. Courses taken at another institution after the student's initial entry into a graduate engineering program at RIT are also eligible for transfer credit. However, to ensure transferability, prior approval should be obtained. The student should contact the individual department office about the procedure for obtaining transfer credits.

Faculty adviser

A member of the faculty is appointed as a faculty adviser for each graduate student. The faculty adviser supervises the progress of the student toward the master's degree. For master of engineering programs that include an internship, a second adviser (for the internship) will be assigned at the time that an internship proposal is submitted. This adviser will monitor and evaluate the student's internship experience (in cooperation with the student's industrial supervisor) and recommend to the department head the number of academic credits to be awarded for the experience.

Grade requirements

The average of the grades for all courses taken at the university and credited toward the master's degree must be at least a "By' (3.0). Transfer credits from other institutions and internship

credits are not included in the computation of the cumulative grade point average. The policy on probation and suspension is explained in the section "Steps Toward Degree" in this bulletin. The student must pay careful attention to that policy. If a student fails any required examination, the student's adviser may recommend to the dean that the student's performance be reviewed and appropriate action taken.

Thesis

For the MS student the thesis requirements vary among the different departments. The requirements of an individual department are stated in the sections describing each department's programs.

The thesis must comply with the following regulation: Three copies of the thesis must be submitted to the departmental office before the certification date of the quarter in question, These copies are for transmittal to the university library, the departmental office, and the student's thesis adviser. For detailed instructions about the organization of the thesis, the student should consult the brochure "Thesis Format," available at the departmental office.

Internship

For master of engineering programs in which an industrial internship is an integral part of the program, a minimum of four and a maximum of 16 credits may be earned through the student's internship experience in a full-time engineering position. The internship is selected to reflect each student's primary professional interest and is integrated with his or her curriculum.

Maximum limit on time

The required credits for the master's degree must be completed within seven years after the student's initial registration in graduate courses at the university as a regular or nonmatriculated student.

Courses of instruction

Information about the courses that will be offered in a particular quarter will be available from the department office prior to registration. The university reserves the right to withdraw any course for which enrollment is insufficient or to make any changes in the schedule of courses, if necessary.

Financial aid

A limited number of teaching assistantships, research assistantships, and tuition scholarships are available for graduate students. Detailed information is available from the appropriate department head.

For information

For specific questions on the individual department programs contact:

Computer Engineering (585) 475-2987 (Savakis)
Electrical Engineering (585) 475-2165 (Amuso)
Industrial and Systems Engineering (585) 475-2598 (Mozrall)
Mechanical Engineering (585) 475-5788 (Hensel)
Microelectronic Engineering (585) 475-6065 (Kurinec)
Microsystems (585) 475-2295 (Abushagur)
Applied Statistics (585) 475-6990 (Voelkel)
Product Development (585) 475-7971 (Smith)

Questions on course schedules and registration:
Computer Engineering (585) 475-5873
Electrical Engineering (585) 475-2164
Industrial and Systems Engineering (585) 475-2598
Mechanical Engineering (585) 475-5788
Microelectronic Engineering (585) 475-6065
Microsystems Engineering (585) 475-2145
Applied Statistics (585) 475-2033
Product Development (585) 475-7102

Computer Engineering Department

Andreas Savakis, Department Head
585-475-2987, axseec@rit.edu

The College of Engineering offers a master of science degree in computer engineering intended to build upon a bachelor of science degree in computer engineering or a related discipline. The objectives of the MS degree are: to provide graduates with a higher level of specialized knowledge in the area of computer engineering, to strengthen their ability to successfully formulate solutions to current technical problems in computer engineering and to offer a significant independent learning experience in preparation for further graduate study or for continuing professional development at the leading edge of the computer engineering discipline. The MS program is expected to accommodate recipients of BS degrees in other majors, such as electrical engineering or computer science, after some additional bridge courses.

Curriculum

The degree requires 45 quarter credits that includes the four-course core curriculum. The requirements also include three courses within an area of concentration, two graduate electives subject to faculty adviser's approval, and 9 quarter credits of thesis research. Core courses and graduate electives are meant to provide breadth of knowledge. The graduate concentration allows a student to pursue an area of specialization in the field of computer engineering by completing a cohesive set of three courses beyond the core degree requirements. This provides the student with enough depth to conduct meaningful thesis research. The graduate committee must approve the student's chosen thesis research topic. The committee consists of at least three faculty members, the majority of whom are computer engineering faculty. The committee chairperson normally serves as the student's faculty adviser.

Master of Science in Computer Engineering

www.ce.rit.edu/academics/msce.htm

Master's degrees in computer engineering core courses:

0306-730	VLSl Design
0306-740	Analytical Topics for Computer Engineers
0306-756	Multiple Processor Systems
0306-759	Principies of Digital Interfacing

The graduate curriculum will require the following courses above a BS degree in computer engineering:

Four courses of the core curriculum (16 quarter credits)
Two courses in graduate electives (eight quarter credits)
Three courses in concentration (12 quarter credits)
Nine credits in master's thesis research
45 quarter credits total

Thesis research

One critically important aspect of graduate study is the student's preparation to lead challenging, state-of-the-art technical projects. To do this effectively, it is essential that the graduate student obtain experience in reviewing related work of others in the field, as well as conducting meaningful independent research under a faculty mentorship. The graduate thesis is the degree component that addresses these issues.

Thesis work begins by selecting a faculty adviser, identifying a thesis topic, forming a thesis committee, and submitting a thesis proposal. The thesis topic is related to recent technical developments in the field of computer engineering, and students typically formulate their thesis topic by working closely with their faculty thesis adviser. Upon completion of the research outlined in the thesis proposal, the work is reported in a thesis document submitted to the faculty committee and a thesis defense presentation. A technical paper resulting from the thesis research is submitted to a refereed conference or journal for publication.

Areas of Concentration

The following areas of concentration are available in computer engineering:

VLSl and Digital Systems Design:

0306-720	Design Automation of Digital Systems
0306-730	VLSl Design
0306-731	VLSl Design Projects
0306-741	Design for Testability
0306-758	Fault Tolerant Digital Systems
0306-759	Principles of Digital interfacing

Computer Architecture:

0306-722	Advanced Computer Architecture
0306-724	High Perfromance Architectures
0306-756	Multiple Processor Systems
0306-772	Special Topics in Computer Architecture

Digital Image Processing and Computer Vision:

0306-784	Digital Image Processing Algorithms
0306-785	Computer Vision
0306-772	Special Topics: Computational Intelligence

Computer Networking:

0306-710	Network Modeling, Design and Simulation
0306-715	Wireless Networks
0306-795	Networking Security
0306-722	Special Topics: Wireless Communications

Embedded Systems and Control:

0306-763	Embedded and Real-time Systems
0306-775	Robotics
0306-764	Modeling of Real-Time Systems
0306-772	Special Topics: Real-Time Operating Systems
0306-776	Robust Control

Admission requirements

Admission into the MS program in computer engineering requires a BS degree in computer engineering or related discipline. For students lacking sufficient background in computer engineering, bridge courses may be required in addition to the regular degree requirements. The evaluation process is primarily based on the student's academic background, undergraduate academic performance, and letters of reference. The GRE exam is required for all applicants and the TOEFL exam is required for international students.

Transfer credits

Transfer of graduate course credit from other RIT departments or from other appropriate institutions of higher learning is based on the graduate committee recommendation and may not exceed nine quarter credits. A grade of "B" or better is required for all transfer courses. The total of 600-level courses applicable to the program may not exceed four quarter credits and no graduate credit will be considered for courses below the 600 level.

Graduation requirements

RIT requires graduate students to maintain a grade point average of 3.0 or higher during all quarters of study, a grade of "B" or better for all transfer courses, and the completion of all degree requirements within seven years.

Electrical Engineering Department

Vincent Amuso, Department Head
585-475-7977, vjaeeerit.edu
www.ee.rit.edu

Focus areas

Within electrical engineering, a student can specialize in one of six separate areas for the MS degree: control systems, communications, digital systems, integrated electronics, signal and image processing, and MEMS (microelectromechanical systems). The boundaries between some of the areas are not as sharp as they were in the past, and students are urged to discuss the significance of their choices with graduate advisers in the department.

Master of Science in Electrical Engineering

www.ee.rit.edu/academics/ms.htm

Admission requirements

Admission into graduate studies leading to the MS degree in electrical engineering requires a bachelor of science in electrical engineering degree from an accredited program.

An applicant with a strong undergraduate record and a bachelor of science degree in another branch of engineering (mechanical, chemical, industrial, etc.) also will be considered for admission. In this case, the student must complete a certain number of undergraduate courses in order to bridge over to electrical engineering. Additional information is available from the department.

Plan of study

At the beginning of the program, every matriculated student must prepare a plan of study in consultation with his or her adviser.

Policies

The following general rules apply to all students:

- All students seeking the master of science in electrical engineering degree must satisfactorily complete the core course Matrix Methods in Electrical Engineering, 0301-703. Students are expected to take the course immediately after entering the program, since it is a prerequisite for many of the other graduate courses.
- Those students who have selected focus areas in control systems, communications, or signal and image processing must also take Random Signals and Noise, 0301-702. Students who want to develop concentrations in the above areas are also encouraged to take Random Signals and Noise.
- Each student must take at least four courses from the EE department in the chosen focus area.
- All course selections must be approved by one of the graduate advisers. All courses must be at 700-level or above with one exception: a student is allowed to take a maximum of two 600-level courses for full credit in the graduate program.
- All students must satisfy a research component through one of the following activities:
  1. Graduate thesis (nine credit hours)
     The inclusion of a thesis (0301-890) as a formal part of the MS degree program in electrical engineering is optional but strongly encouraged. Thesis work is done under the supervision of a faculty adviser and presented and defended before a thesis committee when complete.
  2. Graduate research paper (five credit hours)
     A student may choose to write a “graduate paper” in lieu of a thesis. The graduate paper is an extensive term paper on a topic of professional interest. The objective of the graduate paper is to enable the student to undertake an independent and in-depth literature search and write a report summarizing the findings. A faculty member interested in the paper’s topic will serve as the student’s supervisor and direct the scope and depth of the paper as well as the format of the final written version. The student must first consult a faculty member about a suitable topic for the paper and obtain consent. The course 0301-800, Graduate Paper, is used to register for the paper. The student should plan to take at least five credit hours in 0301-800. The student choosing this option also is required to take a minimum of 10 courses for 40 credits.
- All graduate work must be completed within a seven-year period starting from the first course applied toward the MSEE degree. Also, a student who is pursuing thesis/project options may be required to register for continuation of thesis/project credits if he or she is not enrolled for any credits in a given quarter. For complete details, please consult the continuation of thesis/project/dissertation policies.

Transfer credits

A maximum of eight credit hours can be earned from courses available from other departments within RIT with the prior approval of the faculty/department adviser. Students may transfer a maximum of eight quarter credit hours or two classes from another university. The total number of transfer credits from all sources outside the electrical engineering department cannot exceed eight quarter credit hours.

Under some extraordinary circumstances, a resident full-time student may appeal to the EE department and the Graduate Council for additional transfer credits.

Those electrical engineering students who have an interest in computer science as a concentration area are encouraged to pay special attention to certain specific policies. The bridge courses 0602-701, 702, 703, 704, and 705 will be treated as advanced undergraduate courses; therefore, the total number of credit hours generated from these cannot exceed eight. Also, electrical engineers with interest in computer science are encouraged to complete certain sequences of appropriate courses (within the limits of allowable transfer credits) rather than take one or two courses at random. Please consult the department for more details.

Graduate student advising

All new students will be assigned a graduate adviser. The student generates a plan of study in consultation with his or her faculty adviser. That faculty member will continue to be the student’s adviser until a research topic has been chosen. From that time, the thesis/paper adviser assumes the role of academic adviser as well.

Graduation requirements

The master of science degree in electrical engineering is awarded upon the successful completion of an approved graduate program consisting of a minimum of 45 credit hours. Under certain circumstances, a student chooses or is required to complete more than the minimum number of credits. RIT graduate school requirements will apply, such as grade of “B” or better for all transfer courses as well as the maintenance of a grade point average of 3.0 or better.

Electrical Engineering Scheduled Course Offerings 2006-2007

Focus Area	Fall 2006-1	Winter 2006-2	Spring 2007-3
Core Courses	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	
Communication	0301-794 Information Theory 0301-729 Antenna Theory and Design	0301-717 Microwave Circuit Design	0301-710 Advanced Electromagnetic Theory 0301-796 Multiuser Detection
Control Systems	0301-769 Fuzzy Logic and Applications	0301-753 Optimization Techniques 0301-761 Modern Control Theory 0301-764 Digital Control Systems	0301-733 Robust Control 0301-815 Multivariable Modeling and Control
Signal and Image Processing	0301-877 Digital Signal Processing	0301-770 Pattern Recognition 0301-779 Digital Image Processing	0301-768 Adaptive Signal Processing 0301-803 Digital Video Processing
Integrated Electronics	0301-711 Advanced Carrier Injector Transistor: 0301-821 High-Performance Semiconductor Devices	0301-712 Advanced Field Effect Devices 0301-726 Mixed Signal IC Design	0301-713 Solid State Physics 0301-820 Modeling and Simulation of Semiconductor Devices 0301-730 Advanced Analog IC Design
Digital Systems	0301-810 Advanced Computer Architecture	0301-732 Advanced Topics in Digital System Design 0301-742 Advanced Topics in Embedded System_ Software Design	0301-741 Design for Testability
MEMS	0301-789 Fundamentals of MEMS	0301-799 Nano and Microengineering	0301-798 Microfluidic MEMS 0301-804 MEMS Evaluation

Courses other than those listed in this bulletin are developed and offered periodically by the department of electrical engineering. Information will be available from the department office the month before the beginning of each academic quarter. Course offerings are subject to minimum enrollment requirements.

Schedule of all Electrical Engineering graduate 700- and 800-level courses

Fall Quarter

0301-702 Random Signals and Noise
0301-703 Matrix Methods in EE
0301-711 Advanced Carrier Injector Transistors
0301-729 Antenna Theory and Design
0301-769 Fuzzy Logic and Applications
0301-789 Fundamentals of MEMS
0301-794 Information Theory
0301-810 Advanced Computer Architecture
0301-821 High-Performance Semiconductor Devices
0301-877 Digital Signal Processing

Winter Quarter

0301-702 Random Signal and Noise
0301-703 Matrix Methods in Electrical Engineering
0301-712 Advanced Field Effect Devices
0301-717 Microwave Circuit Design
0301-726 Mixed Signal I.C. Design
0301-732 Advanced Topics in Digital Systems Design
0301-742 Advanced Topics in Embedded Systems SW Design
0301-753 Optimization Techniques
0301-761 Modern Control Theory
0301-764 Digital Control Systems
0301-770 Pattern Recogntion
0301-779 Digital Image Processing
0301-799 Nano and Microengineering

Spring Quarter

0301-710 Advanced Electromagnetic Theory
0301-713 Solid State Physics
0301-730 Advanced Analog IC Design
0301-733 Robust Control
0301-741 Design for Testability
0301-768 Adaptive Signal Processing
0301-796 Multiuser Detection
0301-798 Microfluidic MEMS
0301-803 Digital Video Processing
0301-804 MEMS Evaluation
0301-820 Modeling and Simulation of Semiconductor Devices
0301-815 Multivariable Modeling and Control

Summer Quarter

A selected number of 700-level courses and 600-level courses will be available during the summer quarter. Consult the department for details.

600-level courses

Senior-level undergraduate professional electives. A maximum of two courses from the following list may be taken by a graduate student and counted toward the MS degree.

0301-605 Robotic Vision
0301-610 Analog Electronic Design
0301-611 Semiconductor Devices II
0301-612 Semiconductor Devices III
0301-615 State Space Control
0301-621 Microwave Engineering
0301-622 Antenna Design
0301-625 Modern Photonic Devices and Systems
0301-630 Biomedical Instrumentation
0301-632 Fundamentals of Electrophysiology
0301-633 Biomedical Signal Processinng
0301-636 Biorobotics/Cybernetics
0301-637 Control Systems/Biomedical Applications
0301-646 Power Electronics
0301-647 Artificial Intelligence Systems
0301-650 Design of Digital Systems
0301-651 Physical Implementation
0301-655 Microcomputer Software I
0301-656 Microcomputer Software II
0301-662 Neural Networks
0301-664 Embedded Microcontroller Systems
0301-666 DSP Architecture
0301-674 Fiber Optics: Theory and Applications
0301-677 Diqital Filters and Signal Processing
0301-679 Analog Filter Design
0301-685 Principle of Robotics
0301-686 Microelectromechanical Devices
0301-688 MEMS System Evaluation
0301-692 Communication Networks
0301-693 Digital Data Communications
0301-694 Information Theory and Coding

Industríal Engineering Department

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www.rit.edu/ise

The industrial engineering department (ISE) offers several different degree options to meet the diverse interests of students seeking to continue their engineering education:

- master of science in industrial engineering
- master of engineering in industrial engineering
- master of engineering in systems engineering
- master of engineering in engineering management

There are also dual degree programs, which combine the undergraduate degree in industrial and systems engineering with each master's degree program listed above. In addition, the department offers a combined BS degree in industrial engineering with an MS in applied statistics from the Center for Quality and Applied Statistics. There is also an accelerated program offered jointly with the College of Business (BS/MBA). These programs have different credit hour/degree requirements and are described in detail in the department Web page, www.rit.edu/ise. The student, in conjunction with his or her adviser, formulates a program of study based on the individual's academic background, professional goals, and degree requirements.

Department of Industrial and Systems Engineering: Typical Scheduled Course Offerings

Fall	0303-620	Engineering Economy
	0303-701	Linear Programming
	0303-703	Logistics Management
	0303-726	Contemporary Production Systems
	0303-727	Advanced Manufacturing
	0303-760	Product/Process Development and Design
	0303-765	Databases for IS
	0303-790	Fundamentals of Sustainable Design
Winter	0303-702	Integer and Nonlinear Programming
	0303-710	Systems Simulation
	0303-729	Advanced Systems Integration
	0303-731	Advanced Topics in Ergonomics and Human Factors
	0303-734	System Safety Engineering
	0303-758	Design of Experiments
	0303-784	Project Management
Spring	0303-711	Advanced Simulation Techniques
	0303-732	Biomechanics
	0303-750	Management of Quality Systems
	0303-766	Manufacturing Systems
	0303-801	Design for Manufacture

Master of Science in Industrial Engineering

www.rit.edu/~633www/grad/index.htm

The master of science degree in industrial engineering allows graduate students to customize their course work while working closely with IE faculty in a contemporary, applied research area. Current IE faculty have research interests that include contemporary manufacturing processes/systems, ergonomic/biomechanical analysis, optimization, sustainable design/remanufacturing, systems engineering/product development, systems integration/information systems, and systems simulation modeling. The MS degree in industrial engineering will be awarded upon successful completion of a minimum of 45 credit hours that is equivalent to nine courses and a nine-credit-hour thesis.

Master of Engineering Degrees

www.rit.edu/~633www/grad/me.html

The master of engineering degrees in industrial engineering, systems engineering, and engineering management allow graduate students to align their course work with their professional goals. These programs provide applied, practical degrees that allow students to gain breadth across several different areas or focus in one area. Close cooperation with other engineering departments and the College of Business assures the student of a wide selection of courses and a unique opportunity to build a program that supports his or her professional interests. The ME degrees will be awarded upon successful completion of a minimum of 48 quarter credit hours that is equivalent to 12 courses and an engineering capstone experience.

Master of Engineering in Industrial Engineering

The master of engineering in industrial engineering (IE) focuses on the design, improvement, and installation of integrated systems of people, material, information, equipment, and energy using 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 IE is the optimization of the system, regardless of whether the activity engaged in is a manufacturing or a service-related industry. The student graduates with a variety of skills in the areas of applied statistics/quality, ergonomics/human factors, operations research/simulation, manufacturing, and systems engineering.

Master of Engineering in Systems Engineering

This program concentrates on the IE courses that cover the science and technologies of decision making in a complex world in order to optimize the overall system rather than any one subsystem. Systems engineering is concerned with improving the decision making process by utilizing statistics, simulation, optimization, and computer science skills to enhance the design, control, operation, and understanding of systems. This discipline has shown rapid growth in both its development and recognition as a distinct field of engineering.

Master of Engineering in Engineering Management

This program uses a blend of ISE and College of Business courses to focus on the management of the engineering and technological enterprise. It combines technological expertise with managerial skills. Engineering management is concerned with understanding

the technology involved in an engineering project and the management process through which the technology is applied. The object is to provide a background in areas commonly needed in this role, such as organizational behavior, finance, and accounting, in addition to industrial engineering expertise.

Facilities

The ISE department is located in the James E. Gleason building, within the Kate Gleason College of Engineering. The department houses several state-of-the-art laboratories in support of the college's graduate programs. These labs include the Brinkman Machine Tools and Manufacturing Lab, the Human Performance Lab, the Advanced Systems Integration Lab, the Product and Process Development Lab, and a general Computer Lab. All of these labs are fully accessible to all ISE students.

There are ample computing facilities within these specialized labs as well as a dedicated PC computer lab. These labs offer an extensive library of software to support industrial engineering research and project work, including conventional word processing, spreadsheet, and presentation applications (e.g., Microsoft Office), database management (e.g., Microsoft ACCESS, FoxPro), data acquisition (e.g., Lab View), statistical analysis (e.g., Minitab, SAS), facilities layout (e.g., AutoCAD, Factory Flow, Factory Plan), manufacturing (e.g., Mastercam, material selection software), and optimization and systems simulation software (e.g., CPLEX, Solver, ProModel, Arena).

Admission requirements

Admission into the graduate programs within industrial engineering requires a BS degree in an engineering discipline and a 3.0/4.0 grade point average. Exceptions are made for the related fields of math and physics. Students with other backgrounds are considered for admission only after completing significant undergraduate course work in the engineering sciences. All applicants should have a fundamental knowledge of computers and probability/statistics.

Mechanical Engineering Department

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www.rit.edu/~mecheng0/

Please Note: The master of science (MS) degree program is undergoing a curriculum review as of press time. The department anticipates several changes to the mechanical engineering MS program offering. Additional details will be published on the department's website upon approval by the faculty of the mechanical engineering department.

The graduate program faculty of the mechanical engineering department is dynamic and committed to professional growth. Current thermal science research activity includes micro-scale transport phenomena and micro-channel heat transfer, micro-air vehicles, particulate flow in biological systems, and computational fluid dynamics. Materials science and engineering interests include fracture mechanisms in materials, characterization of inter-metallic materials, microhardness characterization, novel materials for thermal protection, and composites. Energy systems research includes second law analysis of thermal systems, environmental impacts of energy intensive systems, micro-power energy harvesters, and alternative power generation technologies. The department houses several laboratories, which support vibration and modal analysis, robotics, industrial fluids applications, thermal analysis, biomedical systems analysis, and materials science.

Extensive computing facilities include a large network of workstations, personal computers, and laboratories equipped with Windows-based personal computers. Students have access to a vast array of software packages, which include most programming languages and utilities, various word processing software, analytical and statistical data analysis, graph generation, and spreadsheet packages. Software specifically used for mechanical engineering applications includes ALGOR, ANSYS, and Mechanica (finite element analysis); Working Model (mechanical modeling and analysis); FLUENT, FLOW3D, PMARC and TODOR (fluid/thermal analysis); MATLAB/Simulink and LabVIEW (data acquisition and control system analysis); OptdesX (optimization); DFMA by Boothroyd/Dewhurst (designing for manufacturing assembly); and ProEngineer and IDEAS (CAD/CAE software).

Master of Science in Mechanical Engineering

www.rit.edu/~mecheng0/grad/msme.htm

The master of science degree in mechanical engineering is awarded upon successful completion of an approved graduate program consisting of a minimum of 45 quarter credit hours. A minimum of 36 credits are to be earned in course work and nine credits of thesis. A maximum of nine quarter credits may be transferred from graduate courses taken outside the university, provided such courses complement a student's proposed graduate program in the mechanical engineering department. Upon matriculation into the MS program, the student should formulate a plan of study in consultation with his or her adviser.

Admission requirements

1. A bachelor of science degree in engineering or science is required.
2. If an applicant has a BS degree in an area other than mechanical engineering, the graduate admissions adviser will recommend which undergraduate courses must be taken in order to acquire an acceptable background. At least a 3.0 grade point average in the recommended undergraduate courses is required before admission is granted to the mechanical engineering graduate program.

Program requirements

The four elements of study within the program include core

courses, courses required within an elected focus area, selected elective courses, and a thesis.

Core courses

All graduate students in the MS program are required to complete:

0304-870 Mathematics for Engineers I
0304-871 Mathematics for Engineers II

Focus area courses

All graduate students in the MS program are required to select one of the following focus areas and complete the following specific courses within that area:

Group A- Mechanics/Design

0304-758 Engineering Vibrations
0304-816 Finite Elements
0304-885 Advanced Mechanics of Solids

Group B- Systems/Controls

0304-743 Control Systems
0304-823 Systems Modeling
0304-840 Signal Processing

Group C- Thermo/Fluids

0304-830 Introduction to Computational Fluid Dynamic Analysis
0304-838 Ideal Flows
0304-851 Convective Phenomena

Students may select courses outside their focus area for electives.

Elective courses

0304-701 Research Methods
0304-710 Fuel Cell Technology
0304-730 Design Project Management
0304-743 Control Systems
0304-752 Fundamentals of Tribology
0304-754 Fundamentals of Fatigue and Fracture Mechanics
0304-756 Fundamentals of Aerosol Mechanics in Biological Syst.
0304-758 Engineering Vibrations
0304-801 Design for Manufacture
0304-810 Introduction to Continuum Mechanics
0304-811 Theory of Elasticity and Plasticity
0304-816 Finite Elements
0304-820 Advanced Optimal Design
0304-821 Advanced Vibrations
0304-823 Systems Modeling
0304-828 Special Topics in Applied Mechanics
0304-830 Introduction to Computational Fluid Dynamic Analysis
0304-831 Computational Fluid Dynamics (CFD) Applications
0304-833 Heat Exchanger Design
0304-834 Boiling and Condensation
0304-835 Grid Generation
0304-838 Ideal Flows
0304-840 Signal Processing
0304-842 System Identification
0304-843 Advanced Control Systems
0304-844 Nonlinear Dynamical Systems
0304-846 Modal Testing and Signal Processing
0304-847 Microscale Transport Phenomena
0304-848 Special Topics in Thermo Fluid Systems
0304-851 Convective Phenomena
0304-852 Advanced Turbomachinery
0304-864 Production Tool Design
0304-865 Computer Implementation of Finite Elements
0304-872 Analytical Mechanics
0304-874 Numerical Analysis
0304-875 Advanced Aerodynamics
0304-885 Advanced Mechanics of Solids
1028-701 Introduction to Materials Science
1028-705 Experimental Techniques
1028-710 Materials Properties and Selection
0307-712 Fundamentals of Statistics II
0307-770 Design of Experiments for Engineers

Students deficient in computational techniques are strongly advised to take Numerical Analysis (0304-874) as an elective. Based on the student's particular program needs, he or she may, with department approval, elect to take up to 12 credits from other departments in the university. Graduate students are allowed to take a maximum of two upper-level undergraduate electives (with a course number beginning with 0304-6xx) in mechanical engineering. Some examples are:

0304-604 Design for Manufacture
0304-610 Topics in Mechanical Engineering Design
0304-615 Robotics
0304-618 Computer-Aided Design
0304-620 Introduction to Optimal Design
0304-624 Vehicle Dynamics
0304-626 Automotive Control Applications
0304-635 Heat Transfer II
0304-638 Design of Machine Systems
0304-640 Internal Combustion Engines
0304-642 Air Pollution Dispersion Modeling
0304-644 Introduction to Composite Materials
0304-652 Fluid Mechanics of Turbomachinery
0304-660 Refrigeration and Air Conditioning
0304-671 Aerostructures
0304-672 Dynamics of Machinery
0304-675 Aerodynamics
0304-678 Propulsion
0304-680 Advanced Thermodynamics
0304-682 Flight Dynamics

A student also may earn a limited number of credits by doing an independent study with guidance from a member of the graduate faculty. Some of the areas for independent study are selected topics in applied mathematics, analytical mechanics, nonlinear mechanics, fracture mechanics, heat transfer, fluid mechanics, thermodynamics, control systems, optimal control, thermal stresses, composite materials, and biomechanics.

Course calendar

The core and focus area courses are offered every year, which enables a student to fulfill the core requirements in one academic year. The elective courses are generally offered at least every other year. For further information on current course offerings, the student should contact the mechanical engineering department at 585-475-5788, or 585-475-2163.

Thesis

Prior to completing 20 quarter credit hours of graduate work, the student should prepare a formal thesis proposal, and discuss it with the faculty adviser. An acceptable proposal, signed by the student and approved by their faculty adviser and department head, is required prior to registering for thesis credits. Requirements for the degree must be completed within seven years of the date of the oldest course counted towards the MS program. A student is required to deliver a successful written and oral presentation of their thesis.

Master of Engineering in Mechanical Engineering

www.rit.edu/~633www/gradlme.html#meie

This is a post-baccalaureate internship program leading to the professional degree of master of engineering. The objective of the program is to provide the engineering BS graduate the means for earning a terminal master's degree. The capstone experience for the master of engineering (M.Eng.) degree may be a course design project, a well-organized and carefully chosen industrial internship, or an independent study project, in place of the conventional thesis requirement of an MS degree. The M.Eng. degree is particularly well-suited to part-time study, students interested in updating their technical skills, and those who are not focused on a research-oriented master of science thesis.

Core courses (12 credits)
All graduate students in the M.Eng. program are required to complete:

0304-870	Mathematics for Engineering I
0304-823	Systems Modeling
0304-865	Computer Implementation of FEM

The program, although rooted in engineering, will be significantly interdisciplinary. By design, the program may range over several colleges in the university, assembling courses that will best help students meet their professional objectives. The credits for this program are distributed as follows:

Core Courses	12 credits
Concentration Courses	16 credits
Elective Courses	20 credits

At least 32 credit hours of graduate-level course work, including the core courses, must be taken in the mechanical engineering department. Some possible concentration areas are business, print media, controls, manufacturing, materials science, thermo/fluids, and design engineering. A minimum of 48 credits are required for the M.Eng. degree. Students may complete the program as a course-only program of study, with a capstone design project in a graduate elective course. Students may choose to complete a three-month industrial internship or a project that includes a paper (both worth 4 elective credits) as one of their elective courses.

Admission requirements

The admission requirements, general standards, and selection procedures for admission to the engineering program are similar to those for the MS degree program.

Master of Engineering in Manufacturing Engineering

www.rit.edu/~633wwwlgrad/me.html#meie

The department of mechanical engineering and the department of industrial and systems engineering jointly offer this program. In the master of engineering in manufacturing engineering program, the student is required to take one course each from four different groups: computer-aided design, manufacturing systems, computer-aided manufacturing, and probability and statistics. In addition, the student is required to take the core course Design for Manufacture (0304-801). The balance of the course work can be completed by selecting appropriate courses from the course offerings in industrial and mechanical engineering.

A student seeking admission to the master of engineering degree in manufacturing engineering is expected to have undergraduate background in programming, engineering materials, manufacturing processes, and probability and statistics.

Admission requirements

The admission requirements, general standards, and selection procedures for admission to the manufacturing engineering program are similar to those for the MS degree program.

Assistantships and scholarships

Some assistantships and scholarships may be available for full-time students. Appointment as a teaching assistant carries a 20-hour a week commitment to a teaching function and usually permits a student to take graduate work for 8 credits per quarter. The remaining time is devoted to a research effort. Information on tuition scholarships may be obtained by contacting the Office of Part-time and Graduate Enrollment Services at (585) 475-2229.

Microelectronic Engineering Department

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The worldwide semiconductor industry is expected to double, growing from $150 billion to $300 billion over the next five years. The technology is advancing at an astounding pace that requires a specially educated workforce. The Kate Gleason College of Engineering is proud to offer two masters programs in microelectronic engineering. The master of engineering in microelectronics manufacturing engineering is a full-time intensive classroom and laboratory-oriented program culminating with an internship. The master of science in microelectronic engineering is a research-oriented program that includes a master's thesis. Both programs are intended to prepare students for careers in the semiconductor industry.

Integrated circuit technology makes use of many diverse

fields of science and engineering. Optical lithography tools, which print microscopic patterns on wafers, represent one of the most advanced applications of the principles of Fourier optics. Plasma etching involves some of the most complex chemistries used in manufacturing today. Ion implantation draws upon understanding from research in high-energy physics and ion solid interactions. Thin films on semiconductor surfaces exhibit complex mechanical and electrical behavior that stretches our understanding of basic materials properties. Computing skills are necessary to design, model, simulate, and predict processes and device behavior, extremely vital to manufacturing. Statistics is required to manipulate data and process control. Manufacturing concepts are extremely important in maintaining high yields and cost effectiveness. One of the great challenges in integrated circuit manufacturing is the need to draw on scientific principles and engineering developments from such an extraordinarily wide range of disciplines not adequately provided by traditional engineering or science programs. Scientists and engineers who work in this field need broad understanding and the ability to seek out, integrate, and use ideas from many fields. These programs are tailored to meet the demands of the semiconductor industry for a suitably educated workforce.

Students in these programs have hands-on experience in the design and processing of integrated circuits the vital component in almost every advanced electronic product manufactured today. RIT's laboratories are designed for the microelectronic engineering programs. They are among the best in the nation. The microelectronics engineering programs offer an unparalleled opportunity for students to prepare for professional challenges and successes in one of the leading areas of engineering.

Master of Science in Microelectronic Engineering

The objective of the master of science program in microelectronic engineering is to provide an opportunity for students to perform graduate level research as they prepare for entry into the semiconductor industry or a doctorate program. The program requires strong preparation in the area of microelectronics, takes two years to complete, and requires a thesis.

The prerequisites include a bachelor of science degree in engineering (such as electrical or microelectronic engineering), including an introductory course in device physics and an introductory course in fabrication technology. Students from RIT's BS program in microelectronic engineering will meet these prerequisites. Students who do not have these prerequisites can take these courses during their first quarter of study and still complete the MS program in two years. The prerequisite courses will not count toward the 36 credits of graduate courses required for the MS degree.

The program consists of eight graduate courses (700 level or higher), including seven core courses and one elective course for students with a BS degree in a discipline other than microelectronic engineering. Five core courses and three elective courses are required for students with a BS in microelectronic engineering. In addition, all students in this program are required to take a variable-credit (1 or 0 credit) seminar/research course each quarter they are at RIT. Up to four credits will be allowed to count toward the required 36 credit hours. A nine-credit thesis, which includes an oral defense, is required of all students in this program. The total number of credits needed for the MS in microelectronic engineering is 45.

Core courses:

0305-702	Microelectronics II, Lab
0305-703	Microelectronics III, Lab
0305-704	Semiconductor Process and Device Modeling
0305-705	Quantum and Solid State Physics Fundamentals
0301-712	Physics and Scaling of CMOS
0305-721	Microlithography Materials, Lab
0305-731/732*	Microelectronics Manufacturing I/II, Lab

**731 cannot be taken for graduate degree credit by students with a BS in microelectronic engineering.*

Elective courses:

The following elective courses are offered by the department of microelectronic engineering for graduate credits:

0305-706	SiGe and SOI Devices and Technology
0305-707	Nanoscale CMOS
0305-714	Micro- and Nano-Characterization
0305-722	Microlithography Systems, Lab
0305-732	Microelectronics Manufacturing II, Lab
0305-830	Metrology and Failure Analysis
0305-870	Microelectromechanical Systems
0305-890	Special Topics

Based on the student's particular needs, he or she may, with the department approval, choose electives from other programs at the university.

Fall	**Qtr. Cr. Hrs.**
0305-701 Transition Microelectronics I, Lab	4
0305-560 Transition Device Physics	4
0305-721 Microlithography Materials and Processes, Lab	4
0305-801 Seminar/Research	1
Winter	
0305-702 Microelectronics II, Lab	4
0305-731 Microelectronics Manufacturing I, Lab	4
0305-801 Seminar/Research	1
Full Time Equivalency	3
Spring	
0305-703 Microelectronics **III,** Lab	4
0305-7XX Elective	4
0305-801 Seminar/Research	1
Full Time Equivalency	3
Summer Research	
Summer	
Research	
Fall	
0305-705 Quantum and Solid State Physics Fundamentals	4
0305-801 Seminar/Research	1
0305-889 Thesis	3
Full-time Equivalency	

Winter

0305-704	Semiconductor Process and Device Modeling	4
0301-712	Physics and Scaling of CMOS	4
0305-801	Seminar/Research	1
0305-899	Thesis	3

Spring

0305-801	Seminar/Research	1
0305-899	Thesis	3
Full-time	Equivalency	8

Sample schedule for students will a BS in microelectronic engineering:

Fall

0301-705C	Quantum and Solid State Physics Fundamentals	4
0305-801	Seminar/Research	1
0305-xxxE	Elective 1	4
Full-time	Equivalency	3

Winter

0301-712C	Physics and Scaling of CMOS	4
0305-704C	Semiconductor Process and Device Modeling	4
0305-801	Seminar/Research	1
Full-time	Equivalency	3

Spring

Research

Summer

0301-70%	Quantum and Solid State Physics Fundamentals	4
0305-801	Seminar/Research	1
0305-xxxE	Elective 1	4
Full-time	Equivalency	3

Fall

0305-xxxE	Elective 3	4
0305-801	Seminar/Research	1
0305-899	Thesis	3
Full-time	Equivalency	4

Winter

0305-801	Seminar/Research	1
0305-899	Thesis	3
Full-time	Equivalency	4

Spring

0305-801	Seminar/Research	1
0305-899	Thesis	3
Full-time	Equivalency	4

Admission requirements

Applicants must hold a baccalaureate degree in electrical engineering, chemical engineering, materials science and engineering, physics, or the equivalent from an accredited college or university. An undergraduate grade point average of 3.0 or better on a 4.0 scale, or strong academic/supervisor endorsements are required. Graduate Record Exam (GRE) scores are not mandatory but may strengthen the student's candidacy.

Plan of study

The student, in consultation with his or her adviser, formulates a plan of study based on the student's academic background, program objectives, degree requirements, and course offerings. The plan of study is submitted to the department office within the first year. If necessary, a revision of the plan of study may be recommended by the adviser.

Assistantships and fellowships

A limited number of assistantships and fellowships may be available for full-time students. Appointment as a teaching assistant carries a 12-hour-per-week commitment to a teaching function and permits a student to take graduate work at the rate of 12 credits per quarter. The remaining time is devoted to a research effort, which often serves as a thesis subject. Students in the MS program are eligible for research fellowships. Appointments provide full or partial tuition and a stipend. Applicants for financial aid should write directly to the department head for details.

Master of Engineering in Microelectronics Manufacturing Engineering

www.microe.rit.edu/me.php

The department of microelectronic engineering offers the master of engineering degree in microelectronics manufacturing engineering. The program provides a broad based education to students with a bachelor's degree in traditional engineering or science disciplines who are interested in a career in the semiconductor industry.

The master of engineering degree is awarded upon successful completion of an approved graduate program consisting of a minimum of 45 credit hours. The program consists of one transition course, seven core courses, two elective courses, and a minimum of five credits of internship. Under certain circumstances, a student may be required to complete more than the minimum number of credits. The transition course is in an area other than that in which the BS degree was earned. For example, chemistry majors may be required to take a two-course sequence in circuits and electronics. The core courses are Microelectronics (processing) I, II, and III; Microelectronics (manufacturing) I, II, and Microlithography Materials and Processes and Microlithography Systems. The two elective courses are graduate-level courses in a microelectronic-related field. Elective courses may be selected from a list that includes courses such as metrology and failure analysis, semiconductor process and device modeling, and nanoscale CMOS. The program requires an internship, which is at least three months of full-time successful employment in the semiconductor industry. The internship can be completed in industry or at RIT. It will involve an investigation or a study of a problem or process directly related to microelectronics manufacturing engineering. This is not a thesis, but usually requires a report and an oral presentation at the end of the project.

Microelectronics

The Microelectronics I, II, and III sequence covers major aspects of integrated circuit manufacturing technology such as oxidation, diffusion, ion implantation, chemical vapor deposition, metalization, plasma etching, etc. These courses emphasize modeling and simulation techniques as well as hands-on laboratory verification of these processes. Students use special software tools for these processes. In the laboratory, students design

and fabricate silicon MOS and bipolar integrated circuits and they learn how to utilize most of the semiconductor processing equipment, develop and create a process, and manufacture and test their own integrated circuits.

Micrlithography

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, electron beam lithography, and excimer laser 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 to the students. The laboratory for this course is the student-run factory functioning in the department. Important issues that include measurement of yield, defect density, wafer mapping, control charts, and other manufacturing measurement tools are introduced to the students in lectures and laboratory work. Computer integrated manufacturing is also 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 all introduced and supported by laboratory experiences in the integrated circuit factory. An online (distance delivery) version of this program exists for engineers employed in the semiconductor industry. Please refer to the RIT Online Guide for details.

Internship

The program requires a five-credit internship (0305-777), which is equivalent to at least three months of full-time successful employment in the semiconductor industry. The purpose of the internship is to provide a structured and supervised work experience that enables students to gain job-related skills that will assist them in achieving their desired career goals. Students with prior engineering-related job experience may request "credit by experience." This request must be made with the department head supported by a letter from the appropriate authority substantiating the student's job responsibility, duration, and performance quality. Upon approval, the student is advised to deposit the incurred fee to the bursar after the transfer of credit via "credit by experience'' is granted.

For students who are not working in the semiconductor industry while enrolled in this program, the internship can be completed at RIT. It will involve an investigation or study of a subject or process directly related to microelectronic engineering under the supervision of a faculty adviser. An internship may be taken any time after the completion of the first quarter. It must total at least five credits, and may be designed in a number of ways. For example, one five-credit internship (typically a three-month, full-time work experience), five one-credit experiences, or any combination of separate credits interspersed throughout the graduate program, which will total the equivalent of three months of work for the student. In these cases full graduate tuition is charged. At the conclusion of the internship, a final internship report is required to be submitted to the faculty adviser.

Fall	**Qtr. Cr. Hrs.**
0305-701, Microelectronics I, Lab	4
0305-721, Microlithography Materials and Processes, Lab	4
Transition	4
Winter	
0305-702, Microelectronics **I$_i$,** Lab	4
0305-731, Microelectronics Manufacturing I, Lab	4
Transition	4
0305-xxx Elective 1	4
Spring	
0305-703 Microelectronics Ill, Lab	4
0305-722 Microlithography Systems, Lab	4
0305-732 Microelectronics Manufacturing II, Lab	4
0305-xxx Elective 2	4
Summer	
Internship	5

The John D. Hromi Center for Quality and Applied Statistics

Donald D. Baker, Director
(585) 475-5070, ddbcqa@rit.edu
Joseph G. Voelkel, Chair
(585) 475-2231,jgvcqarit.edu
www.rit.edu/~636www/

Statistics is the science of making decisions in the face of uncertainty. Statistical thinking and methods are used over a broad spectrum of industrial, research, educational, business, and government activities. The Kate Gleason College of Engineering, through the John D. Hromi Center for Quality and Applied Statistics, offers a master of science degree in applied statistics that provides state-of-the-art statistical thinking and methods. The college also offers two advanced certificates in statistical quality and in statistical methods for product and process improvement.

Many of our students are full-time professionals who want to learn state-of-the-art statistical techniques to enhance their careers and their value to their companies. Others want to

change careers and become statistical consultants. Those who do not fit the full-time professional category typically use the degree or advanced certificate to gain employment either as statisticians or quality engineers.

Faculty

The center's distinguished faculty members include winners of the American Society for Quality's Shewhart Medal, Grant Award, Brumbaugh Award, and Shewell Award; and fellows of American Society for Quality and the American Statistical Association. Both full-time and adjunct faculty members teach in the program. All instructors have real-world experience in the subjects they teach, evident in their approach to the subject matter. As part of their contracts with RIT, many of the full-time faculty work outside the MS program, through consulting and both public and contract-basis seminars. Many are also engaged in professional activities, present talks at professional society meetings, and publish research or application papers.

Full- or part-time study

Full-time students who take four courses per quarter can complete the MS degree in one year. Students pursuing the MS on a part-time basis (one or two courses per quarter) typically complete the degree in two to four years. Part-time students pursuing an advanced certificate typically complete the requirements in four to six quarters of study.

BS/MS programs

The center has agreements with the department of mathematics and statistics and the department of industrial and systems engineering that allow students to earn both BS and MS degrees in less time and with fewer courses than would be needed if both programs were pursued separately. The undergraduate departments handle entry into these programs.

Cooperative education

Cooperative education allows qualified graduate students to attend school on a full-time basis during certain quarters and to earn a substantial salary during other quarters, typically as employees in a corporation. To qualify for cooperative education, students must complete at least one quarter of appropriate course work and receive department approval. Reverse cooperative education is also available, in which full-time employees get approval to study on a full-time basis, typically by alternating one or two quarters of work and study.

Online learning

Since 1979, when the university offered its first online learning course, RIT has been a leader in the use of electronic forms of communication for course interaction. Our online learning courses have the same objectives, rigorous workload, tuition, and academic credit as our on-campus courses. Both the MS degree and the advanced certificates are available through online learning. No distinction is made between taking courses on campus or through online learning. In particular, programs earned partly or entirely through online learning are registered by the New York State Department of Education and are accredited by the Middle States Association of the Council for Higher Education. Every online learning course offered by the center meets RIT's rigorous academic standards. Each course typically features either videotapes or CDs, professionally prepared for online learners. Courses also include weekly live chat sessions or asynchronous discussion groups, using an electronic medium that allows students and the instructor to interact.

Because online learning courses are designed for the motivated professional who is not able to attend on-campus classes, we recommend enrollment to those over 25 years of age with at least three years of professional employment.

Admission requirements

Admission to the MS degree program will be granted to qualified students who hold a baccalaureate degree from an accredited college or university who have the following credentials: an acceptable GPA and mathematics credits, including acceptable grades in university-level calculus through multiple integration; and acceptable probability and statistics college credits, which should be equivalent to Fundamentals of Statistics I (0307-711) and II (0307-712). Admission to the certificate program in statistical quality requires a baccalaureate degree with the probability and statistics requirements, but not calculus. Admission to the certificate program in statistical methods for product and process improvement also requires a course in calculus.

Entrance exams are not required. However, international students whose native language is not English must have a TOEFL score of at least 550 (paper-based) or 213 (computer-based). Courses are offered on an open-enrollment basis.

Transfer and interdisciplinary credits

Credit for courses of graduate stature from other universities in statistics, mathematics, computer programming, operations research, and other quantitative fields related to statistics may be accepted toward fulfillment of degree requirements at the discretion of the department with due regard to the candidate's objectives. A maximum of nine graduate credits can be accepted toward the MS degree, while three credits may be accepted toward the certificate. A course used toward fulfillment of another degree can be credited only if it corresponds to one of the core courses described below. Transfer credits for the certificate must be from a course covering the same subject matter as the course being credited.

To ensure credit toward the degree, the candidate should write the department indicating courses for which he or she would like transfer credit. Prior approval of such courses is required.

Advising

In consultation with a departmental adviser, each student works out a total program structured to achieve individual professional objectives. Matriculated students will be assigned an

adviser, with whom they are required to meet on a regular basis to review their progress toward meeting program requirements. Non-matriculated students seeking advisement should contact the department secretary.

Non-matriculated students

It is not necessary to be formally admitted or matriculated into the MS program in order to register for course offerings. However, students who desire to enter the MS program will be allowed to apply only four courses taken prior to matriculation into the program. This is done to encourage proper selection of courses and to allow for adequate administrative time for transcript review. Students who desire to enter an advanced certificate program will be allowed to apply only two courses taken prior to matriculation into the program.

Financial assistance

The department awards financial assistance on a competitive basis to qualified applicants. Assistance in the MS program is offered in several forms, including scholarships and graduate assistantships. Awards are generally given to full-time students, with some exceptions for qualified part-time students. For information on other sources of financial assistance, applicants should review the appropriate section of this bulletin.

Masters of Science in Applied Statistics

www.rit.edu/~636www/academics/msappliedstatistics.htm

The MS program in applied statistics, which requires 45 quarter credit hours (equivalent to 15 courses), is available to both part-time and full-time students. Those working toward their baccalaureate degree in certain RIT departments are eligible to apply for a joint BUMS program. Cooperative education options are also available. The MS degree is also available in an online learning format, which is especially appealing to students who are unable to attend classes on campus.

The MS program is primarily intended for students who do not wish to pursue a degree beyond the MS. However, a number of our former students are either working on, or have attained, a Ph.D. at other universities.

Requirements

1. Seven core courses

0307-742	Statistical Computing
0307-801	Design of Experiments I
0307-802	Design of Experiments II
0307-821	Theory of Statistics I
0307-822	Theory of Statistics II
0307-841	Regression Analysis I
0307-842	Regression Analysis II

Students, in conjunction with their advisers' recommendations, should take the core courses early in the program. In any event, they must be taken within the first 30 credit hours of the degree.

2. Four courses from one of the following career options

Quality Engineering

0307-721	Statistical Process Control
0307-731	Statistical Acceptance Control
0307-781	Quality Management
0307-782	Quality Engineering

Industrial Statistics

0307-803	Design of Experiments III
0307-856	Interpretation of Data
0307-862	Reliability Statistics I
0307-883	Quality Engineering by Design

Statistical Theory and Methods

0307-824	Probability Models
0307-830	Multivariate-Analysis Theory
0307-831	Multivariate-Analysis Applications
0307-862	Reliability Statistics I

Advisers will help to identify the appropriate career option and to develop a total program structured to meet individual professional objectives. Alternatively, students may, with the consent of their advisers, choose a set of specialized career-option courses other than those listed above.

3. Four electives, thesis option, or project option

Four additional courses are chosen by students with the help of their adviser. These courses are usually department courses but may include (along with the transfer credits explained previously) up to nine credits from other courses related to the program and that are consistent with students' professional objectives. Students, with adviser approval, may choose to write a research thesis or research project instead of taking the full four electives. Most theses are for six credits, reducing the number of electives to two; projects are usually for three credits.

4. Other requirements

The MS candidate must attain an overall program grade point average of 3.0 (B), with no more than two grades of "C," for graduation. A minimum of 24 credits in 800-level courses is required in the degree program. An oral examination is required for students halfway through the program, to assess whether students have the proper depth of knowledge to progress further in the program. The oral examination tests subject matter and verbal proficiency as well as the ability to perform as a statistician in a working environment. Course work must be completed within seven years. Contact the department secretary for more details on these requirements.

Students are strongly encouraged to develop writing, speaking, presentation, and computer skills as they progress through the program.

Admission procedures

To be considered for admission, prospective students must complete a graduate application, submit transcripts of all previous undergraduate and graduate work, obtain two letters of recommendation, and pay an application fee. (RIT graduates do not have

to pay this fee.) Forms and instructions, including quarterly offerings and registration forms, may be obtained by writing to:

Office of Graduate Enrollment Services
Rochester Institute of Technology
Bausch and Lomb Center
58 Lomb Memorial Drive
Rochester, NY 14623-5604

Advanced certificate program

Two advanced certificate programs in statistical quality and statistical methods for product and process improvement are also available. Each requires 18 quarter credit hours (equivalent to six courses) and both are available to part-time students. In both programs, the courses are a subset of the MS program courses and are offered on campus and in the online learning format. The advanced certificate in statistical quality is aimed primarily at quality managers, quality engineers, or those who aspire to such positions. The advanced certificate in statistical methods for product and process improvement is designed for engineers and scientists who want a good education in the statistical methods that are most closely related to their work, but who wish to finish a program in a shorter time period than the MS program.

Advanced Certificate in Statistical Quality

Requirements

1. Basic familiarity with statistical software

Students should have basic familiarity with MINITAB statistical software, or an equivalent. This may be obtained by self-study; completion of Data Analysis Using MINITAB, a three-day, non-credit course in data analysis and statistical computing; through similar MINITAB short courses; or through Statistical Computing (0307-742), which covers both SAS and MINITAB software.

2. Six courses

0307-721	Statistical Process Control
0307-731	Statistical Acceptance Control
0307-781	Quality Management
0307-782	Quality Engineering
0307-801	Design of Experiments I
0307-802	Design of Experiments II

3. Other requirements

The candidate must attain an overall average program grade point average of 3.0 (B) for graduation. Please see the department secretary for more details.

Advanced Certificate in Statistical Methods for Product and Process Improvement

Requirements

1. Basic familiarity with statistical software

Students should have basic familiarity with MINITAB statistical software, or an equivalent,. This may be obtained by self-study; by completion of Data Analysis Using MINITAB, a three-day, noncredit course in data analysis and statistical computing; through similar MINITAB short courses; or through Statistical Computing (0307-742), which covers both SAS and MINITAB software/

2. Six Courses

Three core courses:

0307-801	Design of Experiments I
0307-802	Design of Experiments II
0307-841	Regression Analysis I

Students, with the help of an adviser, choose three courses from the following list of electives.

0307-803	Design of Experiments III
0307-842	Regression Analysis II
0307-883	Quality Engineering by Design
0307-873	Time Series Analysis
0307-862	Reliability Statistics I
0307-831	Multivariate Analysis Applications
0307-856	Interpretation of Data

The reliability course also requires calculus with integration as a prerequisite.

3. Other requirements

The candidate must attain an overall average program grade point average of 3.0 (“B”) for graduation. Please see the department secretary for more details.

More information

More information, including course schedules and interim updates to this information, is available from the center’s website,www.rit.edu/eng/cqas.

Design Development and Manufacturing Department

Master of Science in Product Development

Mark W. Smith, Director
(585) 475-7102, mwspd@rit.edu
Christine Fisher, Coordinator
(585) 475-7971, mpdmail@rit.edu
www.mpd.rit.edu

Product innovation is essential to business survival and growth. The creation and introduction of new products and services has reached an unprecedented level of complexity, requiring the coordination of diverse teams of professionals from research and development, marketing, finance, manufacturing, procurement, sales, and service. Companies, especially technology-based organizations, need leaders with an enterprise-wide perspective and knowledge base in both engineering and management. This includes individuals who possess a broad blend of technical and business skills, who understand markets and the value-chain, and who have the integrated systems perspective needed to

commercialize increasingly complex products and systems. The master of science degree in product development (MPD) program provides the educational foundation that technical professionals need for high-impact roles in product and technology innovation.

The MPD program is for engineers, scientists, and technical professionals who aspire to product development leadership positions throughout their organizations. Designed by academic and industry leaders at MIT and its Center for Innovation in Product Development, the MPD curriculum integrates business and technical elements to develop leaders with the knowledge, skills, behaviors, and perspective to effectively deploy best-in-class product development methods, tools, and practices. The program integrates formal education, ongoing research, and industrial practice, and continuously refreshes the curriculum through active partnerships with other world-class universities, research centers, and companies.

Students acquire the foundation skills and strategic perspective necessary to become future leaders and senior managers responsible for driving business growth through product innovation. They develop receptiveness to change and continuous improvement, an understanding of the enablers to business success, and an enhanced ability to recognize barriers to success early in the commercialization cycle when corrective actions are least costly.

Format

The two-year program begins each December and continues for eight consecutive quarters, including summers, until graduation. Students take two courses per quarter on Fridays.

Business trips

Two business trips (including one international trip) are taken to augment course work and broaden exposure to product development around the world. The focus of these trips will vary, and students may participate in selecting the venues consistent with program objectives. When feasible, trips will be scheduled in conjunction with partner universities that offer the product development program. Please refer to the MPD website for descriptions of prior business trips.

Curriculum

The MPD program is a 60-credit program consisting of 13 business and engineering courses (10 required courses and three electives) plus a capstone project. Students complete required courses in a defined sequence with the other members of their graduating class.

Core Course

0303-780	Foundations in Product Development
0303-786	Engineering of Systems I
0303-788	Engineering of Systems II
0303-784	Systems and Project Management

Foundation courses

0102-740	Organizational Behavior and Leadership
0105-761	Marketing Concepts
0303-785	Engineering Risk-Benefit Analysis
0303-764	Operations and Manufacturing Systems
0303-787	Systems Optimization
0101-703	Accounting for Decision Makers

Elective courses

Elective courses afford the opportunity for students to tailor the MPD program to better meet personal and organizational needs. Three elective courses (12 credits) are required. The program will offer each cohort of students a series of graduate level electives from engineering and business during the normally scheduled class times on Fridays. Students may select from a list of other courses approved by the program, but at least one elective must be from business and one from engineering. Recommended electives may include such courses as Managing Research and Innovation, New Venture Creation, Systems Dynamics, Sustainable Design, Advanced Topics in Product Development, among others.

Capstone project

Students must successfully complete a project (eight credits) during the final nine months of the program, based on a real-world problem often identified in the companies where they work. The corporate-oriented capstone project encompasses the broad integrative aspects of new product development - it synthesizes, increases, and demonstrates the student's understanding and knowledge of previous program material and underscores the behaviors essential to product development leadership. The capstone project provides immediate benefits to sponsoring organizations and is an excellent opportunity for students to gain visibility and recognition. See the MPD website for descriptions of previous projects.

Sponsorship

Most students are sponsored by an employer who is committed to improving leadership capabilities in product development. Sponsorship includes permitting students to attend classes and participate in business trips, and also involves a commitment to work with the student to provide clear expectations and well-articulated career development plans that build upon the MPD program. Candidates are welcome to sponsor themselves. Contact the MPD program office for information on financial aid.

Admission requirements

Candidates should have the following credentials: an undergraduate degree in engineering or a related scientific or technical field with a minimum GPA of 3.0, and at least five years' experience related to product development. 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 GMAT or GRE. All applicants must provide the following:

- A completed application form
- An official transcript for all undergraduate and graduate work completed
- At least one letter of recommendation from a current or recent supervisor
- A current résumé
- A personal interview with the MPD admissions team (after other completed application materials are submitted)

All application materials are available from the MPD program office or from the MPD website. For further information about the program:

Rochester Institute of Technology
MPD Program
111 Lomb Memorial Drive
Rochester, NY 14623-5608
Tel: (585) 475-7971
Fax: (585) 475-7955
E-mail: MPDmail@rit.edu
Website: www.mpd.rit.edu

Master of Science in Manufacturing Leadership

Mark W. Smith, Director
(585) 475-7102, mwspd@rit.edu
Christine Fisher, Coordinator
585-475-7971, mml@rit.edu
www.mml.rit.edu

The master of science degree in manufacturing leadership (MML) is an 18-month leadership program designed for experienced professionals moving to mid- and senior-level positions in manufacturing and service organizations. The program integrates business and engineering courses, and delivers them in a part-time format where students continue to work while taking classes in the late afternoon and evening.

The MML is a highly focused program developed jointly by the College of Business and the Kate Gleason College of Engineering. Many tools and techniques involved in "black belt" and "lean" initiatives are integral to the program. Particular emphasis is placed on supply chain management, global manufacturing and operations, lean thinking, leadership, and decision making in a complex global economy. A capstone project, oriented to the solution of a management problem or to a business process, enables students to apply new skills and capabilities to the solution of a pressing real-world problem, with significant financial benefit to sponsors. An elective allows for additional depth or breadth in a subject of relevance to students and their sponsoring organizations.

Curriculum

The program consists of 48 credits of engineering and business courses and an integrative capstone project. The courses are:

0102-740	Organizational Behavior and Leadership
0303-703	Supply Chain Management
0303-784	Systems and Project Management
0303-766	Manufacturing Systems
0303-750	Management of Quality Systems
0101-794	Cost Accounting in Technical Organizations
0303-760	Product/Process Development and Design
0303-762	Systems Modeling and Decision Making
0303-723	Facilities Planning
	New Course in Business Decision Making**
	Elective*
0303-891	Capstone Integrative Project

**Contact the program office for elective options.*

*** Pending approval.*

Format

The MML program was designed to be completed in two academic years (excluding summers). Each new class of students will be admitted in the fall quarter and will continue throughout the program as a cohort group. Classes are held in the late afternoon and evening to accommodate students' work schedules.

Prospective students also have the option to enroll at other times during the academic year or take a reduced course load. This flexibility offers other options for students who are interested in the program, but are constrained by time or financial restrictions. Candidates should follow the normal admission process. Contact the Office of Graduate Enrollment Services for more information.

Students may also take up to three courses on a non-matriculated basis. Credits earned while enrolled as a non-matriculated student may be applied to the MML degree program following formal admission.

Admission requirements

Applicants should have the following credentials:

- A baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 2.8.
- At least two years' experience in a manufacturing-related organization or business environment.

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 GMAT or GRE.

Applicants must provide the following:

- A completed RIT graduate application and two professional recommendations
- A current résumé
- An interview with the MML admissions team (after other application materials are received)

All application materials are available from the Office of Graduate Enrollment Services, MML program office, or the program website.

Prerequisite knowledge

Admitted students must possess knowledge and skills at the introductory course level in probability and statistics, engineering economy or basic accounting, basic properties of materials, and manufacturing processes.

Areas that need strengthening can be addressed by guided reading, formal course work, independent study, seminars, or other suitable means. For further information about the MML program:

Rochester Institute of Technology
MML Program
111 Lomb Memorial Drive
Rochester, NY 14623-5608
T 585-475-7971
F: 585-475-7955
E-mail: MML@rit.edu
Website: www.mml.rit.edu

Microsystems Engineering Department

Doctor of Philosophy in Microsystems Engineering

Dr. Mustafa A. G. Abushagur, Director
(585) 475-2295, *maaeen@rit.edu*
www.rit.edu/~630www/grad/phd.htm

The integration of entire systems into micron scale devices and the sensing technology to interface these devices to the real world are and will be core disciplines required for next-generation technology. Within the past decade, microsystems (micro-optical, micro-electrical, and micro-mechanical systems) have emerged as a critical technology worldwide. Simply stated, a microsystem is an ensemble of integrated components, the functionality of which derives from micron-size (or smaller) elements that collectively perform mechanical, electrical, optical, logical, and even biological functions. Microsystems technology will integrate small computer chips with tiny sensors, probes, lasers, and actuators to allow the chips to sense, analyze, and communicate. This enabling technology adds functionality and reduces costs in many product applications, particularly in the areas of telecommunications, imaging, electronics, and biomedical diagnostics and treatment. In short, micro-scale devices and systems will be smaller, faster, cheaper, and more reliable than their macroscopic counterparts.

RIT offers a unique educational and research program that leads to a Ph.D. in microsystems engineering. This multidisciplinary program builds on the strengths in microelectronic fabrications, photonic, imaging, and micro-power research programs at the institute. The program is designed to be application-oriented without sacrificing the scientific and engineering fundamentals. Students will be involved in cutting-edge research and have access to a modern facility, the largest of its kind in any academic institution.

Mission

The need within the international scientific and engineering communities for students trained in microsystems has prompted RIT to combine resources and create the doctoral program in microsystems engineering. This multidisciplinary degree provides the student with a fundamental background in the sciences and engineering, which prepares the student for a successful career.

The mission of the doctorate program in microsystems engineering is to meet the critical need for expanded knowledge and expertise in the design, fabrication, and real-life application of micron-, submicron-, and nanometer-scale devices, components, and systems.

The curriculum is structured to provide each student with a sound background and a thorough foundation in engineering and science for the analysis, design, fabrication, and testing of microsystems. The curriculum provides world-class education through the innovative application of educational technologies and partnerships. RIT is gaining increasing recognition, nationally and internationally, as a leader in education, research, and economic development in the field of microsystems engineering.

Program highlights

- A program designed for students with excellent preparation in the physical sciences and engineering.
- Multidisciplinary faculty sharing resources and expertise.
- Program administered by the doctorate program in microsystems engineering committee, which includes core faculty members from the colleges of Engineering and Science.
- A unique clean-room and research laboratories designed for and dedicated to providing a world-class focus for microsystems engineering research across traditional disciplinary boundaries.
- Collaboration with industry and government laboratories.
- The doctorate in microsystems engineering is first of its kind in the nation.

Curriculum

A total of 92 quarter credit hours of graduate course work is required, of which 16 quarter credit hours are in designated microsystems foundation courses and 36 quarter credit hours are in required courses in a major and two minor specialty areas. An additional 24 quarter credit hours (minimum) are expected in dissertation research. An overall “B” average must be maintained to stay in the microsystem engineering program. In addition, all other requirements of graduate enrollment must be met to remain in good standing.

Phase I

This phase of the program prepares students with a solid foundation in science and engineering and prepares the student for independent research. This phase includes course work and passing the preliminary examination.

Course requirement

The student is expected to fulfill the course requirements by taking courses in the following categories:

1. Four foundation courses
2. Five courses in major specialization areas
3. Two courses in each minor concentration area (total 4 courses)

Foundation courses

1. Mathematical Methods
2. Nano-Scale Physics and Chemistry
3. Processing and Fabrication
4. Systems Engineering

Major specialization area

- Covers courses in the area in which student the will specialize in his/her research
- It should include: A sequence of three courses in the area of research, and a sequence of two courses in a support area

Minor concentration areas

- Covers courses outside of the area in which the student will specialize in his/her research
- It should include: Two sequences of two courses each and at least one of the sequences is chosen outside of the student's undergraduate degree.

Preliminary examination

In order to complete this phase of the program and continue to specialize in a focus area, the student must pass the preliminary examination (only two attempts are allowed). The goal of the preliminary examination is to:

- Determine the student's ability to conduct independent research, and
- Determine that the student has the proper background to pursue his/her research.

An examination committee presents three papers in different areas of concentration. The student chooses one paper and prepares a 30-minute oral presentation and written review for the committee. During the preliminary examination, students are expected to identify the author's hypotheses and methodology, the key areas of investigation, and why they are important to the field. The student should also state the status of the field prior to the author's work and present a critical appraisal of the work—its value and significance in advancing knowledge of the field. Finally, the student should propose valid research that would improve upon or extend the work described in the article.

Papers are given to students the first week in June. Examinations are scheduled the third week of June and results are posted by the first of July.

Ph.D. advisory committee

The student, along with his/her major adviser, should form an advisory committee with the following guidelines:

- Four or more members
- Members represent at least two concentration areas
- Members should include faculty from two departments
- A fifth external member from industry or a government research lab is highly encouraged

Phase II

This phase consists of course work in the program of study. Much of this course work will support the dissertation research conducted in Phase III. This phase will be completed when the student has finished the formal course work as prescribed in the program of study and by passing the qualifying examination.

Phase III

Phase III consists of all experimental and/or theoretical work needed to complete the student's dissertation. The student's adviser will supervise these activities. The final examination will consist of a public, oral presentation, and defense of the dissertation.

Graduate Faculty

Harvey J. Palmer, BS, University of Rochester; Ph.D., University of Washington — Dean; Professor

Computer Engineering Department

Andreas Savakis, BS, MS, Old Dominion University; Ph.D., North Carolina State University — Professor and Department Head

Juan C. Cockburn, BSME, Universidad Nacional de Ingernieria; MSEE, Ph.D., University of Minnesota — Associate Professor

Roy Czernikowski, BEE, ME, Ph.D., Rensselaer Polytechnic Institute — Professor

Kenneth Hsu, BS, National Taiwan Normal University; MS, Ph.D., Marquette University; P.E. — Professor

Fei Hu, BS, Shanghai Institute of Railway Technology; MS, Shanghai Tiedao University; Ph.D., Clarkson University — Assistant Professor

Marcin Lukowiak, MSc, Ph.D., Poznan University — Visiting Assistant Professor

Roy W. Melton, BS, MS, Ph.D., Georgia Institute of Technology — Visiting Assistant Professor

Pratapa V. Reddy, BE, M.Tech., Osmania University; Ph.D., Indian Institute of Technology — Professor

Greg Semeraro, BS, Boston University; MS, Rochester Institute of Technology; Ph.D., University of Rochester — Assistant Professor

Muhammed E. Shaaban, BS, MS, University of Petroleum and Minerals; Ph.D., University of Southern California — Associate Professor

Shanchieh Jay Yang, BS, National Chio-Tung University; MS, Ph.D., University of Texas at Austin — Assistant Professor

Electrical Engineering Department

Vincent J. Amuso Sr., BS, Western New England College; MS, Syracuse University; Ph.D., Rensselaer Polytechnic Institute — Department Head; Associate Professor, Communications/Signal Processing

David Borkholder, BS, Rochester Institute of Technology; MS, Ph.D., Stanford University — Assistant Professor, Biosensors (electro-magnetic and chemical), Biomedical Instrumentation MEMS Fabrication, Systems Engineering

Robert J. Bowman, BSEE, Pennsylvania State University; MSEE, San Jose State University; Ph.D., University of Utah — Professor, Analog Integrated Circuit Design, Semiconductor Physics, Biomedical Instrumentation

Edward Brown, BS, University of Pennsylvania; MS, Ph.D., Vanderbilt University — Assistant Professor, Rehabilitation, Robotics, Control Systems, Biomechatronics

Sohail A. Dianat, BS, Aria-Mehr University; MS, Ph.D., George Washington University — Professor, Control Systems, Communications, Signal/Image Processing

Christopher R. Hoople, BS, Union College; Ph.D., Cornell University — Visiting Assistant Professor, Power Electronics, Device Physics

Mark Hopkins, BS, Southern Illinois University; MS, Ph.D., Virginia Polytechnic Institute — Associate Professor, Control Systems

Syed Islam, B.S.C., Bangladesh University of Engineering and Technology; MS, University of Saskatchewan; Ph.D., University of Connecticut — Assistant Professor, Semiconductor Device Modeling and Characterization

Sergey Lyshevski, MSEE, Ph.D., Kiev Polytechnic Institute — Professor, Microsystems

Athimoottil V. Mathew, BEE, Jadavpur University; M.Tech., Indian Institute of Technology; Ph.D., Queen's University — Professor, Control Systems, Robotic Vision

James Moon, BS ChemE, Carnegie Mellon University; MBA, University of Rochester; MS, Ph.D., University of California at Berkeley — Associate Professor, VLSI Design, Semiconductor Physics, Integrated Circuit Design, Electronic and Photographic Imaging Systems

P. R. Mukund, BS, MS, Ph.D., University of Tennessee — Gleason Professor, VLSI Design, Electronic Devices and Circuit Design

Dorin Patru, BS, MS, Technical University of Cluj-Napoca; Ph.D., Washington State University — Assistant Professor, Mixed-Signal and Digital Integrated Circuits and Systems

Eric Peskin, BS, Princeton; Ph.D., University of Utah — Assistant Professor, Digital Systems, Reconfigurable Computing

Daniel B. Phillips, BS, State University of New York at Buffalo; MS, Ph.D., University of Rochester — Associate Professor, Biomedical Instrumentation, Signal Processing and Visualization, and Embedded Systems

Sannasi Ramanan, BS, BE, M.Tech., Ph.D., Indian Institute of Technology — Associate Professor, Semiconductor Devices

Raghuveer Rao, BS, Mysore University; ME, Indian Institute of Science; Ph.D., University of Connecticut — Professor, Image and Signal Processing

Eli Saber, BS, State University of New York at Buffalo; MS, Ph.D., University of Rochester — Associate Professor, Signal Image and Video Processing, Communications, Biomedical Computer Vision

Ferat E. Sahin, BS, Istanbul Technical University; MS, Ph.D., Virginia Polytechnic Institute — Associate Professor, Artificial Intelligence, Control Systems, Robotics

Shailendhar Saraf, BS, Indian Institute of Technology; MS, University of Hawaii; Ph.D., Stanford University — Assistant Professor, Laser Optics, Electromagnetics

Jayanti Venkataraman, BS, MS, Bangalore University; Ph.D., Indian Institute of Science — Professor, Electromagnetics

Industrial and Systems Engineering Department

Jacqueline Reynolds Mozrall, BS, Rochester Institute of Technology; MS, North Carolina State University; Ph.D., State University of New York at Buffalo — Department Head; Associate Professor, Industrial Engineering, Human Factors, Ergonomics

Andres L. Carrano, BS, Universidad Catolica Andres Bello; MS, Ph.D., North Carolina State University — Associate Professor, Manufacturing

Marcos Esterman, BS, MS, Massachusetts Institute of Technology; Ph.D., Stanford University — Assistant Professor, Systems Engineering, Product Development

Michael E. Kuhl, BS, Bradley University; MS, Ph.D., North Carolina State University — Associate Professor, Systems Simulation

Matthew M. Marshall, BS, Rochester Institute of Technology; Ph.D., University of Michigan — Assistant Professor, Biomechanics, Ergonomics

Nabil Z. Nasr, BS, Helwan University; MS, Rutgers University; M.Eng., Pennsylvania State University; Ph.D., Rutgers University — Professor, Brinkman Professor of Screw . Machine Technology, Robotics, NC Programming, Manufacturing, Remanufacturing

Sudhakar R. Paidy, BS, Osmania University, India; MS, Ph.D., Kansas State University — Professor, Systems Integration, Information Systems, Operations Research

N. Richard Reeve, BS, MS, Ph.D., State University of New York at Buffalo — Professor, Applied Operations Research

Paul H. Stiebitz, BS, ME, Rochester Institute of Technology — Associate Professor, Simulation and Operations Research, Systems Engineering

James B. Taylor, BS, MS, Ph.D., Purdue University — Associate Professor, Manufacturing

Moises Sudit, BS, Georgia Institute of Technology; MS, Sanford University; Ph.D., Pufdue University — Visiting Associate Professor, Operations Research

Brian K. Thorn, BS, Rochester Institute of Technology; MS, Ph.D., Georgia Institute of Technology — Associate Professor, Applied Statistics, Sustainable Design

Mechanical Engineering Department

Edward C. Hensel, BS, Clarkson University; Ph.D., P.E., New Mexico State University—Department Head; Professor, Numerical Simulation of Diffusion-based Systems, Multi-disciplinary Design

Lawrence Agbezuge, BSME, Ghana Imperial College; MS, Eng.Sc.D., Columbia University—Visiting Associate Professor, Mechanics, Simulation

Margaret Bailey, BS, Pennsylvania State University; Ph.D., University of Colorado at Boulder—Kate Gleason Endowed Chair; Associate Professor, Energy Systems, Thermodynamics, Building Systems

Stephen Boedo, BA, State University of New York at Buffalo; MS, Ph.D., Cornell University—Associate Professor, Tribology and Lubrication

Agamemnon L. Crassidis, BS, MS, Ph.D., State University of New York at Buffalo—Assistant Professor, Aerospace Engineering, Nonlinear Dynamics and Controls

Steven Day, BS, Ph.D., University of Virginia—Assistant Professor, Bioengineering, Implantable Devices, Fluids in Biosystems

Elizabeth A. DeBartolo, BS, Duke University; MS, Ph.D., Purdue University—Associate Professor, Fatigue and Fracture Mechanics, Materials Performance

Hany A. Ghoneim, BS, MS, Cairo University, Egypt; Ph.D., Rutgers University—Professor, Finite Elements, Vibrations

Amitabha Ghosh, B.Tech., M.Tech., Indian Institute of Technology; Ph.D., Mississippi State University—Professor, Computational Fluid Dynamics, Aerodynamics, Aerospace Engineering

Surendra K. Gupta, B.Tech., Indian Institute of Technology; MS, University of Notre Dame; Ph.D., University of Rochester—Professor, Materials Science, Computer Software, Image Processing

Satish G. Kandlikar, BE, Marathwada University; M.Tech., Ph.D., Indian Institute of Technology—James E. Gleason Professor, Thermal Systems and Energy

Mark Kempski, BS, Purdue University; MS, Ph.D., State University of New York at Buffalo-Professor, Biomechanics, Bioengineering, Systems and Controls

Kevin Kochersberger, BS, MS, Ph.D., Virginia Polytechnic Institute and State University—Associate Professor, Signal Processing, Structural Dynamics, Design, Aerospace Engineering

Jeffrey D. Kozak, BS, Gannon University; MS, Ph.D., Virginia Polytechnic and State University of Virginia—Assistant Professor, Aerodynamics and Turbomachinery, Aerospace Engineering

Alan H. Nye, BS, MS, Clarkson College; Ph.D., University of Rochester—Associate Department Head; Professor, Automotive Engineering, Design of Systems

Ali Ogut, B.Ch.E., Hacettepe University; MS, Ph.D., University of Maryland—Professor, Fluid Mixing, Thermal Fluid Sciences, Energy and Environment

Risa J. Robinson, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Associate Professor, Bioengineering, Aerosol Transport in Biological Systems

Frank Sciremammano Jr., BS, MS, Ph.D., University of Rochester—Professor, Geophysical Fluid Dynamics and Environmental Engineering

Robert Stevens, BS, Swathmore College; MS, North Carolina State University; Ph.D., University of Virginia—Assistant Professor, Energy and Environment, MEMS, Thermal Properties, Energy Conversion, Thermoelectrics

Josef S. Torok, BS, University of Akron; MS, Ph.D., Ohio State University-Professor, Theoretical and Applied Mechanics, Applied Mathematics, Dynamic Systems, Automotive Engineering

P. Venkataraman, B.Tech., Indian Institute of Technology; MS, Ph.D., Rice University—Associate Professor, Optimal Control, Fluid Mechanics, Optimal Design, Aerospace Engineering

Benjamin Varela, BS, Institute of Technology of Juarez; MS, Ph.D., New Mexico State University—Assistant Professor, Innovative Materials, Automation and Fluid Power, Dynamics

Wayne W. Walter, BE, State University of New York Maritime College; MS, Clarkson College; Ph.D., P.E., Rensselaer Polytechnic Institute—Professor, Applied Mechanics, Robotics, Vibrations

Microelectronic Engineering Department

Santosh Kurinec, BS, MS, Ph.D., University of Delhi—Department Head; Professor, Electronic Materials and Devices, IC Processing, Quantum and Nanoscale Devices

Dale E. Ewbank, BS, MS, Rochester Institute of Technology—Visiting Assistant Professor, Microlithography, Design of Experiments, Materials, Scanning Probe Microscopy

Lynn F. Fuller, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Professor, IC Design, Semiconductor Manufacturing, MEMS and Microsystems

Karl D. Hirschman, RS, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Micron Technology Professor, Director, Semiconductor and Microsystems Fabrication Laboratory; Associate Professor, Semiconductor Process Integration, Photonic Devices

Michael A. Jackson, BS, MS, Ph.D., State University of New York at Buffalo-Associate Professor, Surface Analysis, IC Metrology, Materials, CMP

Robert E. Pearson, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York at Buffalo—Associate Professor, Advanced Device and Process Modeling, VLSI Design and Parameter Extraction

Sean L. Rommel, BS, Ph.D., University of Delaware-Assistant Professor, Emerging Semiconductor Devices, Photonic Devices, Integration

Bruce W. Smith, BS, MS, Ph.D., Rochester Institute of Technology—Intel Professor of Research and Technology, Professor, Advanced Microlithography, Nanolithography

The John D. Hromi Center for Quality and Applied Statistics

Donald D. Baker, BA, Trinity College; M.Ed., MBA, Ph.D., University of Rochester-Professor, Director; Quality Standards, Quality Management and Problem Solving

Peter Bajorski, MS, University of Wroclaw; Ph.D., Technical University of Wroclaw—Associate Professor, Regression Models, Multivariate Analysis, Nonparametrics, Imaging Science Applications

Steven M. LaLonde, BS, State University of New York at Potsdam; MBA, University of Rochester; MS, Ph.D., Syracuse University—Associate Professor, Multivariate Analysis, Survey Design and Analysis, Statistical Computing, Educational and Psychological Measurement

Daniel R. Lawrence, BA, BS, University of Akron; MA, Ball State University; MS, Rochester Institute of Technology; Ph.D., University of Toronto—Associate Professor, Multivariate Analysis (especially of 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—Assistant 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-Associate Professor, Chair, Experimental Design, Process Modeling and Improvement, Multivariate Analysis, Reliability, Nonparametrics

Microsystems Engineering Department

Mustafa A. G. Abushagur, BS, Tripoli University; MS, Ph.D., California Institute of Technology—Director, Professor, Micro-optical Systems, Micro-and Nano-photonic Devices

Note: Prerequisites are within parentheses at the end of the course description

Electrical Engineering

0301-702 **Random Signals and Noise**
In this course the student is introduced to random variables and stochastic processes. Topics covered are probability theory, conditional probability and Bayes theorem, discrete and continuous random variables, distribution and density functions, moments and characteristic functions, functions of one and several random variables, Gaussian random variables and the central limit theorem, estimation of a random variable, random processes, stationarity and ergodicity, auto correlation, cross-correlation and power spectrum density, response of linear prediction, Wiener filtering, elements of detection, matched filters. (Graduate standing) **Class 4, Credit 4**

0301-703 **Matrix Methods in Electrical Engineering**
This course deals with the elements of discrete transforms and linear algebra. Topics include: discrete-time signals and systems, the Z-transform and its application, solution of difference equations, concepts of stability, discrete Fourier analysis, DFT, FFT algorithms, topics in linear algebra and matrices, eigenvalues and eigenvectors, functions of matrices, matrix transformations and operations, matrix polynominals and the Cayley-Hamilton theorem, state variables, relation between transfer functions and state variable representation of LTI systems, state transition matrix, and solution of state equations. **Class 4, Credit 4**

0301-710 **Advanced Electromagnetic Theory**
The primary objective is to provide the mathematical and physical fundamentals necessary for a systematic analysis of electromagnetic field problems. Topics include potential representations, scalar and vector Green's functions, Green's theorem, reciprocity, duality, equivalence principle, image theorem, and radiation from apertures, scattering, integral equation solutions, perturbation and numerical methods. (Graduate standing) **Class 4, Credit 4**

0301-711 **Advanced Carrier Injector Transistors**
An advanced level course in electronic transport in semiconductors and the operation of bipolar devices (pn junction diodes, bipolar junction transistors and semiconductor-controlled rectifiers). Topics include electron drift, diffusion and carrier lattice interactions, energy band diagrams in non-uniformly doped semiconductors, continuity equations, impact ionization, tunneling, advanced static and dynamic analysis of diodes and bipolar transistors, design of bipolar devices. Topics also include Heterojunction physics and Heterojunction Bipolar Transistors (HBT), including SiGe HBT. **Class 4, Credit 4**

0301-712 **Advanced Field Effect Devices**
An advanced level course on MOSFETs and submicron MOS devices. Topics include MOS capacitors, gated diodes, long channel MOSFET, subthreshold conduction and offstate leakage, short channel effects, hot-carrier effects, ion-implanted channels, MOS scaling and advanced MOS technologies. **Class 4, Credit 4**

0301-713 **Solid State Physics**
An advanced level course on solid-state physics, with particular emphasis on semiconductor materials. Topics include: basic semiconductor properties, elements of quantum mechanics, general and time-independent formulation of wave mechanics, outcomes and predictions, energy band theory, statistical mechanics and equilibrium carrier statistics, excess carriers in semiconductors, carrier transport. **Class 4, Credit 4**

0301-717 **Microwave Circuit Design**
The primary objective is to study the fundamentals of microwave engineering with emphasis on microwave network analysis and circuit design. Topics include microwave transmission lines such as wave-guides, coax, microstrip and stripline, microwave circuit theory such as S-matrix, ABCD matrices, and even odd mode analysis, analysis and design of passive circuits and components, matching networks, microwave resonators and filters. (0301-703) **Class 4, Credit 4**

0301-726 **Mixed Signal IC Design**
This course covers basic analog functional blocks and mixed signal blocks, in CMOS technology. Topics include: device models, current sources and active loads, precision reference, operational amplifiers, comparators, sample and hold circuits and data converters design. Course involves circuit design and layout projects. (Graduate standing). **Class 4, Credit 4**

0301-727 **VLSI Design**
A course in the design of very large scale integrated circuits at the level of Mead and Conway's VLSI Design. Topics include MOS devices and circuits, n-channel MOS process, data and control flow in systematic structures, implementing integrated system design, system timing and examples of LSI computer systems. **Class 4, Credit 4**

0301-729 **Antenna Theory and Design**
The primary objective is to study the fundamental principles of antenna theory applied to the analysis and design of antenna elements and arrays including synthesis techniques and matching techniques. Topics include antenna parameters, linear antennas, array theory, wire antennas, microstrip antennas, self and mutual impedances, equivalence principie, Huygen's principle, aperture antennas, traveling wave antennas, reflector antennas. **Class 4, Credit 4**

0301-730 **Advanced Analog IC Design**
An advanced course in analog integrated circuit design. Students will study bipolar and MOS realization of operational amplifiers, analog multipliers, A to D and D to A converters, switched capacitor filters and more. The students will participate in design projects including circuit design, layout and SPICE simulation. (0301-726) **Class 4, Credit 4**

0301-732 **Advanced Topics in Digital System Design**
The purpose of this course is to introduce students to advanced topics in digital systems design not covered in depth in undergraduate classes or topics that are new to the design community. Topics include: design of digital systems using Hardware Description Languages (VHDL/Verilog), design of digital systems using asynchronous circuits, design of digital systems using wave-pipelined circuits, clock distribution in large digital systems, design of digital systems with threshold gates, multi-valued logic and design of DSP specific blocks. For specific evaluation and grading policy, contact assigned instructor before registration. (0301-240, 347, 365, 545) **Class 4, Credit 4**

0301-733 **Robust Control**
One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop system to continue performing satisfactorily despite large variations in the (open-loop plant dynamics. This course will provide an introduction to the analysis and design of robust feedback systems. Topics include overview of linear algebra and linear systems, H2 and h°° control, 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. Software: MATLAB: Robust Control Toolbox, and mu-Toolbox. (0301-703) **Class 4, Credit 4**

0301-741 **Design for Testability**
This course deals with the design systems for testability and for maintainability. A survey of criteria for testability is given. A discussion of fault simulation and test pattern generation is included. Random test pattern generators and associated data compression schemes such as signature analysis are also described. Scanning techniques (both scan path and boundary scan) are discussed. The tradeoffs between built-in testing capacity and additional silicon structures are weighed. A small project, usually involving simulation, will be required. (0301-650) **Class 4, Credit 4**

0301-742 **Advanced Topics in Embedded Systems**
An introduction to the theory and application of top-down design, structure, abstraction, segmentation, high-level languages, and operating systems to real-time programs for microprocessors. Students will become proficient in a structured high-level language. Topics include structure diagrams, separate module compilation, data types, data structures, self-documenting code, procedures, meaningful variable names, linkage with other languages, object code libraries, operating system calls, multi-tasking concurrent and re-entrant programs, and symbolic debugging. (0301-655) **Class 4, Credit 4**

0301-749 **Speech and Image Compression**
Modern compression techniques used in efficient digital transmission and storage of speech and image waveforms are dealt with. Topics include digital communication channels, sam–piing and reconstruction of one-dimensional and two-dimensional signals, coding concepts, bit rate, coder complexity, rate distortion and information-theoretic bounds, characteristics of speech and image waveforms, quantization techniques, uniform nonuniform, logarithmic, optimum (Max), entropy coding, adaptive, pulse code modulation (PCM) of audio and video waveforms, DPCM, ADPCM, and delta modulation, linear prediction, transform coding, optimum (Karhunen-Loeve) transform and its gain, sub-optimum transforms, DFT, DCT, DST, DHT, and DWHT, special coding schemes, run-length coding, block truncation coding, sub-band coding, vector quantization, comparative performance of various schemes. Computer assignments and demonstrations. **Class 4, Credit 4**

0301-753 **Optimization Techniques**
This course provides a rigorous introduction to the principles and applications of optimization techniques. Optimization has applications in almost every branch of science and engineering. The course aims to present those aspects of optimization methods that are currently of foremost importance in solving real world engineering problems. The topics covered include linear optimization, Quadratic models, Descent methods and stability, Newton's technique, Conjugate direction methods, constrained optimization, Lagrange multipliers, Convexity, and Duality. Nonlinear programming and integer programming as well as principles of non-smooth optimization are included. (0301-703) **Class 4, Credit 4**

0301-761 **Modern Control Theory**
An advanced course in control theory, topics covered include review of state-space formulation of SISO systems, solution of state equations, STM and its properties, application of state-space concepts, state variable design, multivariate systems, preliminaries, systems of lease order, stability and control. **Class 4, Credit 4**

0301-763 **Stochastic Estimation and Control**
This course is concerned with the control of systems in the presence of uncertainties. Topics to be discussed: modeling of stochastic processes, estimation theory, least squares estimation, maximum likelihood estimation, MAP estimation, optimum filtering and prediction, optimum smoothing and interpolation, the Wiener-Hopf equation, solution to casual and non-casual cases, state estimation, Kalman filtering, discrete and continuous time filters, Riccati equation, optimum feedback control in presence of noise, LQC problem and applications. (0301-702, 761) **Class 4, Credit 4**

0301-764 **Digital Control Systems**
An introduction to the analysis and design of control systems in which the microcontroller plays a principal role. Topics include sampled data systems, Z and W-place analysis and design, algorithm generation and the effect of computer word length on noise and stability. The student will be expected to make use of the digital computer in the implementation of design procedures. (0301-703) **Class 4, Credit 4**

0301-768 **Adaptive Signal Process**
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. (0301-702 or permission of instructor) **Class 4, Credit 4**

0301-769 **Fuzzy Logic and Applications**
This course introduces fuzzy logic and its applications in areas like control systems, image processing, decision making, etc. Major topics: fuzzy sets, rule base, generation and combinations of rules, defuzzification. Fuzzy systems, choice of fuzzy variables, their division into fuzzy sets, choice of membership functions, the effect of these on system performance. Applications: discussion of published works and student projects using fuzzy logic. Students are required to research the published literature and/or do projects and take an active part in these discussions. **Class 4, Credit 4**

0301-770 **Pattern Recognition**
This course provides a rigorous introduction to the principles and applications of statistical pattern recognition. The topics covered include Bayesian decision theory, nearest-neighbor techniques, linear discriminant functions, and clustering. Parameter estimation and, the supervised learning as well as principles of feature selection are included. (0301-702) **Class 4, Credit 4**

0301-772 **Special Topics**
Topics and subject areas that are not among the courses listed are frequently offered under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. (No regular course schedule) **Class 4, Credit 4**

0301-777 **Digital Signal Processing**
A continuation of the topics studied in 0301-554. Topics include study of the design methods for digital IIR filters via s-plane transformations, study of design methods for digital FIR filters, including emphasis on the question of linear phase response, a review of the discrete Fourier transform (DFT) and an in-depth study of fast algorithms (FFTs) for implementing the DFT, including radix 2, radix 4 and mixed radix algorithms, quantization effects in discrete systems; an introduction to digital signal processing computer chips and their use in the implementation of digital processing systems, and applications of digital signal processing, including speech processing and two-dimensional image processing. Includes several design projects in the digital signal processing laboratory. (0301-554) **Class 4, Credit 4**

0301-779 **Digital Image Processing**
This is an introductory course in digital image processing that begins with a study of two-dimensional signal processing and transform methods with applications to images. Image sampling is discussed followed by gray level description of images and methods of contrast manipulation including linear/nonlinear transformation and histogram equalization and specification. Image smoothing methods are considered including spatial and frequency domain low pass filtering, AD-HOC methods of noise removal and median filtering. Following this, methods of image sharpening are studied including derivative methods and high pass filtering. Edge and line detection methods are discussed using masks and Hough transforms, methods of image segmentation and degradation and image restoration, including deblurring. Several extensive computer and DSP lab assignments are required. (0301-702, 703 or permission of instructor) **Class 4, Credit 4**

0301-780 **Independent Study**
This course number should be used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. **Credit 4**

0301-786 **MEMS Devices**
Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing, and other applications. There is a critical need to synthesize and design high performance MEMS that satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Fourth or fifth year standing for undergraduates, or graduate standing) **Class 4, Credit 4.**

0301-789 **Fundamentals of MEMS**
This course introduces the student to Microelectromechanical systems (microscale transducers, actuators and sensors with ICs). Synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS will be covered. The primary emphasis of the course will be concentrated on development of basic theory to attain fundamental understanding of MEMS, the design, analysis, control, fabrication and application of MEMS in robotics, electronics, biotechnology, medicine, avionics, transportation, security, defense, etc. (graduate standing for graduate students, 0301-531 for undergraduate students) **Class 4, Credit 4**

0301-794 **Information Theory**
This course introduces the student to the fundamental concepts and results of information theory. This is a very important course for students who want to specialize in signal processing, image processing, or digital communication. Topics include definition of information, mutual information, average information or entropy, entropy as a measure of average uncertainty, information sources and source coding, Huffman codes, run-length constraints, discrete memoryless channels, channel coding theorem, channel capacity and Shannon's theorem, noisy channels, continuous sources and channels, coding in the presence of noise, performance bounds for data transmission, rate distortion theory. (0301-702) **Class 4, Credit 4**

0301-796 **Multiuser Detection**
An introduction to the fundamental concepts of multiuser digital communications. Multiuser Detection deals with demodulation of interfering digital streams of information that appears in areas such as wireless communications, high-speed data transmission, satellite communications, and magnetic recording. The course begins with a review of multi-access communication channels, in particular Code Division Multiple-Access (CDMA) channels. This is followed by the design and performance analysis of optimum linear multiuser detectors. Topics such as decision-driven multiuser detection and noncoherent multiuser detection are covered. (0301-702 and 703 or permission of instructor) **Class *4,* Credit *4***

0301-798 **Microfuidic MEMS**
The course begins with an overview of microfluidic technology to provide a framework and to clarify the relationship of microfluidics to microelectromechanical systems (MEMS) and microsystems in general. Three major topics comprise the course: 1) selected elements of fluidic dynamics theory, and the scaling and application of that theory to microscale dimensions; 2) design, fabrication, and characterization of microfluidic devices and microsystems including exploration of major alternative fabrication technologies, process integration and materials issues, and device- and system-level packaging/encapsulation challenges; 3) applications, including microvalves, micropumps, microflow control sensor, and devices for chemical and biochemical analysis. **Class 4, Credit 4**

0301-799 **Nano and Microengineering**
This course focuses on analysis and synthesis of nano- and micro electromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and micro-engineering, distinct systems and devices will be examined. The application of nano and microengineering in nanocomputers avionics, security and transportation will be emphasized. Specific applications included are: super-fast data processing and computing, data storage, imaging, molecular intelligent automata, etc. (Graduate standing for graduate students; permission of instructor for undergraduate students) **Class 4, Credit 4**

0301-800 **Graduate Paper**
This course number is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in electrical engineering. The student must obtain the approval of an appropriate faculty member to supervise the paper before registering for this course. **Credit variable 0–5**

0301-803 **Digital Video Processing I**
In this graduate level course the following topics will be covered: Representation of digital video—introductionand fundamentals. Time varying image formation models including motion models and geometric image formation. Spatio-temporal sampling including sampling of analog and digital video, two-dimensional rectangular and periodic sampling, sampling of 3-D structures, and reconstruction from samples. Sampling structure conversion including sampling rate change and sampling lattice conversion. Two-dimensional motion estimation including optical flow based methods, block-based methods. Pel-cursive methods, Bayesian methods based on Gibbs Randon Fields. Three-dimensional motion estimation and segmentation including methods, point correspondences, optical flow and direct methods, motion segmentation, and stereo and motion tracking. (0301-779 or permission of instructor) **Class 4, Credit 4**

0301-804 **MEMS Evaluation**
This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMS evaluation will be covered. (0301-786, senior standing) **Class 4, Credit 4**

0301-805 **Modern Optics for Engineers**
This course provides a broad overview of modern optics in preparation for more advanced courses in the rapidly developing fields of lasers, fiber optics and non-linear optics. Topics covered: propagation of light, geometrical optics, polarization, interferometry, diffraction, and laser resonators. Introduction to non-linear optics: harmonic generation, optical parametric oscillators and amplifiers. At the end of the quarter, the students should have a firm foundation in classical optics. Lasers and non-linear optics will be introduced from a semi-classical perspective and will not require a quantum mechanical background. Students will write a paper on a topic of current research interest in the field. (0301-474) **Class 4, Credit 4**

0301-810 **Advanced Computer Architecture**
This course covers advanced topics in computer and processor architecture. Topics include: pipeline and parallel processor design, branch tables and prediction algorithms, single issue versus multiple issue processor architectures (VLN, SIMD, superscalar), cache architectures, quantitative and qualitative evaluation of instruction set architectures. For specific evaluation and grading contact the assigned instructor before registration. (0301-240,347, 365,545) **Class 4, Credit 4**

0301-812 **Advanced Topics-Physical Implementation**
This course covers the analysis and physical design of very large scale integrated circuits. Topics covered include synthesis, cell layout, cell placement and system routing, extraction, layout versus schematic check, signal integrity, timing and noise immune design techniques. The course will address issues in current state-of-the art submicron and deep submicron CMOS technologies, with an emphasis on digital circuits and systems. For specific evaluation and grading policy contact the assigned instructor before registration. (0301-240,347, 365, and 545) **Class 4, Credit 4**

0301-814 **RF Integrated Circuit Design**
An advanced course in analog RF integrated circuit design. Topics include: accurate modeling of passive elements, modeling of devices, low noise amplifiers, voltage controlled oscillators, and mixer circuits. Circuits will be designed using CMOS technology for frequencies up to 5 GHz. (0301-726) **Class 4, Credit 4**

0301-815 **Multivariable Modeling and Control**
This course introduces students to the major topics, methods, and issues in modeling and controlling multiple-input, multiple-output (MIMO) linear systems. In the first part of the course, students study methods of creating models and tuning them. Modeling topics include model-order determination, canonical forms, numerical issues in high-order models, numerical issues in broadband models, model transformations and information loss, and estimating model accuracy of MIMO models. In the second part of the course, students study approaches to observer and controller design for large-scale systems. Control topics include controller design goals, methods of model order reduction, observer/controller co-design, model uncertainty, sensitivity and robustness issues, and disturbance rejection. (0301-703 and 615 or 761) **Class 4, Credit 4**

0301-816 **Design and Characterization of Microwave Systems**
The primary objective is the design and experimental illustration of the fundamentals of microwave circuits and antennas. Projects will involve the design, construction and characterization a microwave system to satisfy a set of specified design criteria. Microwave measurement techniques will involve the use of network analyzers, and spectrum analyzers in conjunction with the probe station. Simulated results will be obtained using some popular commercial EM software for the design of microwave circuits and antennas. (0301-717, 729) **Class 4, Lab 3. Credit 4**

0301-820 **Modeling and Simulation of Semiconductors**
Semiconductor process and device simulation techniques are introduced. Standard process simulators - ATHENA is used for modeling and simulation of process technologies - crystal growth, deposition, oxidation, diffusion, ion implantation, dry etching, metallization, oxygen implantation, annealing, etc. Physics based modeling topics-carrier transport, Poisson's equation, current continuity equation, breakdown phenomena, device scaling, etc. are covered. Standard multi-dimensional device simulator - ATLAS is used to simulate different semiconductor devices. In conjunction with ATHENA and ATLAS, UTMOST is used to extract BSIM model parameters for circuit simulation using SPECTRE. (Graduate standing) **Class 4, Credit 4**

0301-821 **Physics and Modeling of High Performance Semiconductors**
Semiconductor devices based on III-V materials are introduced. Basic properties and physics of III-V materials and metal-semiconductor contacts and two-terminal Heterojunction devices are covered. Physical operation, non-idealities, modeling DC and microwave characteristics of Heterojunction Bipolar Transistors (HBT), Metal Semiconductor Field-Effect Transistors (MESFET) and High Electron Mobility Transistors (HEMT) are analyzed. Analysis of small and large-signal amplifiers is covered. (0301-360 or equivalent) **Class *4***

0301-823 **Digital Video Process II**
In this graduate level course the following topics will be covered: Still image compression including lossless compression, DPCM and transform coding. JPEG and JPEG 2000, Vector Quantization, and sub banding coding. Video compression including inter-frame compression methods (3-d waveform and motion compensated waveform coding), video compression standards (H261, H263, MPEG 1, MPEG 4), and model-based coding. Video filtering including motion compensated filtering, noise filtering (Intra-frame filtering, motion adaptive, and motion compensated filtering). Video restoration and enhancement including restoration techniques, standards conversion techniques, and super resolution. (0301-803 or permission of instructor) **Class 4, Credit 4**

0301-831 **Biomedical Sensors and Transducers II**
This course will discuss the fabrication and design of sensors and transducers for biomedical applications. It will include discussion of applicable fabrication processes and techniques including consideration associated with the utilization of microelectromechanical and nanoelectromechanical structures to allow the integration of sensor and transduction mechanisms with signal simulation and fabrication design tools will be covered. The course will involve the design and simulation of an actual transducer suitable to be considered for actual fabrication. (0301-610, 631 and permission of instructor) **Class *4,* Credit *4***

0301-877 **Digital Signal Processing**
A continuation of the topics studied in 0301-554. Topics include study of the design methods for digital IIR filters via s-plane transformations, study of design methods for digital FIR filters, including emphasis on the question of linear phase response, a review of the discrete Fourier transform (DFT) and an in-depth study of fast algorithms (FFTs) for implementing the DFT, including radix 2, radix 4 and mixed radix algorithms, quantization effects in discrete systems; an introduction to digital signal processing computer chips and their use in the implementation of digital processing systems, and applications of digital signal processing, including speech processing and two-dimensional image processing. Includes several design projects in the digital signal processing laboratory. (0301-554) **Class 4, Credit 4**

0301-890 **Thesis**

An independent engineering project or research problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty member to guide the thesis before registering for the thesis. A thesis may be used to earn a maximum of 9 credits.

Industrial and Systems Engineering

0303-701 **Linear Programming**

Applied linear programming. Computational techniques for solving constrained optimization problems. Linear programming, the Simplex method and variations) duality and sensitivity testing. (1016-331 or equivalent) **Credit 4 (F)**

0303-702 **Integer and Nonlinear Programming**

An introduction to the mathematical foundations of integer programming and nonlinear optimization techniques. Study of algorithms and computer-aided solutions for applied optimization problems. (0303-701) **Credit 4 (W)**

0303-703 **Supply Chain Management**

As business competition becomes global and product life cycles shorten, the need exists for a systems approach to studying all elements of the supply chain. This course will give students breadth of knowledge in Supply Chain Management along with strategies that can be utilized in the design and operation of efficient subsystems within the supply chain. Students will understand the supply chain in the context of the business value chain and profitability goals. This course will take a "macro" view, without emphasizing the details of each subcomponent within the supply chain. For example, the importance of warehouse location and its impact on the overall system will be considered without looking at details associated with material handling within a warehouse. **Class 4, Credit 4 (F)**

0303-710 **Systems Simulation**

Methods of modeling and computer simulation of stochastic and dynamic manufacturing systems are discussed. A high-level simulation language such as ProModel, ARENA, etc., will be used to model the system and examine system performance. Model validation, design of simulation experiments, variance reduction techniques and random number generation will be discussed as time permits. (1016-352 or equivalent) **Credit 4 (W)**

0303-711 **Advanced Simulation Techniques**

An advanced course in developing simulation models using good model building verification and validation procedures. Emphasis will be on review and use of probability distributions, simulation output data analysis for making good decisions, comparison of alternative system configurations, use of designed experiments and the use of advanced simulation techniques. Real world case studies will be examined to convey understanding and teaching of the material. Students will be asked to build models, so simulation experience and working knowledge of a simulation language will be required. (0303-710) **(S)**

0303-716 **Applied Linear Regression Analysis**

A first course in least squares linear regression. Topics covered include estimation of model parameters, significance testing of model parameters, detection and treatment of influential observations, model adequacy checking and variable selection techniques. May not be used as a professional elective. (1016-352 or equivalent) **Credit 4 (S)**

0303-720 **Production Control**

This course will cover the role, the steps and the analysis methods to produce goods and services in support of the production and operations management functions. Topics include: forecasting, inventory policies and models, 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. (0303-701, 1016-352) **Credit 4 (W)**

0303-723 **Global Facilities Planning**

This course addresses the global planning, design, and utilization of fixed assets associated with design, manufacturing, storage and distribution, service and support functions. Topics include: strategic considerations in facilities planning to meet customer and market objectives, product, process, and schedule design; determining flow, resource, and space requirements; layout at the plant level; material handling systems design, warehousing, storage and retrieval policies, process technology transfer, incorporation of lean principles, and quantitative design and analysis tools. Students will understand facilities planning from a strategic and tactical perspective as well as the link between business goals, design, and engineering activities. Visits to local companies are included. (Requires acceptance into MML program or permission of instructor) **Credit 4 (S)**

0303-726 **Contemporary Production Systems**

This course will survey models of contemporary production systems and their operation and control strategies in both manufacturing and service systems. Topics will include lean manufacturing principles, total quality management, six sigma quality, kaizen, and agile manufacturing. Principles of manufacturing resource planning and enterprise resource planning will be included as well as state-of-the-art layout and factory flow techniques. (permission of instructor) **Class 4, Credit 4. (S)**

0303-727 **Advanced Manufacturing Engineering**

This course will provide an advanced treatment of manufacturing engineering in the context of industrial and systems engineering. Emphasis will be place in process design, development and engineering, using state-of-the-art solid modeling tools and materials selection software. Process tooling, gauging, and automation will be cornerstones of the course and will provide material for a variety of term projects. Advanced processing, such as electronics and microsystems, will be explored and developed in depth. Quality systems and process documentation will also be covered. (0303-343, graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

0303-729 **Advanced Systems Integration**

Basic concepts and techniques need to specify, design and implement systems that are computer controlled. Real-time data acquisition, process control as related to computer-integrated manufacturing, and information systems topics will be introduced within the context of systems integration. Cannot be used as a professional elective for ISE majors. (0303-302 or permission of instructor) **Class 3, Lab 1, Credit 4 (W)**

0303-730 **Ergonomics and Human Factors**

A survey course of human factors and ergonomics emphasizing a systems approach in looking at human capacity for physical and mental work versus the demands placed upon the human by the task, machine and environment. Various models of human performance are covered. **Credit 4 (on demand)**

0303-731 **Advanced Topics: Ergonomics and Human Factors**

Advanced topics are selected based on current ergonomic and human factors issues and interests of students. Course is taught using a seminar format. (0303-730 or equivalent) **Credit 4 (W-even years)**

0303-732 **Biomechanics**

Theoretical fundamentals of human physiology and mechanics applied to work. Biomechanical models are developed to evaluate the effects of physical loading on the human body. Topics include modeling, biomaterials, and bioinstrumentation. (0304-331, 332, 0303-730 or equivalent) **Class 4, Credit 4 (S)**

0303-733 **Cognitive Engineering**

Measurements of human performance. Fundamentals of human information processing and how they relate to the design of human-machine systems. (0303-730 or equivalent) **Credit 4 (on demand)**

0303-734 **Systems Safety Engineering**

Acquaints students with practical aspects of safety engineering. Students acquire a working knowledge of legal and technical aspects of safety. Focuses on a systems approach to safety engineering. Topics include Workers Compensation, OSHA, Consumer Product Safety Commission and various hazard analysis and utilization techniques. Students also are exposed to various theories of accident causation, research methodology and ways of evaluating safety programs and related research. Professional elective. **Class 4, Credit 4 (W-odd years)**

0303-735 **Design Project Management**

Training for multidisciplinary studies in project management for leadership of product/process development and design projects. (e.g., senior design) (Permission of instructor required) **Class 4, Credit 4 (F, S)**

0303-742 **Artificial Intelligence Applications**

An introductory course in the development and application of "intelligent" (knowledge-based) systems. An introduction to Artificial Intelligence (AI) as a tool to deal with problems that require "intelligence." Computational complexity will be used to address "hard problems. Generic and problem-specific procedures will be used and analyzed. (0303-701 or equivalent) **Credit *4* (on demand)**

0303-750 **Management Quality Control Systems**
This course is designed to expose upper-level students to managerial aspects of quality systems, with an emphasis on lean thinking and a customer-centric approach to quality. Students will learn to measure, analyse, improve, and control quality systems consistent with corporate objectives. Ideas from a number of quality consultants (Juran, Gryna, Crosby, Taguchi, Deming, etc.) will be covered to give students an overview of topics such as fitness for use, quality costs, quality planning, statistical quality control and experimental design for quality improvement. Frameworks such as "lean six sigma" will be utilized extensively, and students will meet objectives associated with contemporary industry certification programs. (Requires acceptance into MML program or permission of instructor; 1016-352 or equivalent) **Credit 4 (S)**

0303-756 **Decision Analysis**
This course presents the primary concepts of decision analysis. Topics important to the practical assessment of probability and preference information needed to implement decision analysis are considered. Decision models represented by a sequence of interrelated decisions, stochastic processes and multiple criteria are also considered. (1016-352 or equivalent) **Credit 4 (on demand)**

0303-757 **Reliability**
This course deals with mathematical concepts and techniques for modeling and analyzing the reliability of systems. (1016-352 or equivalent) **Credit** *4* **(on demand)**

0303-758 **Design of Experiments**
This course presents the primary concepts of experimental design. Its applied approach uses theoretical tools acquired in other mathematics and statistics courses. Emphasis is placed on the role of replication and randomization in experimentation. Numerous designs and design strategies are reviewed and implications on data analysis are discussed. (1016-352 or equivalent) **Credit 4 (W)**

0303-760 **Product/Process Design and Development**
This course covers the principles of product, manufacturing process and supply chain development in an integrated fashion. Examines the linkages between design specifications and manufacturability, between product architecture and manufacturing system, between the manufacturing system and supply chain and between in-house and outsourced manufacturing. Major topics include: product strategies, product, architectures and manufacturing strategies; product development processes and organizations; product requirements and benchmarking; concept generation and evaluation; the application of systems engineering tools to product design, design for "X" (manufacturing/assembly/service/environment, etc.) and life cycle costing. (Acceptance into the MML program or permission of instructor, 0303-766 or 764) **Credit 4 (F)**

0303-762 **Systems Modeling and Decision Making**
This course emphasizes how process modeling and simulation can be utilized to aid business and technical decision making. Students will learn to identify and analyze key decision making factors associated with topics such as sourcing and the supply chain, lean manufacturing systems, product and service delivery, activity based costing, call centers, and order-to-cash systems. Students will also learn how to identify performance measures for a manufacturing or service systems and use those measures in the evaluation of system performance. A high-level modeling language will be utilized to simulate systems and examine performance. (Requires acceptance into the MML program or permission of instructor) **Credit 4 (W)**

0303-764 **Operations Management and Manufacturing Systems**
This course introduces students to problems and analysis related to the design, planning, control, and improvement of manufacturing and service operations. Emphasis is placed on the principles of planning and designing modern manufacturing systems, consistent with corporate objectives and new product development strategies. The course will extensively utilize case studies and analytical problem sets. Topics include: enterprise and manufacturing strategies, operations strategy, architecting manufacturing systems, system thinking, process and project analysis, materials management, production planning and scheduling, quality management computer-aided manufacturing, and process management options. The course will equip students with the basic tools and techniques used in analyzing operations and manufacturing systems, as well as the strategic context for making decisions. (Requires acceptance into MPD program)

0303-765 **Data Bases-Information Systems**
The course focuses on implementation of information systems applications using SQL and object oriented software for user interface design (e.g. Visual FoxPro). Students will design, develop and implement multiple database projects and also be expected to conduct literature searches on contemporary issues in information systems architectures. **Class 4, Credit 4 (F)**

0303-766 **Manufacturing Systems**
This course introduces the principles of planning and designing modern manufacturing systems that are consistent with corporate objectives. This course will provide an introduction to concepts and techniques in the design and analysis of manufacturing systems. A blend of traditional and modern approaches is used to assess and analyze the performance of a given manufacturing system as well as to provide a framework for system redesign and improvement. Topics include factory physics, queuing theory, cellular manufacturing, and lean manufacturing. (Requires acceptance into the MML program or permission of instructor) **Credit 4 (W-MML only, S)**

0303-771 **Special Topics in Industrial Engineering**
This is a variable topics course that can be in the form of a regular course or independent study under faculty supervision. **Credit 4**

0303-775 **Data Structures Using C**
An introductory course in data structures and algorithms using the (visual) C++ programming language. Topics include sorting, searching and lists. This course can be used as a foundation for many computer-based courses in engineering. **Class 4, Credit 4 (F-odd years)**

0303-777 **Engineering Internship**
This course number is used by students in the master of engineering degree program to register for an internship experience. The number of credits is to be determined by the student's faculty adviser and is subject to the approval of the Graduate Committee of the College of Engineering. **Credit variable**

0303-778 **Leadership Capstone**
For students enrolled in the BS/ME dual degree program. Student must either: 1) serve as a team leader for the multidisciplinary senior design project, where they must apply leadership, project management, and system engineering skills to the solution of un-structured, open-ended, multi-disciplinary real-world engineering problems, or 2) demonstrate leadership through the investigation of a discipline-related topic. **Credit 0**

0303-779 **Engineering Capstone**
For the Master of Engineering programs in industrial engineering, engineering management, and systems engineering. Students must investigate a discipline-related topic in a field related to industrial engineering, engineering management, or systems engineering. The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular area. The capstone should draw upon skills and knowledge acquired in the program. (Restricted to EIEG, EIEM, EIES, EIEA) **Credit 4 (W)**

0303-780 **Foundations in Product Development**
A modular course designed to lay **the** groundwork for **the rest of the** program and **its over-**arching goal to prepare engineers and technical professionals to lead end-to-end product development initiatives. The course focuses on how all aspects of product development, with systems engineering at the core, must be integrated and accounted for in end-to-end product development. Students will gain a perspective and appreciation for the critical factors and inhibitors to the commercialization of complex products and systems. Emphasis will be on the role of the product development manager in leading product strategy and development activities, and on the experiences of engineering managers who have successfully led technical, task oriented, multi-disciplinary teams and organizations. (Requires acceptance into the MPD program or permission of instructor) **Credit 4**

0303-781 **Advanced Topics in Product Development**
This modular course is designed to complement previous coursework in the MS in product development program, with an emphasis on engineering concepts and tools needed by technical leaders of product development projects. Topics may include: impact of the Internet on product realization, the product development process within the extended enterprise, intellectual property management and implications for product and platform architecture, and information technology and supply chain management. (Requires completion of all coursework in the MPD program) **Credit 4**

0303-784 **Systems and Project Management**
Systems and Project Management ensures progress toward objectives, proper deployment and conservation of human and financial resources, and achievement of cost and schedule targets. The focus of the course is on the utilization of a diverse set of project management methods and tools. Topics include strategic project management, project and organization learning, cost, schedule planning and control, structuring of performance measures and metria, 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. (Requires acceptance into the MML or MPD program or permission of instructor, 0101-740) **Credit 4 (W, S-MPD only)**

0303-785 **Engineering Risk Benefit Analysis**
The ERBA 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. (Requires acceptance into MPD program or permission of instructor; 0101-703) **Credit 4 (W)**

0303-786 **Engineering of Systems I**
The engineering of a system is an essential aspect of its development that focuses on the overall concept, performance requirements and behavioral aspects of the system. This course treats the creation of products, product platforms and product families as systems that create value for both the customer and the enterprise. Topics include value creation and strategy, product development processes, translating market requirements to system requirements, functional analysis, development of the system's architecture, development of platforms and modules, and concept selection. Students will learn several systems analysis techniques and apply them in a team-based project. (acceptance into the MPD program or permission of instructor) **Credit 4 (S)**

0303-787 **Systems Optimization**
This course is an application-oriented introduction to optimization, focused on the understanding of system tradeoffs. It introduces modeling methodology (linear, integer and nonlinear programming), modeling tools (sensitivity and post-optimality analysis), optimization software, applications in production planning and scheduling, inventory planning, personnel scheduling, project scheduling, distribution systems planning, facility sizing and capacity expansion, communication systems design, and product development. (Requires acceptance into the MPD program or permission of instructor) **Credit 4 (W)**

0303-788 **Engineering of Systems II**
The engineering of a system is an essential aspect of its development that focuses on the overall concept, performance, requirements and behavioral aspects of the system. This course builds on the concepts discussed in Engineering of Systems I. Topics include an introduction to computer and software architecture, defining the structure and work content of the product development organization, refinement and flowdown of requirements to subsystems, performance and life cycle trade studies, interface management, robust design, and certification planning. Students will learn several systems analysis techniques and apply them in a team based project. (Requires acceptance into the MPD program or permission of instructor, *0303-786)* **Credit 4 (SU)**

0303-789 **Systems Dynamics**
Systems dynamics deals with the time-based behavior and control of nonlinear systems. This course will introduce the concepts of systemic thinking, nonlinear dynamics, and control principles as they apply to enterprise issues such as the product development process, innovation diffusion, product differentiation, supply chain dynamics, and organizational learning. Topics include casual models, system archetypes, feedback and feed forward loops, exponential growth, goal seeking behavior, instability and sensitivity analysis. A continuous time simulation tool, such as I Think, Stella or Vensim, will be utilized to model and analyze the behavior of a variety of enterprise systems. (Requires acceptance into the MPD program or permission of instructor) **Credit 4**

0303-791 **Lifecycle Assessment/Costing**
This course will introduce students to the challenges posed when trying to determine the total costs and environmental impacts associated with a product/process design across its entire lifecycle. Various assessment and costing models and their inherent assumptions will be reviewed and critiqued. **Class 4, Credit 4 (S)**

0303-792 **Design for the Environment**
A course on systematic approaches of designing and developing environmentally responsible products. Topics covered include: guidelines for product structure, materials selection, fastening, labeling and finishing, techniques to reduce environmental impact (such as design to minimize material usage, design for disassembly, design for recycling, design for remanufacturing, design to minimize hazardous materials, design for energy efficiency, design to regulations/standards), and environmental impact inventory methods. (0303-343, 0304-344 or equivalent) **Class 4, Credit 4**

0303-800 **Graduate Seminar**
Seminar series intended to present the state of the art in industrial engineering. Other research-related topics may be presented such as library search techniques, thesis writing, etc. All MS industrial engineering students are required to register for at least *3* quarters. (Graduate standing in MS in industrial engineering) **Credit 0 (F, W, S)**

0303-801 **Design for Manufacture**
This course presents an overview of the factors influencing product design and the manufacturing cycle. Topics include component design and analysis, design for manufacturability as well as function and design for manual and automated assembly. Students will gain hands on experience with the Boothroyd-Dewhurst system to quantify design efficiency. The various manufacturing processes as they relate to modern trends in DFM are covered. (0303-343) **Class 4, Credit 4 (S)**

0303-886 **Systems Engineering**
An introduction to systemic thinking, systems architecture, and systems analysis with a focus on devices that are integrated into the larger systems. Systems engineering, systems architecture and product development processes are introduced and applied in a term-long project centered on a device of the student's choosing. Students identify customer requirements, translate them to critical design parameters, define a system architecture, then analyze the behavior, design windows, reliability and life-cycle cost trade-offs. Enrollment in microsystems engineering degree program or permission of the instructor) **Class *4,* Credit 4 (W)**

0303-890 **Research and Thesis**
In conference with a faculty adviser, an independent engineering project or research problem is selected. The work may be of a theoretical and/or computational nature. A state-of-the-art literature search in the area is normally expected. A formal written thesis and an oral defense with a faculty thesis committee are required. Submission of bound copies of the thesis to the library and to the department and preparation of a written paper in a short format suitable for submission for publication in a refereed journal are also required. Approval of department head and faculty adviser needed to enroll. **Credit variable (0 to 9) (F, W, S, Su)**

0303-891 **Capstone Integrative Project**
In the Capstone Project students to demonstrate integrative applications of knowledge and skills that they have acquired through the MML program. A capstone project will be team-based and oriented to the solution of manufacturing management problems or to technically related processes. Each project will define an actual problem and solve it, or select and develop a needed process in a manufacturing firm. Each project must be approved 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. Normally, a suitable project will constitute the equivalent of one quarter course workload per student, however, a suitable project could be larger (Requires acceptance into the MML program) **Credit 4 (W)**

0303-892 **Capstone Research Project**
For the MS program in product development (MPD). Students in the MPD program must demonstrate intellectual leadership in the field of new product development. The general intent of the capstone project is to demonstrate the students' knowledge of the integrative aspects of new product development in the context of a corporate-oriented problem solving research project. The project should address issues of significance to multiple functions or disciplines and should draw upon skills and knowledge acquired from various courses and experience in the program. Students are encouraged to start work on the project in advance of receiving formal credit during the final two quarters of the program. Team-based projects are strongly recommended (Requires acceptance into the MPD program) **Credit *4* (each course)**

Mechanical Engineering

0304-701 **Research Methods**
This course introduces students to research methods in mechanical engineering. A primary focus of the course is on conducting critical reviews of research literature, preparing a formal thesis proposal, and initiating background research on a thesis topic. At the conclusion of the course, the students are expected to submit a formal thesis proposal, literature review, and plan of study for the completion of the Master of Science degree. This course is specifically designed for students enrolled in the dual degree MS/BS program offered through the department. (Consent of instructor. Restricted to dual degree students.) **Class 4, Credit 4**

0304-710 **Fuel Cell Technology**
Fuel cell technology is an emerging technology for electric power on demand, and can be used for stationary power generation or for driving vehicles. Fuel cell, the heart of this technology, is an electro-chemical devise that produces electricity via cell reactions from useful chemical energy stored in fuel. After learning fuel cell basics and operating principles, fuel cell performance will be considered from energy and thermodynamic viewpoints. Types discussed are polymer electrolyte membrane fuel cell (PEMFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cell (SOFC). Modeling of one fuel cell type will demonstrate design and analysis of systems and the information and components needed to make the system successful. Also discussed: thermal system design and analysis issues, limitations, cost effectiveness and efficiency. **Class 4, Credit 4**

0304-714 **Thermal Radiation Heat Transfer**
Course focuses on the following topics: fundamentals of radiative heat transfer, the blackbody, electromagnetic theory, properties of solid materials, gray surfaces, and shape factors; energy exchange between surfaces and in enclosures when no attenuating media is present. An introductory discussion of radiative transfer in the presence of an attenuating medium is also included. (Graduate standing and departmental approval required) **Class *4,* Credit *4***

0304-730 **Design Project Management**
This course focuses on preparing students to take on a leadership role in design project teams. Topics include product development processes, management of design project teams, developing a business case for design projects, understanding customer needs and translating them into engineering specifications, tools for developing design concepts, tools for assessing the feasibility of design concepts, conducting engineering tradeoffs and analysis to synthesize a preliminary design. Students use the concepts and tools discussed throughout the course in a team-based environment to develop project readiness packages for subsequent use by senior design teams. **Class 4, Credit 4**

0304-743 **Control Systems**
Introduces the student to the study of linear control systems, their behavior and their design and use in augmenting engineering system performance. Topics include control system behavior characterization in time and frequency domains, stability, error and design. This is accomplished through classical feedback control methods that employ the use of Laplace transforms, block diagrams, root locus, and Bode diagrams. A companion laboratory will provide students with significant hands-on analysis and design experience. (0304-543) **Class 3, Lab 3, Credit 4**

0304-745 **Micro/Nano Characterization**
This technical elective with weekly lab component focuses on tools and techniques for micro- and nano-characterization of materials surfaces and thin films. The course covers the principles and applications of four experimental techniques: quantitative imaging, x-ray diffraction, scanning probe microscopy, and micro- and nano-indentation. Students will learn the physics of interaction processes used for characterization, quantification and interpretation of collected signals, and the fundamental detection limits for each technique. (0304-344 or 1028-701 or 0305-460) **Class 3, Lab 2, Credit 4 (W or S)**

0304-746 **Engineering Properties of Materials**
The course provides an understanding of the relationship between structure and properties for development of new materials. Topics include atomic and crystal structure, crystalline defects, diffusion theories, strengthening mechanisms, ferrous alloys, cast irons, structure of ceramic and polymeric materials, and corrosion principles. (Graduate standing or permission of instructor) **Class 4, Credit 4**

0304-752 **Tribology Fundamentals**
This course provides an overview of the role of fluid-film lubrication in mechanical design, with strong emphasis on applications. Various forms of the Reynolds equation governing the behavior of lubricant films for planar, cylindrical, and spherical geometry are derived. Mobility and impedance concepts as solution methods of the Reynolds equation are introduced for the performance assessment of lubricated journal bearings under static and dynamic loading. Short, long, and finite bearing assumptions are discussed. Finite element methods for the analysis of fluid-film bearings of arbitrary geometry will be introduced. (0304-415, 437 or equivalent, finite element background desirable but not required) **Class 4, Credit 4**

0304-754 **Fundamentals of Fatigue and Fracture Mechanics**
This course is an introduction to the fatigue life prediction methodologies and basic fracture mechanics. Students will be introduced to linear elastic fracture mechanics, including stress intensity factor and crack tip plastic zone models. The fatigue methodologies to be covered include the Stress-Life Theory (used for machine elements), Strain-Life Theory (used for large-displacement samples and low cycle fatigue problems), and a fracture mechanics approach to fatigue analysis (used in the aircraft and space industries). (0304-437, *440)* **Class 4, Credit 4**

0304-756 **Aerosols in the Respiratory Tract**
This course introduces the student to the fundamentals of modeling and particulate flow in biological systems. Examples are drawn from a variety of fields, including deposition of particulates in the human lung, medicine delivery, and numerical modeling and simulation techniques. Students will be introduced to the morphology of the lung, diseases, and particulate characterization. *(0304-415)* **Class 4, Credit 4**

0304-758 **Engineering Vibrations**
This is a course on 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; harmonic and transient forced motion including support motion, machinery unbalance, and isolation. Modal analysis of multi-degree of freedom systems is introduced. In addition to laboratory exercises on vibration instrumentation, an independent design project is assigned. *(0304-543)* **Class 3, Lab 2, Credit 4**

0304-801 **Design for Manufacture**
This is a required course in the manufacturing option of the master of engineering degree program. The course is offered jointly by the departments of Industrial and Manufacturing Engineering and Mechanical Engineering and presents an overview of the factors influencing product design and the manufacturing cycle. Topics include component design and analysis, design for manufacturability as well as function and design for manual and automated assembly. Students will gain hands-on experience with the Boothroyd/Dewhurst system to quantify design efficiency through a term project. The various manufacturing processes as they relate to modern trends in DFM are covered in detail. (Graduate standing) **Class 4, Credit 4**

0304-810 **Introduction to Continuum Mechanics**
A rigorous basis for the study of advanced fluid mechanics and theory of elasticity is presented. Cartesian tensors. Analysis of stress and deformation. Motion of continuous medium. Applications to theory of elasticity, thermoelasticity, viscoelasticity and fluid mechanics. *(0304-871)* **Class 4, Credit 4**

0304-811 **Theory of Elasticity/Plasticity**
Stress-strain relations and formulation of boundary value problems. State of plane strain, state of plane stress. Solutions by potentials, Airy stress function. Torsion of bars with circular, elliptic, rectangular cross-sections. Stresses and displacements in thick cylinders, disks and spheres. Contact stress problems. Energy principles. *(0304-810)* **Class 4, Credit 4**

0304-816 **Finite Elements**
This is an introductory course on the modern theory of finite element analysis. Although the necessary mathematics will be kept to a minimum, the course content has been designed to provide the skills necessary to write an F. E. program and to understand the structure and capabilities of commercially available codes. Applications to problems in structural mechanics, heat transfer and fluid mechanics. (0304-870, *885)* **Class 4, Credit 4**

0304-820 **Advanced Optimal Design**
Topics from nonlinear programming as applied to automated optimal design. Use of penalty functions for the transformation of constrained nonlinear optimization problems. Multivariate pattern and gradient based algorithms. Linear programming, Quasi-Newton's method, Newton's method and direct methods for constrained problems. Applications to the solution of practical nonlinear optimization problems will be required through available software on the mainframe computer. (0304-871, 874) **Class 4, Credit 4**

0304-821 **Advanced Vibrations**
Vibration of discrete multi-mass systems using matrix methods. Normal mode theory and matrii eigenvalue extraction procedures. Matrix forced response. Practical examples using two-and-three degrees of freedom. Vibration of continuous systems. Computer simulations. (0304-758) **Class 4, Credit 4**

0304-823 **Systems Modeling**
This course is designed to introduce the student to state-space modeling techniques and response characterization. Both lumped and distributed parameter systems will be considered. Bond-graph theory will be used extensively. System performance will be assessed through numerical solution using MATLAB/Simulink. Traditional closed form solution methods utilizing Laplace and Fourier transforms and transfer functions are also discussed. (0304-543 or equivalent) **Class 4, Credit 4**

0304-828 **Special Topics**
In response to student and/or faculty interest, special courses which are of current interest and/or logical continuations of regular courses will be presented. These courses will be structured as ordinary courses with specified prerequisites, contact hours and examination. (Graduate standing) **Class 4, Credit 4**

0304-830 **Introduction to CFD Analysis**
This graduate core course covers basic numerical techniques applicable to equations in fluid mechanics and heat transfer. Numerical methods required for programming partial differential equations are introduced. Course work involves analytical programming and design examples. Commercial software is also explored. *(0304-838, 851)*
Class 4, Credit 4

0304-831 **CFD Applications**
This course introduces the students to some of the commercial CFD codes being used for solving thermal-fluid problems. After an introduction to in-house CFD codes, students are expected to complete an individual CFD study project including a written report and a presentation of the results as part of the course requirements. (0304-830, 851) **Class 4, Credit 4**

0304-833 **Heat Exchanger Design**
This course presents an overview of the different heat exchangers used in industry including shell-and-tube, plate, tube-fin, and plate-fin heat exchangers. Analytical modeling of recuperators, regenerators, and transient performance is also covered. Thermal design methods for designing shell-and-tube and compact heat exchangers are presented. Students are required to carry out a major design project in the course. (0304-514; 0304-550 or 851) **Class 4, Credit 4**

0304-834 **Boiling and Condensation**
This course provides a basic understanding of the phase change phenomena associated with boiling and condensation heat transfer., This knowledge is applied in the design of industrial systems such as evaporators, condensers and distillation columns. Students are required to undertake a major design project in the course. (0304-514, 550) **Class 4, Credit 4**

0304-835 **Grid Generation**
This graduate elective course introduces modern topics in the theory of grid generation techniques. Although the primary focus will be on the topics of thermal/fluid sciences, the applicability of the theory holds in other fields of interest as well. Topics include algebraic and elliptic grid generation, structured and unstructured grids, and boundary element methods. Some commercially available software will be introduced. (0304-830) **Class 4, Credit 4**

0304-838 **Ideal Flows**
This graduate core course covers the fundamental topics in the theory of aerodynamics and high speed flows. The course discusses modern aerodynamic applications in the areas of wing and airfoil design, wind tunnel testing and compressible flows. (0304-415) **Class 4, Credit 4**

0304-840 **Signal Processing**
This course introduces the student to discrete-time signal , processing fundamentals, analog-to-digital conversion, and computer-based data analysis. Analytical mathematical developments are supplemented with hands-on computer-based laboratory and homework assignments that promote practical understanding. Topics covered include continuous-time and discrete time convolution, correlation, Fourier transformation, and power spectral estimation. Coverage includes the DFT, FFT, z-transform, autocorrelation and cross correlation functions, and an introduction to statistical data processing via ARMA models for spectral estimation. (0304-870) **Class 4, Credit 4**

0304-842 **System Identification**
This course introduces the student to continuous-time and discrete-time identification from input-output data series. Practical aspects of the "synthesis" of system character will involve data conditioning, analog-to-digital conversion, and computer-based system analysis using MATLAB. Analytical mathematical developments are supplemented with hands-on computer-based laboratory and homework assignments that promote practical understanding. Topics covered include system response functions, non-parametric and parametric model estimation, model definition and validation, and system response prediction; builds on topics covered in 0304-840, Signal Processing, and supplements this material as appropriate. (0304-823, 840) **Class 4, Credit 4**

0304-843 **Advanced Control Systems**
Introduction to advanced control systems, including elements of continuous, digital, and nonlinear control systems theory. Topics include continuous to digital control conversion using finite difference solutions; continuous to digital control conversions using state equation approach; stability of discrete systems; PID control design for digital systems; frequency domain control system design methods (PID, lead, lag, lead-lag compensation design) for continuous systems, and for digital systems using phase loss methods and bilinear transformations; z-transforms for discrete systems; digital control system design using root locus; deadbeat control design; nonlinear control design using feedback linearization; sliding control method; eigen-structure assignment methods; fuzzy logic; neural-net; and introduction to H-infinity control. (Graduate standing) **Class 4, Credit 4**

0304-844 **Nonlinear Dynamical Systems**
This course is an introduction to nonlinear systems theory and is intended for students in engineering and the physical sciences. Non linear systems are classified and analyzed using both analytical and computational methods. The emphasis is on the stability and bifurcation theory of discrete and continuous nonlinear systems. Specific examples from mechanics and other areas are discussed in detail. (0304-870) **Class 4, Credit 4**

0304-846 **Modal Testing and Signal Processing**
This course covers the important aspects of obtaining good modal data so that the natural frequencies, damping ratios, and mode shapes of a structure can be determined. Signal processing as applied to modal analysis will be covered including the auto- and cross-correlation functions, Fourier series and transforms, sampling and filtering and DFT/FFT theory. Transducers, excitation methods and commonly used practices in setting up a modal test will be discussed. Curve fitting techniques to extract modal parameters such as SDOF, MDOF, orthogonal polynomial and time domain will be covered. *(0304-758)* **Class 4, Credit 4**

0304-847 **Microscale Heat/Mass Transfer**
Deals with the effects of microscale dimensions on fluid flow, and heat transfer phenomena. The basic difference associated with these phenomena at microscale levels are presented through analytical equations, presenting theoretical aspects followed by practical examples. Topics covered include microscale heat conduction, heat transfer in thin film, transport equations for single-phase flow for high Knudsen number flows, gas compressibility, effects, single phase pressure drop equations for gases and liquids, heat transfer equations, laminar to turbulent transition, slip flow, transition flow, free molecular flow, two-phase flow considerations, and practical applications in micro-scale thermal and fluid flow devices. Each student will also work on an independent analytical or experimental project. (0304-413, 415, 416, 514. Consent of instructor) **Class 4, Credit 4**

0304-848 **Special Topics-Thermal Fluids**
In response to student and/or faculty interest, special courses that are of current interest and/or logical continuation of regular courses will be presented. (Graduate standing) See instructor for more details. **Class 4, Credit 4**

0304-851 **Convective Phenomena**
This course introduces the student to the flow of real incompressible fluids. The differential approach is used to develop and solve the equations governing the phenomena of mass, momentum, and heat transfer. The material in the course provides the necessary background for a study of computational fluid dynamics. (0304-415, 514) **Class 4, Credit 4**

0304-852 **Advanced Turbomachinery**
This course introduces the student to some of the advanced topics in turbomachinery. Topics include airfoil theory, two-and three-dimensional flow analysis in radial and axial turbomachines, and turbomachinery flow stability characteristics. Students are expected to do a design project using FLUENT Computational Fluid Dynamics code. (0304-550, 652) **Class 4, Credit 4**

0304-864 **Production Tool Design**
This is a course in the core group, CAD, of the manufacturing engineering option in the master of engineering degree program. Design of production tooling, jigs and fixtures for the economical manufacture of modern parts is covered in detail. The student must do research in current publications, and complete and present a project. Project selection can usually be arranged to incorporate an assembly of parts from the student's normal work. There will be field trips to local specialty firms. (Graduate standing) **Class 4 Credit 4**

0304-865 **Computer Implementation of F.E.M.**
This course emphasizes the application of the finite element method to problems in the area of static and dynamic structural analysis, heat transfer, and analogous solution. A standard commercial software package is used for these applications where the general structure, operating characteristics and use of a complex program are presented. Topics include the finite element method; shape factors, element formulation, and the element library; program sequencing; general modeling methods (loads, constraints, material factors, mesh generation, interactive graphics, model conditioning); convergence, error analysis and the "patch" test, vibration and heat transfer analysis, and analogous analysis such as acoustics, illumination, etc. (Graduate standing) **Class 4, Credit 4**

0304-870 **Mathematics for Engineers I**
A concise introduction to the concepts of matrix and linear algebra, including determinants, eigenvalues, systems of linear equations, vector spaces, linear transformations, diagonalization, orthogonal subspaces and the Gram-Schmidt orthonormalizing procedures. The use of complex exponentials in differential equations is introduced. Fourier series, Laplace and Fourier Transforms are also presented. (Graduate standing) **Class 4, Credit 4**

0304-871 **Mathematics for Engineers II**
Topics covered are orthogonal functions including Fourier Series, Fourier Integrals, Bessel functions, Legendre Polynomials, Sturm-Liouville problems and eigenfunction expansions; an introduction to calculus of variation including problems with constraints; vector analysis including the directional derivative, the gradient, Green's Theorem, the Divergence Theorem and Stokes' Theorem; Laplace transform methods. (Graduate standing) **Class 4, Credit 4**

0304-872 **Analytical Mechanics**
This **is a** course on advanced dynamics and variational methods. Newtonian vector mechanics and energy formulations are applied to two and three-dimensional problems involving discrete and continuous dynamical systems. The concepts of Virtual Work, Hamilton's Principle, and LaGrange's equations are thoroughly covered. Vibrations and multi-body systems are emphasized. The course also includes an introduction to the calculus of variations. (0304-543, 871) **Class 4, Credit 4**

0304-874 **Numerical Analysis**
This course emphasizes the development and implementation of methods available to solve engineering problems numerically. Specific topics include root finding for algebraic and transcendental equations, systems of linear and non-linear equations, interpolation of numerical data and curve fitting, numerical differentiation and integration, ordinary and partial differential equations, including initial and boundary value problems. *(0304-870)* **Class 4, Credit 4**

0304-875 **Advanced Aerodynamics**
This course covers the fundamental topics of aerodynamics and high speed flows. It discusses modern aerodynamic applications in the areas of wing and airfoil design, wind tunnel testing, and compressible flows. *(0304-550, 675, 838)* **Class 4, Credit 4**

0304-877 **Internship**
This course number is used by students in the master of engineering degree program for earning internship credits. Students must submit a proposal for the internship, to be approved by an employing supervisor and the department prior to enrolling. Students are required to submit an evaluation report at the conclusion of the internship. **Credit variable**

0304-880 **Independent Study**
An opportunity for the advanced student to undertake an independent investigation in a special area under the guidance of a faculty member. A written proposal is to be forwarded to the sponsoring faculty member and approved by the department head prior to the commencement of work. (Graduate standing) **Credit variable (maximum of 4 credits per quarter)**

0304-885 **Advanced Mechanics of Solids**
This course extends the student's knowledge of stressed mechanical components covered in Mechanics of Materials and lays the foundation for, a follow-on course in finite elements. The basic relationships between stress, strain, and displacements are covered in more depth. Stress and strain transformations, plane elastic problems, and energy techniques are covered. Topics from Advanced Strength of Materials include beam bending and torsion problems not covered in Mechanics of Materials. (0304-347) **Class 4, Credit 4**

0304-888 **Project with Paper**
This course is used by students in the master of engineering degree program for conducting an independent project. The student must demonstrate an acquired competence in an appropriate topic within mechanical engineering. The topic is chosen in conference with a faculty advisor. The work may involve an independent research and/or a design project and/or literature search with a demonstration of acquired skill. A written paper, approved by the advisor and the department, and an oral presentation of the work are required. **Credit 4**

0304-889 **Graduate Seminar**
This seminar course presents topics of contemporary interest to graduate students enrolled in the program. Presentations include off campus speakers, and assistance with progressing on your research. Selected students and faculty may make presentations on current research under way in the department. All graduate students enrolled full time (whether dual degree or single degree) are expected to attend each quarter they are on campus. **Credit 0 (F, W, S)**

0304-890 **Research and Thesis**
In conference with an advisor, a topic is chosen. Periodic progress reports and a final written document with an oral examination are required. (Approval of a thesis proposal approved by a thesis advisor and the department) **Credit variable (5-9 Credits total)**

Microelectronic Engineering

0305-701 **Microelectronics I**
This course introduces the beginning graduate student to the fabrication of solid-state devices and integrated circuits. The course presents an introduction to basic electronic components and devices, lay outs, unit processes common to all IC technologies such as substrate preparation, oxidation, diffusion and ion implantation. The course will focus on basic silicon processing. The students will be introduced to process modeling using a simulation toll such as SUPREM. Associated are a lab for on campus section (01), and discussion of laboratory results and a graduate paper for distance learning-section (90). The lab consists of conducting a basic metal gate PMOS process in the RIT clean room facility to fabricate and test a PMOS integrated circuit test ship. Laboratory work also provides an introduction to basic IC fabrication processes and safety. **Class 3, Lab 3, Credit 4 (S)**

0305-702 **Microelectronics II**
The fundamental silicon based processing that includes state-of-the-art issues such as thin oxide growth, atomistic diffusion mechanisms, advanced ion implantation and rapid thermal processing (RTP). Physical vapor deposition (PVD) to form conductive and insulating films introduced. Computer simulation tools (i.e. SUPREM) are used to model processes, build device structures, and predict electrical characteristics, which are compared to actual device structures that are fabricated in the associated laboratory for on campus *(01)* and discussion of laboratory results and a graduate paper for distance learning section (90). A bipolar IC process in conducted to build and test a variety of bipolar devices employing ion implantation. Extensive use of CAE and SUPREM. (0305-701) **Class 3, Lab 3, Credit 4 (W)**

0305-703 **Microelectronics III**
This course focuses on the deposition and etching of thin films of conductive and insulating materials for UIC fabrication. A thorough overview of vacuum technology is presented to familiarize students with the challenges of creating and operating in a controlled environment. Chemical Vapor Deposition (CVD) and electroplating technologies are discussed as methods of film deposition. Plasma etching and Chemical Mechanical Planarization (CMP) are studied as methods for selective removal of materials. Applications of these fundamental thin film processes to IC manufacturing are presented. Associated is a laboratory for on

campus (01) and a graduate paper for distance learning (90). Labs include: vacuum pump-down and evaporation, dc sputtering, reactive magnetron sputtering, chemical mechanical planarization, atmospheric and low pressure chemical vapor desposition and plasma and reactive ion etching. **Class 3, Lab 3, (S, SU)**

0305-704 **Semiconductor Process and Device Modeling**
A senior graduate level course on the application of simulation tools for design and verification of microelectronic processes and operation of semiconductor devices. Technology CAD tools include MicroTec and Silvaco (Athena/Atlas) process/device simulators, as well as other simulation tools for specific processes, and math programs that can be used for custom simulation. Various models that describe front-end silicon processes are explored emphasizing the importance of complex interactions and 2D effects, as devices are scaled deep submicron. Includes laboratory exercises on simulation and modeling. (0305-560, 701,702) **Class 3, Lab 3, Credit 4 (W)**

0305-705 **Quantum and Solid State Fundamentals**
This course describes the key elements of quantum mechanics and solid state physics that are necessary in understanding the modern semiconductor devices. Quantum mechanical topics include solution of Schrodinger equation solution for potential wells and barriers, subsequently applied to tunneling and carrier confinement. Solid state topics include electronic structure of atoms, crystal structures, direct and reciprocal lattices. Detailed discussion is devoted to energy band theory, effective mass theory, energy-momentum relations in direct and indirect band gap semiconductors, intrinsic and extrinsic semiconductors, statistical physics applied to carriers in semiconductors, scattering and generation and recombination processes. **Class 4, Lab 0, Credit 4 (F)**

0305-706 **SiGe and SOI Devices and Technologies**
This course introduces students to the fundamentals of SiGe and Silicon on Insulator (SOI) devices and fabrication technologies. The course will first discuss the band structure of the SiGe material system, and how its properties of band structure and enhanced mobility may be utilized to improve traditional Si devices. Basic heterojunction theory is introduced to students. Some specific applications that are introduced include heterojunction bipolar transistors (HBTs), SiGe-channel MOS devices, and high-electron mobility transistors (HEMTs). Fabrication technologies for realizing SOI substrates that include SIMOX and SMART 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 term paper summarizing the literature in a key topical area of this course. **Class 4, Lab 0, Credit 4 (S)**

0305-707 **Nanoscale CMOS**
An in-depth study of principles and practice of scaling-driven CMOS front and back end processing. The course discusses the Semiconductor Industry Association (SIA) International Technology Roadmap for Semiconductors (ITRS) and exposes students to the next generation of nanometer-scale CMOS with device concepts that include quantum mechanical phenomena such as channel confinement and dopant fluctuations. Front end processing includes super steep retrograde wells, high-k gate insulators, metal gate, and ultra shallow sourceldrains. Back end topics include interconnect modeling and delay, Low k dielectric and copper damanscence processes. The use of novel substrates such as strained silicon, SiGe and Ge will be described. (0305-560, 701, 702, of nanometer-scale CMOS with device concepts that take advantage of 703) **Class 4, Lab 0, Credit 4 (W)**

0305-714 **Micro/Nano Characterization**
This mechanical elective with weekly lab component focuses on tools and techniques for micro- and nano-characterization of materials, surfaces and thin films. The course covers the principles and applications of four experimental techniques: quantitative imaging, x-ray diffraction, scanning probe microscopy, and micro- and nano-indentation. Students will learn the physics of interaction processes used for characterization, quantification and interpretation of collected signals, and fundamental detection limits for each technique. *(0304-344 or 1028-701 or 0305-460)* **Class 3, Lab 2, Credit 4 (W or S)**

0305-721 **Microlithography Materials and Processes**
Covers the chemical aspects of microlithography and resist processes. The chemistry of positive (novolac-based) and chemically amplified resist systems will be studied. Topics include the principles of photo polymerization, including synthesis, photo absorption and emission, processing technologies and methods of process optimization. Also advanced lithographic techniques and materials, including multi-layer techniques for BARC, TARC, and silylation are applied to optical lithography. Associated lab for on campus section (01) and discussion of lab results and a graduate paper for distance learning section (90). In the lab, materials characterizations and process optimization are carried out using experimental design techniques. Processes to be studied include development rate monitoring, DUV resists, BARC, resist silylation and SEM evaluation of imaged resists and etched structures. **Class 3, Lab 3, Credit 4 (F, W)**

0305-722 **Microlithography Systems**
A course covering the physical aspects of lithography. Image formation in optical projection, optical proximity, and high-energy systems (DUV/VUV e-beam/SCALPE, X-ray, and EUV) are studied. Fresnel diffraction, Fraunhofer diffraction, and Fourier optics are utilized to understand diffraction-limited imaging processes. Topics include illumination, lens parameters, image assessment (resolution, alignment and overlay), phase-shift masking, and resist interactions. Lithographic systems are designed and optimized through use of modeling and simulation packages. Current status of the practical implementation of advanced technologies in industry as well as future requirements will be presented. Lab for on campus section (01) and a graduate paper for distance learning section (90). Lab topics emphasize optical microlith modeling, illumination sys., reticle enhancement techniques, alignment and others. **Class 3, Lab 3, Credit 4 (S, SU)**

0305-731 **Microlithography Manufacturing I**
A course in 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. Lot tracking, data collection, lot history, cycle time, turns, CPK and statistical process control are introduced to the students. Silicon wafers are processed through an entire CMOS process and tested. Students design unit processes and integrate them into a complete process. Students evaluate the process steps with calculations, simulations and lot history, and test completed devices. **Class 3, Lab 3, Credit 4 (W)**

0305-732 **Microlithography Manufacturing II**
A course in CMOS manufacturing. Topics include query processing, measuring factory performance, factory modeling and scheduling, cycle time management, cost of ownership, defect reduction and yield enhancement, reliability, 6 sigma manufacturing, process modeling and RiT's advanced CMOS process. Associated is a lab for on campus section *(01)* and a graduate paper for distance learning section (90). Laboratory experiences are related to the operation of the student run integrated circuit factory. Silicon wafers are processed through a complete CMOS process. *(0305-731)* **Class 3, Lab 3, Credit 4 (S)**

0305-760 **Principles of Semiconductor Devices**
This course will discuss the fundamentals underlying the operations of basic semiconductor devices employed in modern integrated circuits. The course includes modules on Semiconductor Fundamentals, P-N junction Diodes, Metal-Semiconductor Junctions, Metal-Oxide Semiconductor Capacitors, Field Effect Transistors, and Bipolar Junction Transistors presented through a series of lectures that qualitatively and quantitatively explain the operation of semiconductor devices. Each module features a segment on "deviations from ideality" that are observed in practical semiconductor devices and will provide insight into the constraints imposed by VLSI design rules and processing. This course is an online course only intended for professionals employed in various aspects of the semiconductor industry. **Class 4, Credit 4 (F, S)**

0305-770 **Independent Study**
This course number should be used by students who plan to study a topic on an independent basis under the guidance of a faculty member. A written proposal with an independent study form is to be submitted to the sponsoring faculty member and approved by the department head prior to the commencement of work. **Credit variable (maximum of *4* credits per quarter)**

0305-777 **Internship**
This course number is used to fulfill the internship requirement for the master of engineering degree program. The student must obtain the approval of the department head before registering for this course. **Credit variable**

0305-801 **Seminar/Research**
Weekly seminar series intended to present the state of the art in microelectronics research. Other research-related topics will be presented such as library search techniques, contemporary issues, ethics, patent considerations, small business opportunities, technical writing, technical reviews, effective presentations, etc. Required of all MS microelectronic engineering students for one credit up to total *4* credits total. After *4* credits, graduate students are required to register each quarter for zero credits. (Graduate standing in MS in microelectronic engineering) **Credit 0-1 (F, W, *S)***

0305-830 **Metrology and Failure Analysis**
Successful IC manufacturing must detect defects (the non-idealities) that occur in a process), eliminate those defects that preclude functional devices (yield enhancement), and functionality for up to ten years of use in the field (reliability). Course surveys current CMOS manufacturing to compile a list of critical parameters and steps to monitor during manufacturing. This survey is followed with an in depth look at the theory and instrumentation of the tools utilized to monitor these parameters. Tool set includes optical instrumentation, electron microscopy, surface analysis techniques, and electrical measurements. Case studies from industry and prior students are reviewed. Students are required to perform a project either exploring a technique not covered in class, or to apply their course knowledge to a practical problem. (0305-560, 701) **Class 4, Lab 0, Credit 4 (F)**

0305-870 **Microelectromechanical Systems**
This course will provide an opportunity for students to become familiar with the technology and applications of microelectromechanical systems (MEMS)--one of the fastest growing areas in the semiconductor business. MEMS represents the integration of microelectronic chips with microsensors, probs, lasers, and actuators. Topics include basic principles of MEMS and fabrication methodologies. The accompanying laboratory will carry out design and fabrication of MEMS structures/devices using microfabrication techniques. **Class 3, Lab 3, Credit 4** (W, **S)**

0305-890 **Special Topics**
This is a variable credit, variable special topics course that can be in the form of a regular course or independent study under faculty supervision. Some of the topics are SOI device technology, compound semiconductors and devices, quantum devices, and Nanotechnology. **Class 4, Lab 0, Credit 4**

0305-899 **Thesis**
The master's thesis in microelectronic engineering requires the student to prepare a written thesis proposal for approval by the faculty; select a thesis topic, adviser and committee; present and defend thesis before a thesis committee; submit a bound copy of the thesis to the library and to the department; prepare a written paper in a short format suitable for submission for publication in a journal; complete course work and thesis within a seven-year period; register for one credit of Continuation of Thesis each school term (except summer quarter) after the 45 credits required for the master's degree until the thesis is completed. (Graduate standing in MS in microelectronic engineering) **Class 0, Lab 0, Credit variable 0 to 9 (F, W, S, SU)**

Computer Engineering

0306-710 **Network Modeling, Design and Simulation**
This course covers theories for network design and modeling and case studies to apply the theories. Mathematical models, such as queuing theory, graph theory, and optimization techniques for analyzing network topology, traffic, and algorithms will be introduced. State of-the-art network problems and solutions will be discussed and analyzed using the various network theories as well as network simulation tools (e.g., OPNET). Students are expected to actively research technical papers and participate in in-class discussions. Assignments may include homework, exams, paper readings, projects, and individual presentations. (0306-381, 694; Graduate standing or undergraduate with permission of instructor) **Class 4, Credit 4**

0306-715 **Wireless Networks**
As interest in wireless technology is booming, wireless networks are enjoying very fast growth. This course covers fundamental techniques in design and operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, radio propagation models, error control techniques, handoff, power control, common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc), radio resource and network management. As an example for the third generation air interfaces, wireless Internet and sensor networks are discussed in detail since they are expected to have a large impact on future wireless networks. This course is intended for graduate students who have some background on computer networks, but it is also open to senior undergraduates. (0306-694) **Class 4, Credit 4**

0306-720 **Electronic Design Automation**
The creation of large, complex electronic systems has grown beyond the capabilities of any number of designers without computer support. Successful completion of large design projects requires that computers be used in virtually all aspects of design. This course will investigate some of the basic design automation tools and algorithms in order to understand their capabilities, limitations and internal operations. Topics covered will be review of the VHDL hardware description language, simulation techniques, design synthesis, placement and routing, and design verification methods. Laboratory projects in the use and creation of design automation tools will be required. (0306-351, 0306-561 or equivalent; 0306-630/730 recommended) **Class 4, Credit 4**

0306-722 **Advanced Computer Architecture**
This course will emphasize the impact of VLSI and communication issues on computer architecture. Topics include highly concurrent, multiprocessor and reconfigurable computer systems as well as data flow architectures. Modeling techniques for system verification will also be included. (0306-551, 0605-720 recommended) **Class 4, Credit 4 (W)**

0306-724 **High Performance Architecture**
This course is an in-depth study of state-of-the-art high performance computer architectures. The primary objective of the course is to understand the architectural features used in modern processors and the corresponding impact on performance. The course material will be derived from current and recent micro-architecture research publications. The course will include programming assignments and a term paper. (0306-551) **Class 4, Credit 4 (W)**

0306-730 **VLSI Design**
An introduction to the design and implementation of Very Large Scale Integration (or VLSI) including NMOS and PMOS devices, CMOS circuits and digital subsystems. The procedures for designing and implementing digital integrated systems will be covered including the Mead and Conway structured design approach consisting of the use of stick diagramming, scaling of CMOS design rules and techniques for estimating time delays. Emphasis will be placed on the use of static CMOS circuits and regular structures such as programmed logic arrays in custom and standard cell-based designs. The use of workstations with Mentor Graphics design tools for circuit simulation and physical layouts will be stressed. Graduate level laboratory design projects will be required. (0306-351, 561) **Class 4, Lab 2, Credit 4 (F, S, SU)**

0306-731 **VLSI Design Projects**
A second course in the design and implementation of Very Large Scale Integration (VLSI) circuits and systems. Emphasis will be placed on the design and use of dynamic precharge and precharge-evaluate CMOS circuitry including Domino, NORA and Zipper CMOS logic, and subsystems. Basic requirements of a clocking system and a general clocking strategy for timing design in both static and dynamic CMOS circuits will be investigated. Topics on the design and use of a standard cell library in the implementation of large system designs will be covered. The use of workstations with Mentor Graphics design tools and Synopsys synthesis tool suite will be required in laboratory projects leading to the design, VHDL synthesis and testing of an integrated circuit device. (0306-730) **Class 4, Lab 2, Credit 4 (S)**

0306-740 **Analytical Topics for Computer Engineers**
This course begins by reviewing signal and system analysis techniques for analyzing linear systems. It includes Fourier techniques and moves on to present fundamental computational techniques appropriate for a number of applications areas of computer engineering. A section on numerical linear algebra covers techniques for analyzing discrete time signals and systems. Other course areas are symbolic logic and discrete optimization techniques. (Graduate standing or department permission) **Class 4, Credit 4**

0306-741 **Design for Testability**
This course will introduce the concepts of failure mechanisms and fault modeling in digital circuits. It describes various test strategies for the digital systems. Techniques to integrate design and test for VLSI circuits will be included. Design for autonomous test, SCAN-PATH concepts and testability analysis will be discussed. Built-in self-test (BIST) techniques will be detailed. Concepts of easily testable logic will be introduced. In addition, testability bus and the boundary-scan techniques will be included for system level testability. (0306-561) **Class 4, Credit 4**

0306-756 **Multiple Processor Systems**
Introduces basic concepts of parallel and high-performance computing and current methodologies and trends in the design and programming of multiprocessor systems. Theoretical models of parallel computing and performance metrics are studied and contrasted with practical parallel system architectures, programming environments, and benchmarking techniques. Parallel architectures are classified according to mode and degree of parallelism, memory organization, and type and topology of interconnection networks used in the design. 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. (0306-551 or equivalent) **Class 4, Credit 4 (S)**

0306-758 **Fault Tolerant Digital Systems**
This course addresses the following advanced topics: formal models and concepts in fault diagnosis, test generation, design for testability techniques, design techniques to achieve fault tolerance, system evaluation techniques, design of practical fault-tolerant systems, and fault-tolerant design of VLSI circuits and systems. (0306-561) **Class 4, Credit 4 (W)**

0306-759 **Principles of Digital Interfacing**
The objective of this course is to give students basic concepts of interfacing to microcomputer bus systems, including familiarity with various peripheral components currently available. Students will gain experience in the actual implementation of microcomputer systems. The course is hardware oriented, but some high-level software will be required to make the experimental systems operational. (0306-561 or equivalent) **Class 3, Lab 3, Credit 4 (F)**

0306-761 **Engineering Design of Software**
An advanced course moving the student beyond computer programming to the engineering of complex software systems. At the end of this class, students will be able to make the right selection of design methodologies or architectures, produce executable structure models that can be verified by computer, formulate a design that meets all functional and performance requirements, and perform trade-off analyses that enhance decision making. Students will work in teams on large-scaled software projects. (Knowledge of software engineering process models and related activities, basic familiarity with a high-level programming language) **Class *4,* Credit *4***

0306-762 **Concurrent and Embedded Sohare Design**
This course introduces methods for developing and designing concurrent software, which consists of many cooperating processes. Formal logical formulas are used to characterize sets of states and sets of program behaviors. The software is then analyzed by manipulating these logical formulas. Several classical concurrent programming problems such as critical section, producers and consumers, and resource allocation are examined. Practical examples and exercises are used to illustrate key are used to illustrate key points and evaluate design tradeoffs. (0306-761 or instructor permission) **Class 4, Credit 4**

0306-763 **Embedded and Real-time Systems**
A first course in an elective sequence begins by presenting a general road map of real-time and embedded systems. Conducted in a studio class/lab format with lecture material interspersed with lab work, this course introduces a representative family of microcontrollers exemplifying unique positive features as well as limitations of microcontrollers in embedded and real-time systems. Microcontrollers will be used as external, independent performance monitors of more complex real-time systems. Much of the material focuses on a commercial real-time operating system, using it for programming projects on development systems and embedded target systems. Fundamental material on real-time operating systems will be presented, including scheduling algorithms, priority inversion, and hardware-software co-design. (4010-361 and 0306-250 or equivalent, 4003-440 recommended) **Class 4, Credit 4**

0306-764 **Modeling of Real-time Systems**
This course introduces the modeling of real-time software systems. It takes an engineering approach to the design of these systems by analyzing a model of the system before beginning implementation. UML will be the primary modeling methodology. Non-UML methodologies will also be discussed. Implementations of real-time systems will be developed manually from the models and using automated tools to generate the code. (4010-441 or 4003-440) **Class 4, Credit 4**

0306-772 **Special Topics in Computer Engineering**
Topics and subject areas that are not among the courses listed here are frequently offered under the title of Special Topics. Such courses are offered in a normal format; that is, regularly scheduled class sessions with an instructor. **Credit variable (no regular course schedule)**

0306-775 **Robotics**
This course is a seminar style survey of mobile robotics. The development of the field and an overview of the different approaches to mobile robot guidance (knowing where we are and where we want to go), navigation (formulating a plan to get where we want to go), and control (following a desired path) will be given. The emphasis of the course will be on algorithms and techniques. (0306-451) **Class 4, Credit 4.**

0306-776 **Robust Control**
One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop control system to continue to perform satisfactorily despite large variations in the (open-loop) plant dynamics and the environment. This new approach has been successfully applied to high performance servo drive systems, unmanned aerial vehicles, visual feedback systems and mobile robots among others. This course will provide an introduction to state-of-the-art techniques for analysis and design of robust feedback systems. MATLAB will be used extensively for analysis, design and simulation. (0306-553 or equivalent, 1016-331 or equivalent is recommended) **Class 4, Credit 4**

0306-784 **Digital Image Processing Algorithms**
Emphasizes both theory and implementation of image processing algorithms. Two-dimensional sampling, transforms, and filtering are introduced and used for image enhancement, compression, restoration, segmentation, and applications in color and video processing. Project assignments involve MATLAB implementation of algorithms and paper reviews. (0306-451, or permission of instructor) **Class 4, Credit 4**

0306-785 **Computer Vision**
This course covers both fundamental concepts and the more advanced topics in Computer Vision. Topics include image formation, color, texture and shape analysis, linear filtering, edge detection and segmentation. In addition, students are introduced to more advanced topics, such as model based vision, object recognition, digital image libraries and applications. Homework, literature reviews and programming projects are integrated with lectures to provide a comprehensive learning experience. *(0306-451* or permission of instructor) **Class 4, Credit 4**

0306-790 **Graduate Seminar in Computer Engineering**
The purpose of the Graduate Seminar in Computer Engineering is to prepare graduate students to effectively conduct their thesis research. Current literature topics in the computer engineering discipline are reviewed through interactive presentations and discussions. Professional communications are stressed for the purpose of giving presentations and writing thesis documents and technical papers. Student assignments include literature surveys, in class presentations, and critical analysis reports. (Graduate standing or permission of instructor) **Class 1, Credit variable 0–2**

0306-794 **Data and Computer Communications**
Provides a unified view of the broad field of data and computer communications and networks. Emphasis is on the basic principles underlying the technology of data and computer networks. Critical issues in data communication networks as well as the current and evolving standards in computer communication architecture are discussed. The topology, access control and performance of various types of networks are studied in detail. A comprehensive student project is required. (1016-351 or permission of instructor) **Class *4,* Credit 4 (F, W)**

0306-795 **Networking Security**
This course covers a set of advanced topics in the network area. The topics include advanced scheduling algorithms (e.g., WFQ), queue management schemes (e.g., RED), and network security (e.g., cryptography, DOS, key management, firewalls, etc.) In addition, network programming based on Java (RMI, UDP/TCP socket, etc.) and network simulation using C++ and OPNET will be introduced and carried as course projects. *(0306-694* or equivalent) **Class 4, Credit *4***

0306-890 **Thesis**
An independent engineering project or research problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty member to guide the thesis before registering. The thesis may be used to earn a minimum of 5 and a maximum of 9 credits. **Credit variable**

Applied Statistics

0307-711 **Fundamentals of Statistics I**
For those taking statistics for the first time. Topics include organizing observed data for analysis, understanding of variability graphical methods, and summary statistics; simple, conditional, and joint probabilities; combinations, permutations; binomial, Poisson, and normal distributions; sampling distributions and the Central Limit Theorem. This course does not count as credit for either the CQAS advanced certificates or MS degree. **Credit 3 or 4**

0307-712 **Fundamentals of Statistics II**
Continuation of 0307-711. Topics include estimation, confidence intervals, and hypothesis testing; tests for independence and analysis of categorical data; two-sample problems; designed experiments with one or two factors; introduction to analysis of variance, simple and multiple linear regression, and correlation. This course does not count as credit for either the CQAS advanced certificates or MS degree. (0307-711 or equivalent) **Credit 3 or 4**

0307-721 **Statistical Process Control**
A practical course designed to provide in-depth understanding of the principles and practices of statistical process control. Topics include statistical concepts relating to processes, Shewhart charts for measurement and attribute data, CUSUM charts, EWMA charts, measures of chart performance, tolerances, specifications, process capability studies, short-run control charts. (0307-712 or equivalent) **Credit 3 or 4**

0307-731 **Statistical Acceptance Control**
How to apply modern process-oriented sampling plans to assess performance of product and processes. Topics include single, double, multiple and sequential sampling plans, variables sampling, techniques for sampling continuous production, skip-lot plans, chain plans, AOQL schemes, AQL sampling systems and recent contributions to literature. (0307-7 12 or equivalent) **Credit 3 or 4**

0307-742 **Statistical Computing**
This course focuses on the programming language used in SAS statistical software to read in raw data, create and manipulate SAS data sets, and create SAS macros. This course covers the material required for "SAS Base Programmer" certification and students seeking employment in statistical professions are encouraged to go on after the course to seek professional certification. Corresponding Minitab commands and macro programming will also be covered. (0307-712 or equivalent) **Credit 3**

0307-751 **Mathematics for Statistics**
This is a survey of the mathematical tools of some of the more rigorous statistics courses of the MS program. The topics include partial and higher-order differentiation, various methods of integration, the gamma and beta functions, and a brief overview of linear algebra, all in the context of application to statistics. (The course assumes calculus prerequisites for the program have been met; it is not a substitute for the program's calculus requirements.) (0307-712 or equivalent) **Credit 3**

0307-762 **Reliability Management**
This course reveals many of the management tools used in the aerospace industry, introducing reliability as a scientific discipline to be implemented in an industrial setting. Topics. include introduction to reliability, maintainability and testability; reliability requirements, definitions, program planning; methods used for vendor selection and surveillance; reliability testing, screening and burn in; failure definitions; reporting analysis, classification; reliability acceptance testing, qualification testing; software reliability/software quality; reliability growth models. (0307-712 or equivalent) **Credit 3**

0307-770 **Design of Experiments for Engineering and Science**
This course covers the fundamentals of the logical and economical approach to the design and analysis of engineering, scientific and industrial experiments. It integrates the essential organizational aspects of experimentation with proven statistical approaches. Designs covered include the two-level factorial and fractional factorial, response surface designs (CCD), blocking designs when randomization is restricted, nested designs to uncover sources of variation. The appropriate analysis methods complement the designs. Simulation modeling and robust design show the power and applicability of the information derived from the designed experiments. This course is intended for non-CQM students. It does not count as credit for either the CQAS advanced certificates or MS degree. (1016-314 or 1016-319 or 1016-351 or 0307-712 or equivalent) **Credit 4**

0307-772 **Applied Survey Design and Analysis**
This course is an introduction to sample survey design with emphasis on practical aspects of survey methodology. Topics include survey planning, sample design and selection, survey instrument design, data collection methods, and analysis and reporting. Application areas discussed will include program evaluation, opinion polling, customer satisfaction, product or service design, and evaluating marketing effectiveness. Data collection methods to be discussed will include face-to-face, mail, Internet and telephone. (0307-712 or equivalent) **Credit 3 or 4**

0307-781 **Quality Management**
This course focuses on ASQs Certified Quality Manager body of knowledge and introduces process improvement methodologies, including the Six-Sigma framework. Topics include quality standards and awards, organization for quality, customer satisfaction, continuous improvement, team management, quality costs, project management, process improvement methodologies. **Credit 3 or 4**

0307-782 **Quality Engineering**
This course, in conjunction with 0307-781, covers the non-statistical elements in ASQs Certified Quality Engineer body of knowledge. Topics include quality philosophies, elements of a quality system, quality planning, supplier management, quality auditing, quality and management tools, process and material control, measurement systems, and safety and reliability. **Credit 3 or 4**

0307-784 **Statistical Consulting**
This course prepares students for real-world use of the analytical and planning tools learned in other courses, with the assumption that the consultant will generally be a company employee. Students role-play clients and consultants utilizing videotaped simulated interviews to encourage class discussion. Topics include the psychology of statistical consulting, report writing, lecture note preparation, database search, the business aspects of consulting, and proposal writing. A major team project integrates the learning. (0307-802) **Credit 3**

0307-801 **Design of Experiments I**
How to design and analyze experiments with an emphasis on industrial applications. Topics include the role of statistics in scientific experimentation, completely randomized designs, randomized complete block designs, nested designs, Latin square designs, incomplete block designs, general factorial designs, split-plot designs. (0307-712 or equivalent) **Credit 3 or 4**

0307-802 **Design of Experiments II**
Continuation of 0307-801. Topics include two-level factorial and fractional-factorial designs, three-level designs, response surface designs, evolutionary operation (EVOP). (0307-801) **Credit 3 or 4**

0307-803 **Design of Experiments III**
A continuation of the DOE sequence, covering more advanced, but applied, topics and providing a strong foundation for handling complex and nonstandard situations. Topics include design and analysis of general, complete balanced designs, including continued study of variance components, mixed models, split-plot, and arbitrarily complex "no-name'' designs; restricted and unrestricted forms of the model; design and analysis of general unreplicated designs; optimal designs for non-standard situations, using D optimality and related criteria. (0307-802,0307-841) **Credit *3***

0307-821 **Theory of Statistics I**
This course introduces the student to the fundamental principles of statistical theory while laying the groundwork for study in the course sequel and future reading. Topics include classical probability, probability mass/density functions, mathematical expectation (including moment-generating functions), special discrete and continuous distributions, and distributions of functions of random variables. (1016-283 or equivalent and 0307-712 or equivalent) **Credit 3**

0307-822 **Theory of StatisticsI II**
Building on foundations laid in the first course, this second course in statistical theory answers some of the "How?" and "Why?" questions of statistics. Topics include the sampling distributions and the theory and application of point and interval estimation and hypothesis testing. (0307-821) **Credit 3**

0307-824 **Probability Models**
An introduction to stochastic processes, this course is intended to encourage a greater appreciation of statistical theory, while at the same time more fully enabling students to read, understand and even contribute to statistical journals. Topics include Poisson processes and their relationship to uniform, exponential, gamma and beta distributions; the basics of queuing theory; and discrete-time Markov chains. Characteristic functions and using Taylor series to approximate the mean and variance of functions of one or more random variables are among miscellaneous topics. (0307-821) **Credit 3**

0307-830 **Multivariate-Analysis Theory**
Multivariate data are characterized by multiple responses. This course concentrates on the mathematical and statistical theory that underlies the analysis of multivariate data. Some important applied methods are covered. Topics include matrix algebra, the multivariate normal model, multivariate t-tests, repeated measures, MANOVA and principal components. (Basic matrix algebra; 0307-712 or equivalent; 0307-821 or equivalent; 0307-822 is recommended) **Credit 3**

0307-831 **Multivariate-Analysis Applications**
This course includes some theory, but concentrates on the applications of multivariate analysis methods. The course relies heavily on the use of computer sohare. Topics include principal components, factor analysis, canonical correlation, discriminant analysis, cluster analysis and scaling. (basic matrix algebra; 0307-712 or equivalent, 0307-830 is useful) **Credit 3 or 4**

0307-834 **Multivariate Statistics for Imaging Science**
This course introduces multivariate statistical techniques and shows how they are applied in the field of Imaging Science. The emphasis is on practical applications, and all topics will include case studies from imaging science. Topics include the multivariate Gaussian distribution, principal components analysis, singular value decomposition, orthogonal subspace projection, cluster analysis, canonical correlation and canonical correlation regression, regression, multivariate noise whitening, least squares energy minimization, and signal-to-noise optimization with generalized eigenvector (matched filter). This course is intended for students from the Imaging Science department. It does not count as credit for either the CQAS advanced certificates or MS degree. (Basic matrix algebra; 0307-712 or equivalent; 0307-841 or equivalent) **Credit 4**

0307-841 **Regression Analysis I**
A course that studies how a response variable is related to a set of predictor variables. Regression techniques provide a foundation for the analysis of observational data and provides 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. (0307-712 or equivalent; 0307-801 is useful) **Credit 3 or 4**

0307-842 **Regression Analysis II**
A continuation of 0307-841. Topics include dummy variables, orthogonal polynomials, selection of best linear models, regression applied to analysis of variance problems, the geometry of least squares, ridge regression, generalized models, nonlinear estimation, and model building. (0307-841) **Credit 3 or 4**

0307-851 **Nonparametric Statistics**
This course emphasizes how to analyze certain designs when the normality assumption can not be made, with an emphasis on applications. This includes certain analyses of ranked data and ordinal data. The course provides a review of hypothesis testing and confidence interval construction. Topics include sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, runs tests, chi-square tests, rank correlation, rank order tests and Kolmogorov-Smirnov statistics. (0307-801) **Credit 3**

0307-856 **Interpretation of Data**
How to use statistics in troubleshooting processes and interpreting data. Topics include coordination of use of statistical measures, employing control charts in data analysis, outlier tests, analysis of small-sample data, narrow-limit gauging, analysis of means for variables and attributes data, identification of assignable causes. (0307-802) **Credit 3**

0307-862 **Reliability Statistics I**
A methods course in statistical aspects of reliability. Topics include applications of normal, log-normal, exponential and Weibull models to reliability problems; censored data; probability and hazard plotting; series systems and multiple-failure modes; maximum likelihood estimation; introduction to accelerated-life models and analysis. (1016-282 or equivalent, 0307-801, 841, 0307-822 is strongly recommended as a prerequisite or corequisite) **Credit 3**

0307-863 **Reliability Statistics Ii**
A continuation of Reliability Statistics I. Topics include demonstration testing, accelerated life tests, systems reliability, competing risks, burn-in, reliability growth, and introduction to repairable systems. Some topics, introduced in Reliability Statistics I, are covered in more depth. (0307-862) **Credit 3**

0307-864 **Advanced Acceptance Sampling**
An advanced course in the utilization of process oriented sampling plans in modern quality control. Topics include basis of acceptance sampling, Moods theorem, attributes plans, variables plans for process parameters and proportion nonconforming, sampling schemes including Dodge-Romig and ANS/IASQC Z1.4, plans for special applications, rectification and continuous procedures, cumulative results plans, compliance sampling, reliability sampling, administration of acceptance control. (0307-731) **Credit 3**

0307-865 **Repairable Systems**
Most reliability courses and texts cover techniques that are only applicable to items that are non-repairable. This course is intended to clarify some common misconceptions about repairable systems and provide techniques that are appropriate for use in systems that are improving or degrading with age. Topics include review of probability concepts, stochastic processes applied to repairable systems, misconceptions about repairable systems, statistical analysis of repairable systems failure data, reliability growth models, tests for reliability growth or deterioration, examples and case studies, Cox's proportional hazard model. (0307-862,824) **Credit 3**

0307-867 **Decision Making with Bayesian Models**
This course covers essential ideas in statistical decision analysis. Topics include how to make the best decision under conditions of uncertainty; utilities, risk, and decision diagrams; Bayesian philosophy and methods; assessment of probabilities. (0307-7 12 or equivalent) **Credit 3**

0307-872 **Survey Sampling and Estimation**
This course focuses on sample size determination and parameter estimation in complex example surveys such as those conducted by the Bureau of Labor Statistics. Topics include random, systematic, stratified, cluster, and multi-stage sampling; and statistical techniques such as ratio, difference and regression estimators. (0307-822) **Credit 3**

0307-873 **Time Series Analysis and Forecasting**
The course develops statistical methods in modeling and forecasting of time series data with emphasis on model identification, model fitting and diagnostic checking. Topics include survey of forecasting methods, regression methods, moving averages, exponential smoothing, seasonality, analysis of forecast errors, Box-Jenkins models, transfer function models. (0307-841) **Credit 3 or 4**

0307-880 **Design and Analysis of Mixture Experiments**
Mixture experiments, those in which the response depends only on the proportion of the components added and not their actual amount, are used widely in the chemical, material-science, food-science and related fields. Topics include unconstrained designs; models, canonical polynomials; constrained regions, pseudocomponents, multiple constraints, algorithms for constrained regions; majorlminor components; analysis of mixture experiments, including effects and response traces; mixture-amount designs; mixture-process variables designs; design optimality. (0307-802, 841) **Credit 3**

0307-883 **Quality Engineering by Design**
This course introduces the Taguchi approach to off-line quality control including loss function, signal-to-noise metria, parameter design and tolerance design. These methods are aimed at producing improved products and processes at lower costs. Full attention is given to the more controversial aspects of Taguchi methods and alternatives to these methods that follow better statistical protocol are presented. (0307-802) **Credit 3**

0307-886 **Sample Size Determination**
This course presents procedures to determine the proper sample size needed for the most commonly applied statistical methods. Topics include confidence intervals and hypothesis tests for the parameters of applied distributions and approximations to distributions. Sample size determination for designed experiments is covered extensively. (0307-802) **Credit 3**

0307-889 **Independent Study Project**
Credit will be assigned at the discretion of the candidate's adviser and will depend on the character and involvement of the project. A written proposal setting forth the character and procedures involved will be required of the candidate and may be modified at the discretion of the candidate's adviser before approval is given to proceed. **Credit 1, 2, 3, 6 or 9**

0307-891 **Special Topics in Applied Statistics**
This course number provides for the presentation of subject matter of important specialized value in the field of applied statistics not offered as a regular part of the statistics program. (Consent of instructor) **Credit 3**

0307-895 **Statistics Seminar**
This course (or sequence of courses) provides for one or more quarters of independent study and research activity. This course may be used by other departments of other colleges at RIT to provide special training in statistics for students who desire an independent study program in partial fulfillment of graduate degree requirements. (Consent of all departments involved) **Credit 3**

0307-896 **Thesis**
For students working for the MS degree who are writing a research thesis. (Consent of department chair) **Credit 3, 6 or 9**

0307-899 **Individual Achievement Project**
Research project under faculty supervision for students working for the MS degree. (Consent of faculty supervisor) **Credit 1–9**

Microsystems Engineering

0308-711 **Microsystem Fundamentals**
This course covers the fundamentals of microsystems with emphasis on a broad range of applications. The course covers the underlying principles of micro-actuators and micro-sensors; analysis and modeling of micro-devices; scaling laws; microfuidics; photonics; microsystems fabrication processes; microelectromechanical (MEMS) and micro-optoelectromechanical (MOEMS) systems analysis; applications in the fields of telecommunications and sensing will be presented. **Lecture, Credit 4**

0308-720 **Independent Study**
This course number should be used by students who plan to study a topic on an independent basis under the guidance of a faculty member. A written proposal with an independent study form is to be submitted to the sponsoring faculty member and approved by the program director prior to the commencement of work. **Credit 4**

0308-721 **Micro-Optics**
This course covers the propagation and diffraction of light and micro-optical components. Subjects covered: diffraction, Fourier optics, diffractive optical elements analysis and design, fabrication of micro-optic components and micro-optics for microsystems applications. (0301-474 or equivalent) **Class 4, Credit 4**

0308-786 **MEMS Design**
Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing and other applications. There is a critical need to synthesize and design high-performance MEMS that satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Fifth year BS/MS, MS and PhD students) **Class 4, Credit 4**

0308-798 **Microfluidic MEMS**
The course begins with an overview of microfluidic technology to provide a framework and to clarify the relationship of microfluidics to microelectromechanical systems (MEMS) and microsystems in general. Three major topics comprise the course: 1) selected elements of dic dynamics theory, and the scaling and application of that theory to microscale dimensions; 2) design, fabrication, and characterization of microfluidic devices and microsystems including exploration of major alternative fabrication technologies, process integration and materials issues, and device- and system-level packaging/encapsulation challenges; 3) applications, including microvalves, micropumps, microflow control sensor, and devices for chemical and biochemical valves, micropumps, microflow control sensor, and devices for chemical and biochemical analysis. **Class 4, Credit 4**

0308-799 **Nano & Microengineering**
This course focuses on analysis and synthesis of nano- and micro electromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and micro-engineering, distinct systems and devices will be examined. The application of nano and microengineering in nanocomputers, avionics, security and transportation will be emphasized. Specific applications included are: super fast data processing and computing, data storage, imaging, molecular intelligent automata, etc. **Class 4, Credit 4**

0308-804 **MEMS Evaluation**
This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced sohare and hardware in MEMS evaluation will be covered. (0301-786, 0305-870) **Class 4, Credit 4**

0308-811 **Microsystem Design and Packaging**
Design considerations; design process; mechanical design; photonic design; modeling; system integration; packaging technologies; microsystems packaging; assembly of micfosystems; testing; design case studies. (0308-711) **Class 4, Credit 4**

0308-82 1 **Micro-Optics and Photonics**
Light propagation; passive optical components; micro-optics; digital devices; laser diodes; photodiodes; micro-optical systems; design case studies. (0308-711) **Class 4, Credit 4**

0308-831 **Micro and Nano-Photonics**
This course covers the generation and propagation of light in guided media. Subjects covered: two and three-dimensions slab wave guides, coupled-wave analysis, wave guide modeling and design, photonic crystals structures, photonic band gap devices in one and two dimensions and fabrication of photonic wave guides. (0308-721) **Class 4, Credit 4**

0308-841 **Advanced Microphotonics**
This course covers the latest advances in the field of microphotonics as published in the current literature. Subjects covered will include: silicon photonics as applied to light generation, detection and guiding, photonic crystals and microring resonators. The class format will be based on reviewing, analyzing and critiquing recent published research results in this field. Active student participation is required. (0308-721) **Class 4 Credit 4**

0308-890 **Dissertation and Research**
Research in an appropriate topic as arranged by doctoral candidate and dissertation advisor in hlfillment of the dissertation requirement. Department approval required. **Credit 0-4**

0308-990 **Doctoral Dissertation I**
Research in an appropriate topic as arranged by doctoral candidate and dissertation advisor in fulfillment of the dissertation requirement. Departmental approval required. **Credit *4***

0308-991 **Doctoral Dissertation II**
Research in an appropriate topic as arranged by doctoral candidate and dissertation advisor in fulfillment of the dissertation requirement. **Credit 8**

The College of Imaging Arts and Sciences

www.rit.edu/~660www/

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Joan Stone, Dean

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. The college is a diverse, world-class collaboration of six schools: School of Art, School of Design, School for American Crafts, School of Photographic Arts and Sciences, School of Film and Animation, and School of Print Media. Its scope gives students a perspective that can be found nowhere else — a place where some students create fine art using centuries-old methods while others push the edges of digital creativity. At no other university can you explore so many different aspects of the imaging fields to such a level of professional excellence. In addition, RIT, as a career-oriented university, offers expertise in the professional aspects of running a studio or gallery.

Faculty

RIT'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 that can support both course work and research. Their role as mentors is evidenced in the national awards won by their students. Both

College of Imaging Arts and Sciences

graduate students and our alumni have received prestigious awards for their work:

- Students have won the Graduate Film Honorarium of the Princess Grace Award
- A computer graphics design alumnus was awarded a Golden Globe
- An emerging filmmaker received the overall grand prize in the Adobe Flash Point Student Design Contest for multimedia projects
- Computer graphics design students have won awards in the Macromedia Student Web Design Contest
- Graphics design alumni received awards of excellence from the Society of Technical Communications, both locally and internationally
- Students have received a "finalist" designation in the People's Choice Awards at the Macromedia International User Conference and Exhibition
- A computer graphics design graduate received honors from *Communication Arts* and I.D. magazines for her interactive thesis project
- An industrial design student received an award from Volvo of North America for his winning child car seat in the Design for Automobile Safety Competition at the 2000 World Traffic Safety Symposium

With this practical, professional experience, graduates' success upon employment is excellent. Their achievements represent what our programs are about-excellence through exploration and experimentation.

General Information

Master of fine arts degrees

The MFA is a professional, terminal degree for artists, designers, craftspersons, animators, photographers, and filmmakers. Those seeking the graduate degree desire to leave a lasting impression on their fields by devotion to their work, high standards of discipline, and educational ideas. Students who possess a baccalaureate degree will develop expertise in their major area and in related fields under the guidance of professionals.

The college sponsors many guest lectures, seminars, and exhibits to further encourage personal and professional growth.

The MFA is generally a two-year, full-time program that requires the presentation of a thesis.

Acceptance for graduate study

Students are admitted to graduate study by action of the Graduate Committee. Enrollment in graduate courses does not constitute admission to the graduate program, and credit is not given for courses taken prior to acceptance unless the grade received in the course is a "B" or higher. In such a case the student, if admitted to graduate study, may petition for a grant of credit, but not in excess of 12 quarter credit hours.

A student who needs additional undergraduate study requirements may be admitted. This Study will be structured for breadth or increased performance in areas designated, and will be determined at the time of acceptance.

Such prerequisites must be satisfied as defined in the letter of acceptance, which applicants will receive prior to admission as graduate students. Extended study may require additional time on campus. Human gross anatomy and biology, or equivalent content, are necessary for the MFA in medical illustration.

Upon full acceptance into any of the graduate programs, the student is considered qualified to pursue the degree. This status would be changed by evidence of poor performance in the program. A 3.0 grade point average must be maintained. A student is accepted into the program with the understanding of full-time status unless granted part-time status at admission.

Admission as a non-matriculated student

Students who have a baccalaureate degree and who wish to take particular courses may be admitted as non-matriculated 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.

Those coming from foreign countries where the baccalaureate 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 their academic records and portfolios indicate an ability to meet graduate standards.

Admission requirements

Applicants should hold a baccalaureate degree in a field of arts, sciences, or education from a regionally accredited college in the United States or Canada, and demonstrate, through quality of the undergraduate record in creative production, a genuine, professional potential. (Please see section regarding non-matriculated students.) The undergraduate degree should include 75 quarter credit hours (50 semester hours) in studio courses.

International students need a minimum TOEFL score of 550 (paper-based) or 213 (computer-based). Those 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.

Applicants to the computer graphics design MFA program in the School of Design must have an understanding of basic design principles and computer skills. Software skills must include Adobe Photoshop, Macromedia Freehand or Adobe Illustrator, Macromedia Director, and Flash.

To apply for admission to graduate study a student must submit the following items:

- **Application:** Submit your graduate application for admission, accompanied by the application fee, to the Office of Graduate Enrollment Services in the envelope provided in the application packet. When making your program choice, do *so* by indicating the major on the application. Applicants should indicate for which degree they are applying, the master of fine arts (MFA) or master of science in teaching (MST). Some programs are sequential in nature and begin in fall quarter only.* Art education is a full-time program offered only during the regular three quarters of the academic year.

** Major courses for art education, computer graphics design, graphic design, industrial design, and medical illustration are offered only during fall, winter, and spring quarters. Art education applicants should arrange a personal interview by calling 585-475-7562.*

- **Transcripts:** Evidence of a baccalaureate degree is required. Request that official transcripts be sent to the Office of Graduate Enrollment Services from all colleges and universities previously attended.

- **Recommendations:** Submit two letters of recommendation from individuals familiar with your education and/or work experience.

- **Personal statement:** Submit a personal statement of objectives outlined in the admissions application. This statement should indicate in what manner RIT's graduate program would assist the student in attaining these goals. See the application form for directions.

- **Portfolio: Each applicant must submit a portfolio of their work.**

Portfolio guidelines for graduate applicants

Graduate students applying for admission into the School of Art, School of Design, School for American Crafts, or School of Photographic Arts and Sciences (Imaging Arts-Photography) are required to present a portfolio that will be used to assess their performance and academic capabilities.

- Please label your portfolio with your name and address (and e-mail address, if available). While every precaution is taken to ensure proper care and handling, the university assumes no responsibility for lost or damaged slides.
- The school will keep portfolios until the graduate application, scholarship, and assistantship process is complete. The portfolio will be returned if a return postage-paid envelope is enclosed.
- A written description of contents must accompany the portfolio. Include project name, date, media used to create it, and purpose. Please send portfolio and application materials to The Office of Graduate Enrollment Services.

Any correspondence concerning applications, catalogs, and portfolios should be addressed to the Office of Graduate Enrollment Services.

School of Art and School for American Crafts

The portfolio should consist of at least 20 to 40 examples of the applicant's best visual work; 35mm slides are preferred, displayed in 8 1/2" x 11" vinyl protective slide pages. (Additional computer files for video or interactive samples should be stand-alone files that will run on a MAC or PC.) For further information on sending in a digital portfolio or a guide to shooting slides for your portfolio, visit our website at www.rit.edu/~960www/applyonline.php3.

School of Design

The portfolio should contain samples of your work, including a combination of drawings, two-dimensional design, three-dimensional design, photo imaging, website design, product renderings, CAD drawings, page layouts, etc. Visual content is dependent upon your experience and program for which you are applying. The portfolio should consist of 20 to 40 samples of the applicant's best work. Slides, CD-ROM, DVD, or a combination of these is acceptable. They must be stand-alone files that will run on a MAC or PC.

School of Film and Animation

The portfolio should contain your best visual work on CD or DVD. Slides should be submitted in sleeves, not in a carousel. Apple QuickTime movies and Mac-friendly CDs are preferred. For more information refer to the graduate admissions application.

School of Photographic Arts and Sciences, Imaging Arts-Photography

The portfolio must consist of 20 examples of the applicant's best **work; 35mm** slides, displayed in 8 ½ x 11 vinyl protective slide pages. CD-ROM and DVD are all acceptable formats. For more information refer to the graduate admissions application.

Bevier Gallery

During the year, the Bevier Gallery presents a continuing series of important exhibitions planned to present new directions in the fields of art, design, and the crafts, as well as to honor the works of the past. The gallery, architecturally impressive and part of the college, serves to enrich the cultural life of the community and the university at large, as well as to inform and inspire the college's graduate body.

The Faculty Show, Graduate Thesis Shows, and the Student Honors Show are annual events on the gallery calendar.

Transfer of credit

Twelve quarter credit hours (nine semester hours) of graduate work pursued at other institutions may be applied at the discretion of the Graduate Committee to specific course requirements, depending on the nature of the student's program and major, if

completed within the five preceding years. This evaluation will be made after one quarter of full-time study.

Policy regarding student work

The School of Art, School of Design, and School for American Crafts reserve the right to retain student work for educational use or exhibition for a period of time not to exceed 1 1/2 quarters beyond the year the object has been made.

Attendance regulations

The programs of the college utilize the studio, lab, and shop experiences as an essential part of the educational program; therefore it is imperative that the student regularly attend all classes unless specifically excused for special projects or activities by the instructors. Failure to attend classes and complete assignments will be taken into consideration in grading.

Graduate scholarships, assistantships, and other financial aid

To be considered for a graduate scholarship, please see the graduate application packet and submit required application materials by deadline indicated.

Applications for graduate and teaching assistantships are usually distributed in early spring to applicants and current graduate students. If you have questions, contact the appropriate school office: School of Art, (585) 475-7562; School of Design, (585) 475-7469; School for American Crafts, (585) 475-6114; Imaging Arts-Photography, (585) 475-2884; School of Film and Animation, (585) 475-7403.

Need-based financial aid, such as loans and grants, may be investigated through the Office of Financial Aid and Scholarships.

School of Art

www.rit.edu/~651bwww/ART/Art.html

Master of Fine Arts in Fine Arts Studio

Painting/Printmaking/Sculpture/New Forms

The master of fine arts studio program has intensive study in painting, printmaking, sculpture, and related media leading to mastery in the fine arts field on a professional level. Faculty guidance focuses upon research strategies that support sequential studio production leading to individual solutions. Critical discussion is developed from both 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. Moving forward from the sound fundamental backgrounds of their undergraduate art programs, students explore advanced techniques in painting, sculpture, and nontoxic printmaking. These may be pursued singly, combined, or brought together with nontraditional media to create new forms. Gallery r, an art gallery in downtown Rochester operated by School of Art students, helps solidify the learning experience by bringing the work of our students to the greater Rochester community. Along with critical dialogues about contemporary art, students progress toward the production of a body of work and report for the master's thesis. The following general pattern of studies covers degree requirements in the MFA studio art program:

Major Concentration	Qtr. Cr. Hrs.
Major	30
Minor	15
Studio Electives	18
Humanities	8
Forms of Inquiry	2
Graduate Forum	3
Thesis	48
Total	90

Master of Fine Arts in Medical Illustration

The master of fine arts program in medical illustration enables students to exhibit critical and creative thinking and problem solving through the accurate translation of medical and scientific concepts into effective visual support for instruction or advertisement. Students learn to demonstrate effective research techniques and efficient use of time and resources during concept and development of projects to satisfy course assignments. The following general pattern of studies covers degree requirements in the MFA medical illustration program:

Major Concentration	Qtr. Cr. Hrs.
Major	36
Minor	15
Electives	15
Humanities	10
Thesis	14
Total	90

Entrance requirements are one year of biology and three of the following: histology, embryology, immunology, genetics, pathology, or cellular physiology.

Admission requirements

Applicants should hold the baccalaureate degree in a field of the arts, sciences, or education from a regionally accredited college in the United States or Canada and demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential. (Please see section regarding nonmatriculated students.) The undergraduate degree should include 75 quarter credit hours (50 semester hours) in studio courses.

International students need a minimum TOEFL score of 550 (paper-based) or 213 (computer-based). Those 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.

Master of Science for Teachers Programs

MST Visual Art - All Grades

The MST in art education leads toward permanent art K-12 certification to teach in New York State public schools and features pedagogical studies and student teaching. Master of science for teachers in art education is for those holding the BFA or BA (art major) degree. Classes begin in September and end in May. Graduates of teacher education programs at RIT have a 96-percent pass rate on the New York State Teacher Certification Examination.

Admission requirements

The applicant should have received the baccalaureate degree in a field of the arts from a regionally accredited college or university in the United States or Canada, with a major concentration in art, art education, or industrial arts education. The undergraduate studies should include a minimum of 54 quarter credit hours (36 semester hours) in drawing, painting, design, or the crafts. If the applicant for admission holds the BA or BFA degree and seeks the MST degree in art education, the undergraduate program must have adhered to the studio course distribution required by the New York State Education Department.

The following general pattern of studies covers degree requirements in the MST art education program:

Major Concentration	Qtr. Cr. Hrs.
Education, Psychology, and Sociology	20
Art Education Concentration	22
Methods and Materials in Art Education, Seminar in Art Education, Practice Teaching Studio Electives	6
Total Credits	48

MST Fine Arts Studio

The MST fine arts studio offers a masters option for students who have received “initial” teaching certification from another institution. Students combine major fine arts studio classes in painting, printmaking, sculpture, drawing, and new forms with supporting courses, if desired, from graduate offerings in other schools and departments of the institution. This MST option alone does not result in teacher certification. This program may be completed in one year.

Admission requirements

The MST fine arts studio is offered to candidates who are holders of an undergraduate art education degree (with a minimum of 36 semester credits in art). Candidates need to be well versed in studio production, art history, and aesthetic and art criticism. Candidate must have in-depth knowledge of the subject matter that they plan to teach as described in professional, state, and institutional standards. Candidate must submit a slide portfolio representing their studio practice, an essay reflecting on becoming an art educator and a complete graduate application form.

The following general pattern of studies covers degree requirements:

Major Concentration	Qtr. Cr. Hrs.
Fine Arts Studio	24
Humanities, Art History	8
Forms of Inquiry	2
Minor Concentration	9
Electives	5
Total	48

Advanced Certificate in Non-Toxic Intaglio Printmaking

This program offers technical training and retraining for artists and printmaking professionals seeking a comprehensive working knowledge of nontoxic intaglio printmaking techniques, including a study of methodology and aesthetic applications.

		Qtr. Cr. Hrs.
2021-741	Graduate Certificate Non-Toxic Intaglio Printmaking I	4
2021-742	Graduate Certificate Non-Toxic Intaglio Printmaking II	4
2021-743	Graduate Certificate Non-Toxic Intaglio Printmaking II	4
Total		12

Admission requirements

Candidates must submit a letter of intent, resume, slide portfolio (between 10 - 20 slides) and the names and contact details of three references, and satisfy one of the following e Entry requirements:

1. Graduated with a BFA or master in fine arts.
2. Be recognized as a master printer or professional printmaker.

School of Design

www.rit.edu/~651www/

The School of Design offers three professional MFA degree programs: graphic design, industrial design, and computer graphics design. These unique programs allow for advanced study that integrates creativity, philosophy, history, theory, applied concepts, and technology. Students who seek to advance their skills or change careers find our programs to be challenging and professionally based. The school sponsors guest lecturers, interdisciplinary projects, and special events to encourage personal and professional growth.

The school also offers four cross-disciplinary courses. All graduate students in the School of Design’s MFA programs take the following courses: Design Research, Design Theory and Methods Seminar, Design History Seminar, and Design Issues Seminar. These cross-disciplinary courses help to foster a sense of community among students and faculty and encourage dialogue and interaction related to philosophy, process, practice, history, goals, and responsibilities across the design disciplines.

The MFA programs in graphic design and industrial design require a fall entry. Computer graphics design prefers a fall entry but can be flexible, dependent upon the student’s qualifications and/or experience. The application deadline is February 15. Applications reviewed and accepted after this date are based upon seats available. Applicants may be put on a waiting list.

Master of Fine Arts in Computer Graphics Design

Marla Schweppe, Coordinator
(585) 475-2754, mkspph@rit.edu

This internationally recognized program offers concentrations in motion graphics, instructional multimedia, game art and design, Web design, and visualization. The curriculum combines knowledge of design theory, methodology, and aesthetics with skills in two-dimensional and three-dimensional computer graphics, interactive techniques, and interfaces. Students utilize cutting-edge technology to produce a vast array of dynamic experiences.

The program focuses on experimental and practical approaches to the expression of unique visions. Students create interactive installations, kiosks for museums, opening titles for movies, interactive animation, Web-based environments, virtual theatre, and computer games realized from their imaginations. Resources in the Digital Studio are accessible 24 hours a day, seven days a week and include three-dimensional digitizers, physical computer interfaces, motion capture systems, three-dimensional printers, monitor tablets, and a wide variety of software applications.

As part of the entrance requirements, applicants must demonstrate an understanding of basic design principles and visual computer skills. Software skills must include: Adobe Photoshop, Adobe Illustrator, Maya, Apple Shake, or Macromedia Flash.

MFA in Computer Graphics Design	Qtr. Cr. Hrs,
Major studio courses	45
Elective/Minor	17
Design Core	14
Thesis	14
Total	

Master of Fine Arts in Graphic Design

Deborah Beardslee, Coordinator
(585) 475-2664, dabfaa@rit.edu

Graphic design is a professional major that consists of a sequence of courses addressing advanced visual communication problems, with an emphasis on meaning, form, and function. In a professional studio setting, students work with faculty on the understanding and implementation of design process, design theory, history and criticism, research methods, visual aesthetics, systems design, information design, ethics and values, project development and evaluation, and cross-disciplinary problem-solving methods.

Course work and thesis projects incorporate both theory and application in the solution of hypothetical or actual design problems. Courses within this major evidence a balanced approach toward the application of electronic media and traditional processes. Final design outcomes may range from small- or large-scale, two-dimensional printed artifacts to electronic, time-based, and/or interactive applications. Special lectures, guest speakers, exhibitions, and workshops complement the studio work experience. Student projects also utilize other RIT resources such as the Graphic Design Archive and the Cary Graphic Arts Collection.

MFA in Graphic Design	Qtr. Cr. Hrs.
Major	24
Design Core	12
Minor	15
Electives	15
Liberal Arts	12
Thesis	12
Total	90

Master of Fine Arts in Industrial Design

David Morgan, Coordinator
585-475-4769, dcmfaa@rit.edu

The master of fine arts degree program is available for students pursuing specialized study in industrial design at the graduate level for the purpose of 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, there are studio courses that 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.

MFA in Industrial Design	Qtr. Cr. Hrs.
Major	39
Eiectives/Minor†	21
Design Core	12
Liberal Arts	4
Thesis	14
Total	90

† Minors are declared within the College of Imaging Arts and Sciences and in other colleges at the university. This is done with approval from the individual program's graduate adviser/coordinator: The minor should support the goal of the MFA degree.

School for American Crafts

www.rit.edu/~652www/

Master of Fine Arts

The MFA is a professional, terminal degree for practicing artists, craftspersons, 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 formal exhibition of a body of work.

Studio residence program

The School for American Crafts offers a craft residence program. Participants will be accepted in the ceramics, glass, metals, and wood studios.

Residence positions are limited and will be awarded by portfolio, transcript, and references. An interview is required. Accepted studio residents are required to register for at least two credits of independent study during every quarter of residence. These two credits can be taken as an audit, thus reducing the tuition cost to the resident.

Accepted residents are expected to be present in their major studio during class hours and to contribute up to 10 hours of work per week in the major studio. These work hours will be coordinated and overseen by the major faculty in the area. In exchange, the school will provide workspace, access to facilities, and supportive instruction. The resident is invited to participate in the full range of studio activities.

Participants may be people seeking additional studio experience prior to undergraduate or graduate study, early career professionals, or teachers on leave who wish to work again in an academic studio environment. The major faculty in the area will make decisions concerning appropriate candidates.

Inquiries should be made to Residence Program, College of Imaging Arts and Sciences, School for American Crafts, Rochester Institute of Technology, 73 Lomb Memorial Drive, Rochester, NY 14623-5603.

MFA in American Crafts	Qtr. Cr. Hrs.
Major	42
Humanities	10
Graduate Forum	3
Electives (optional minor)	15 (18)
Thesis	18
Total	90

Admission requirements

Applicants should hold a baccalaureate degree in a field of arts, sciences, or education from a regionally accredited college in the United States or Canada, and demonstrate, through the quality of the undergraduate record and creative production, a genuine, professional potential. (Please see section regarding non-matriculated students.) The undergraduate degree should include 75 quarter credit hours (50 semester hours) in studio courses.

International students need a minimum TOEFL score of 550 (paper-based) or 213 (computer-based). Those 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.

Master of Fine Arts in Ceramics

The ceramics studio embraces the contemporary spectra of aesthetic ideas and innovative techniques to educate and train professional artists/craftspeople. It strives to support students' career goals with pragmatic information and suitable facilities and equipment.

Our structured courses address specific issues inherent to utilitarian pottery, vessel aesthetics, ceramics sculpture, and mixed media. The ceramics program also receives substantial reinforcement from the other craft studios because they, too, explore similar formats and concerns that face artists and craftspeople in the 21st century.

Master of Fine Arts in Glass

This two-year program is structured on the basis of individual needs, interests, and professional preparation, as they may be determined through individual/group discussions. A rapid series of exploratory works is developed during the first year, with emphasis on broadening technical and aesthetic understanding. The second year's focus will be on developing a body of work based on a sustained interest from the first year's investigation. The final work must be supported by a written thesis, a high-quality portfolio, and an exhibition.

Master of Fine Arts in Metals

This program is structured on the basis of individual needs, interests, and background preparation, as they may be determined through faculty counseling. The program gives the student a broad exposure to metal working techniques, expands the student's knowledge of applied design, strengthens perceptual and philosophical concepts, and develops an individual mode of expression. This sequence leads to the master's thesis, inaugurated by the student and overseen by the faculty.

Master of Fine Arts in Wood

This program leads to the terminal degree in the studio arts. Men and women come to the program from diverse backgrounds such as architecture, interior design, industrial design, art history, law, and teaching, as well as undergraduate wood programs. In the first year, students identify issues in their technical and aesthetic background and, along with faculty, create a program of study to address these areas. Simultaneously, they discover directions in their work that are promising for further exploration. Based upon this experience, they develop a thesis proposal and, in the second year, create a comprehensive body of work. This work culminates in the end-of-the-year graduate thesis exhibition in the college gallery and a written thesis in support of the work.

School of Print Media

www.rit.edu/printmedia

The graphic communication industry is large and extremely varied, and continues to be driven by changes in technology. Graduates from the School of Print Media are working as professionals in production management, marketing, technical sales, research and development, quality assurance, administration, teaching and other areas. A graduate degree from the School of Print Media pays off by attracting leading employers from every graphic discipline. The master of science degree in print media has had a greater than 95-percent placement rate for the past several years.

A graduate degree from the School of Print Media can be your roadmap to a creative, prosperous, and exciting career. Our programs offer you the tools necessary to be successful as a manager and leader in the graphic communications industry. With state-of-the-art facilities and technology, internationally renowned faculty, and unequaled course offerings, the School of Print Media is widely considered the premier provider of graphic communications education in the world.

Admission requirements

Prior to being admitted to a master of science degree program, applicants must show the Graduate Admission Committee of the School of Print Media that their previous training, ability, and practical experience indicate a reasonable chance of success.

Requirements

- A bachelor's degree from a four-year program in an accredited college or university
- An undergraduate grade point average of 3.0 or higher
- A completed application form, including official transcripts, personal statement, and two letters of recommendation

GRE requirements

- Applicants should submit Graduate Record Examination (GRE) scores.

24 International students must submit TOEFL scores of 550 or higher (paper-based) or 213 or higher (computer-based).

Students are encouraged to apply to the graduate program at any time during the year. To be assured of the best opportunity for admission and scholarships, interested students should have their application process completed by April 1. Applications received later than April 1 will be considered on a space-available basis.

Foundation program

The Foundation Program is common to the graduate programs within the School of Print Media. During the admissions process, the graduate program chair evaluates the background of an applicant to determine whether a portion of the Foundation Program might be waived because of prior course work or work experience.

The Foundation Program involves the following course work

0307-711 Fundamentals of Statistics **I** (or equivalent)
2082-303 Professional and Technical Writing (or equivalent)

If the applicant has taken Technical Writing and Statistics I as an undergraduate, the requirement may be waived. If not, they may be taken at RIT or another undergraduate institution.

Master of Science in Print Media

Twyla J. Cummings, Graduate Program Chair
(585) 475-5567, tjcppr@rit.edu

Although it might seem like another age, it was just a few short years ago when terms like "digital workflow" and "electronic publishing'' were unknown to most people in the graphic communications industry. Today, the challenge of keeping up with technological change is difficult and even risky. Every decision has an impact on productivity across the organization and affects its ability to compete in the marketplace.

A focus on technology

The print media program provides an in-depth understanding of technical printing and imaging concepts, as well as exposure to high-level research methods. Although this program provides broad exposure to the graphic communication industry, it allows students an opportunity to specialize in a relevant technical or business area. The program offers the maximum flexibility in terms of tailoring the program to meet individual needs. Recent students have focused on information technology, imaging science, or business, depending upon interest and aptitude.

Curriculum	Qtr. Cr. Hrs.
2081-701 Research Methods and Trends	4
2081-711 Tone and Color Analysis	4
2081-716 Grad Materials and Processes I	4
2081-717 Grad Materials and Processes II	4
2081-747 Cross-Media Workflow I	4
2081-748 Cross-Media Workflow II	4
0307-712 Fundamentals of Statistics II or equivalent	4
2081-890 Thesis	4
Minor Concentration	16
Total	48

Minor concentrations options

Minor concentration courses are selected by the student to develop additional expertise in a particular area of interest. The degree offers flexibility in terms of tailoring the program to meet individual needs. The electives and minor concentration courses are comprised of selected courses offered by CIAS or other RIT colleges. All courses must be pre-approved by the graduate program chair.

Proposed plan of study

Fall Quarter	Qtr. Cr. Hrs.
2081-701 Research Methods and Trends	4
2081-716 Grad Materials and Processes I	4
0307-712 Fundamentals of Statistics II	4
Winter Quarter	
2081-711 Tone and Color Analysis	4
2081-717 Grad Materials and Processes II	4
2081-747 Cross Media Workflow I	4
Minor Concentration	4
Spring Quarter	
2081-748 Cross Media Workflow II	4
Minor Concentration	4
Minor Concentration	4
Summer Quarter (options)	
Research - Fellowships, PIC, Grad Co-op	
Grad Assistantships	
Fall Quarter	
Minor Concentration	
2081-890 Thesis	4
Full-Time Equivalency	4
Winter Quarter	
2081-890 Continuation of Thesis	
Full-Time Equivalency	
Spring Quarter	
2081-890 Continuation of Thesis	
Full-Time Equivalency	

Thesis

All students in the on-campus print media graduate programs 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 topics in which they have an intense interest and a desire to make a significant contribution to the body of knowledge in the industry. Fellowship awards are often available to help fund their research. Students may not register for thesis prior to the fall quarter of their second year.

Online option

Next-generation technologies are transforming the workplace and creating new challenges for the entire graphic communications industry. The competitive and fast-changing nature of today's marketplace requires printing and publishing professionals who can react to market needs more quickly than ever before.

To assist students in preparing for these changes in the work place, the master of science degree is available online. For working professionals who cannot participate in a full-time program, RIT's online curriculum can be completed in two years (two courses per quarter). The courses are as rigorous as those taught on campus. Those with full-time jobs may wish to start with one course per quarter.

Course material is presented in many forms: Web resources, multimedia, video and audio lectures and demos, and one-on-one interaction with faculty via e-mail and chat conferences. The courses earn the same credit and are taught by the same faculty who teach the on-campus courses.

This degree program is oriented toward individuals in technical and management positions in the printing and publishing industry. Whether you aim to strengthen your resume or explore new career directions, this degree can help you achieve your goals.

Curriculum (Online Option)	Qtr. Cr. Hrs.
2081-767 Media Industry Analysis	4
2081-709 Trends in Print Technology	4
2081-711 Tone and Color Analysis	4
2081-721 Digital Printing and Publishing	4
2081-723 Contemporary Publishing	4
2081-728 Database Publishing	4
2081-742 Document Processing Languages	4
2081-740 Technology Practicum	2
2080-xxx Independent Study (Tech Practicum)	2
2081-840 Research Projects	4
Electives	12
Total	48

Laboratory facilities

Take one look around the School of Print Media and you'll see why RIT is known as the number-one graphic media school in the world. Students have full access to powerful tools for learning in our cutting-edge laboratory facilities. The campus is wired to provide instant access to information resources with more than 500 computer workstations dedicated for student use in the College of Imaging Arts and Sciences alone. Our print media labs include:

- **Prepress and Publishing Lab (PPL),** featuring 21 fully configured and networked dual-processor Macintosh G4 workstations, the latest graphics and imaging software, scanners, and a complete selection of output devices.
- **Design and Color Lab,** containing 21 fully configured and networked flat-screen "superdrive" Macintosh G4 computers loaded with the latest design, imaging, and multimedia software.
- **Advanced Publishing Lab,** containing 14 fully configured and networked Macintosh G4 computers loaded with cutting-edge graphics, imaging, and database publishing software.
- **Color Proofing Lab,** featuring the Kodak Approval digital color proofing system in addition to other state-of-the-art color proofing systems.
- **Desktop Scanning Lab,** a facility that reflects the growing range of image-capture tools available to professionals, including high-end flatbed and drum scanners.
- **Color Measurement Lab,** addressing the growing industry focus on managing color. This facility contains 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.
- **Web Offset Lab,** a lab that developed from a partnership development in 2001 with Heidelberg based on the donation of a world-class Sunday six-color commercial web offset press.

- **Print Science Laboratory,** a materials research and teaching laboratory housed in the Gannett Building and the Center for Integrated Manufacturing Studies facilities. The materials and process course series, among other print science courses, is conducted in this laboratory setting. The laboratory is also the activity center for materials research in the field of printing.
- **Integrated Printing Lab,** containing a Heidelberg Speed-master six-color press, a Komori perfecting press, a Quick-Master-DI press, and a Creo Trendsetter. For flexography, there is a Mark Andy multicolor web press.

School of Film and Animation

www.rit.edu/~sofa/

The School of Film and Animation offers the master of fine arts degree in imaging arts, with concentrations in computer animation, traditional animation, and narrative and documentary film.

Master of Fine Arts in Imaging Arts—Film, Video, Animation

Malcolm Spaull, Coordinator, MFA Program, Film and Animation (585) 475-7403, mgscdm@rit.edu

The master of fine arts program in film and animation emphasizes a broad interpretation of the moving image as an art form, with the intention of inspiring and nurturing the individuality of each student as a creative, productive person. The program encourages graduate study in filmmaking and animation as a means to personal aesthetic, intellectual, and career development.

The MFA curriculum provides a flexible pattern of study that is continually sensitive to the needs of each student, building upon the strengths that each individual brings to the program. A full range of courses in two-dimensional computer animation; three-dimensional computer animation; drawing for animation; stop motion animation; and documentary, experimental, and narrative film are available. Successful completion of the program enables a student to seek a career in film or animation production.

Program goals

1. Provide students with the opportunity to use animation, filmmaking, and other imaging arts as a means to pursue a career and earn a livelihood.
2. Provide students with the opportunity to use animation, filmmaking, and other imaging arts as a means to enrich their personal lives and society as a whole.
3. Provide a nurturing intellectual environment that encourages a sense of community, creativity, scholarship, and purpose.

Degree requirements

The MFA degree in imaging arts normally requires a minimum of two years of full-time course work as a resident graduate student and completion of a thesis film. A minimum of 90 quarter credit hours of graduate work is outlined below. The 90 hours do not include undergraduate work required by action of the MFA admission committee in accepting a particular applicant, nor do they include undergraduate prerequisites for graduate courses.

Computer and traditional animation

The computer animation concentration incorporates courses in two-dimensional and three-dimensional computer and camera animation.

The computer animation concentration consists primarily of courses in single-frame filmmaking, taught in the School of Film and Animation, and programming courses, offered by the computer science and information technology programs of the College of Computing and Information Sciences. Course work includes exercises and major projects in both two- and three-dimensional computer animation, as well as support courses in filmmaking technique and interactivity.

The computer animation degree encompasses 90 quarter credit hours of course work in the following areas of study:

1. Concentration (computer animation) designed to give depth of experience in the area of the student's primary interest. All students must complete required courses; other course work is selected from many flexible alternatives. (40 quarter credit hours)
2. History and aesthetics of film and related art forms (12 quarter credit hours)
3. Programming (8 quarter credit hours)
4. Electives (12 quarter credit hours)
5. Research Seminar, Graduate Seminar, and Research and Thesis (18 quarter credit hours)

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.

Film

The film concentration incorporates courses in film, video, and scriptwriting. Students produce fiction, documentary, and experimental films. The film degree encompasses 90 quarter credit hours of course work in the following areas of study:

1. Concentration (film) designed to give depth of experience in the area of the student's primary interest. All students must complete required courses; other course work is selected from many flexible alternatives. (40 quarter credit hours)
2. History and aesthetics of film and related art forms (20 quarter credit hours)
3. Electives (12 quarter credit hours)
4. Research Seminar, Graduate Seminar, and Research and Thesis (18 quarter credit hours)

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.

General Information

Electives

Elective courses are available in animation, film, video, multimedia, screenwriting, printmaking, painting, sculpture, communication design, museum studies, crafts, bookmaking, typography, color photography, new media, studio photography, advertising photography, perception, sensitometry, computer graphics, art history, and archival preservation and conservation. There are also opportunities for independent studies, internships, and concentrations.

The faculty

The MFA in imaging arts computer animation program is supported by a staff of 13 full-time faculty members with the School of Film and Animation and a variety of adjunct faculty members. Faculty and course work are also available from the School of Photographic Arts and Sciences, School of Print Media, School of Art, School of Design, School for American Crafts, and the College of Liberal Arts.

Admission requirements

Students with a baccalaureate degree or equivalent from an accredited college or university, or equivalent, are eligible for admission, provided they present a portfolio of work that demonstrates their skills, visual sophistication, and aesthetic awareness. Acceptance depends on the strength of portfolios as judged by the graduate faculty, past academic performance, letters of recommendation, and personal statements of purpose.

There are no examination requirements for admission to this MFA program. If applying with an undergraduate GPA of less than 3.0, however, the GRE or GMAT test is strongly recommended. 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 will make recommendations based on the above interlocking criteria.

Students who are evaluated to have MFA potential but need additional study in preparation for graduate courses will be advised to take such courses either prior to entrance or during their first year of study. The graduate faculty will make recommendations.

To apply for admission, students must submit an official transcript of their undergraduate degree(s), an acceptable portfolio (slides, videotape, CDs, etc.), a statement of purpose detailing why they want to attend graduate school and what they will bring to the program, and a minimum of two letters of reference. All correspondence concerning applications or catalogs should be addressed to the Office of Graduate Enrollment Services.

Transfer credit

Graduate-level course work taken prior to admission to the program should be submitted for approval upon entrance into the program. Up to 12 quarter credit hours (8 semester 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.

Portfolio

The portfolio, along with written records of accomplishment and recommendations, serves to inform the faculty of the applicant's imaging accomplishments. It provides a visual statement of the candidate's performance to date in terms of his or her skills, aesthetic development, and maturity.

Applicants are encouraged ta submit their best visual work in their portfolio, whether computer-generated or not. Photography, painting, film, animation, illustration, webpage design, and other forms of visual expression can be included. Do not send master tapes or originals of any work. Where possible, all digital files should be Mac-friendly. For CDs, the only type of movie files we can accept are QuickTime movie files. We strongly prefer all digital media to be Macintosh compatible. We will not accept slide carousel trays. Slides should be submitted in plastic sleeves.

Admission selection for the fall quarter in the imaging arts program is made in the spring from among all portfolios and completed applications received. Applications should be postmarked by February 15 to optimize the opportunity for fall admission. Portfolios and completed applications will be reviewed as they are received. Once the available slots are filled, qualified candidates will be placed on a waiting list, and any slots that open will be filled by the candidate at the top of the list.

With the submission of the student's work, a list detailing the contents of each tape should be included. The list should detail the title and length of the work, as well as the applicant's role in the production of the piece. Please include a table of contents on CDs and DVDs.

Slides should be submitted in sleeves, not in a carousel. Submit the portfolio with the application material to the Office of Graduate Enrollment Services.

Grades and time limit

The average of all grades for graduate credit taken at the university must be at least a "B" (3.0) to qualify for the MFA imaging arts degree. Thesis hours are usually taken over several quarters. Only the letter "R" is recorded, indicating a thesis in process. No letter grade is assigned. Acceptance or rejection of the thesis is made by the candidate's thesis board and the graduate faculty. All course work, including an accepted thesis, must be completed within seven years of entrance into the program.

Screenings
Screenings are required for all student-produced films and are coordinated through the professor or the thesis chair.

Thesis
The thesis project should be an original production appropriate to the major commitment of the degree candidate. A written report will be prepared for inclusion in the library. Specific directions 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. Graduates must also leave the school copies on videotape or CD of complete work and master's thesis projects.

Cultural influences
Rochester is a unique place for anyone seriously interested in a broad pursuit of studies in imaging arts. Fine-art imaging at RIT is keeping pace with some of the newer visual imaging methods through courses in computer graphics, interactive installations, virtual reality, computer animation, and webpage design. The Rochester area is enhanced by such outstanding resources as the George Eastman House International Museum of Photography and Film and the Visual Studies Workshop, and has historically been noted as a center for experimental film.

The MFA program in imaging arts computer animation is unique in that it is the only such program housed in a School of Film and Animation with full production facilities, as well as the additional support of highly specialized faculty in photography, imaging science, computer science and information technology, and printing.

School of Photographic Arts and Sciences

www.rit.edu/~661www/

Master of Fine Arts in Imaging Arts–Photography

Therese Mulligan, Ph. D., Coordinator,
MFA Program, Photography
(585) 475-2616, mtmpph@rit.edu

The master of fine arts program in imaging arts emphasizes a broad interpretation of photography as an art form, with the intention of inspiring and nurturing the individuality of each student as a creative, productive person. The program encourages graduate study in photography and related media as a means to personal, aesthetic, intellectual, and career development.

The MFA curriculum provides a flexible pattern of study that is continually sensitive to the needs of each student, building upon the strengths each individual brings to the program. Successful completion of the program enables a student to seek careers in education, museum or gallery work, or as a self-employed professional.

Photography concentration
This concentration provides students with the opportunity to pursue a rigorous course of study in photography and related media. It incorporates the study of practice, history, and criticism, from the beginnings of photography to present-day digital, moving image, experimental techniques, and aesthetics. Students engage in discursive studies, extensive research, and experimental learning in a content-rich environment. Parallel courses in art and related areas complement core classes.

Art electives
Elective courses are available in animation, video, multimedia, film, 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 and internships.

Program goals
1. Provide students with the opportunity to use the still and moving image as a means to pursue a professional career and earn a livelihood.
2. Provide students the opportunity to use the still and moving image as a means to enrich their personal lives and society as a whole.
3. Provide a nurturing intellectual environment that encourages a sense of community, creativity, scholarship, and purpose.

Faculty
Eleven full-time faculty members, all critically regarded for their artistic work in exhibition and publication, contribute to the MFA program. The faculty bring individual expertise and dedication to their work with graduate students, encouraging intellectual inquiry of contemporary art making practices and aesthetics. The MFA program is also supported by a staff of 40 full-time faculty members from the School of Photographic Arts and Sciences, School of Print Media, School of Art, and adjunct faculty members from George Eastman International Museum of Photography and Film, as well as noted regional, national, and international practitioners, critics, and historians.

Admission requirements
Students with a baccalaureate degree or equivalent from an accredited college or university are eligible for admission, provided they present a portfolio of work that demonstrates their skills, visual sophistication, and aesthetic awareness. Acceptance depends on the strength of portfolios as judged by the graduate faculty, past academic performance, letters of recommendation, and personal statements of purpose.

There are no examination requirements (e.g., GRE) for admission to this MFA program. Personal interviews are encouraged but not required. 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 recommended. Students who are evaluated to have MFA potential but require additional study in preparation for graduate courses will be advised to take necessary courses either prior to entrance or during their first year of study.

To apply for admission, students must submit an official transcript of their undergraduate degree, an acceptable portfolio, and a minimum of two letters of reference, as well as a statement of purpose detailing what attributes they bring to graduate study, including expectations and professional goals they wish to achieve. All correspondence concerning applications or catalogs should be addressed to the Office of Graduate Enrollment Services.

Transfer credit

Graduate-level course work taken prior to admission to the program should be submitted for approval upon entrance into the program. Up to 12 quarter credit hours (8 semester hours) of graduate work with a minimum grade of a "B" better is transferable toward the degree, with the approval of the graduate coordinator.

Portfolio

The portfolio, along with written records of accomplishment and recommendations, serves to inform the faculty of the applicant's accomplishments. It provides a visual statement of the applicant's performance to date in terms of his or her skills, aesthetic development, and maturity.

Applicants should send 20 images representing a cohesive body or bodies of recent work.

Admission selection for the fall quarter in the imaging arts program 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. Admission occurs only once a year.

Portfolio instructions

- Submit no more than 20 images.
- Submit 35mm slides, CD or DVD
- If submitting 35mm slides, place a red dot in the lower left corner of each slide mount. Label each slide with your name, title of work, date, size of work, and medium. If submitting CD or DVD size each digital file to no more than a maximum of 5 megabytes.
- Number images 1 to 20 in the order you wish them projected.
- Include a numbered page detailing slide, CD or DVD image information. Please include the title of the work, date, size, and medium. Include a self-addressed, stamped envelope for the return of your portfolio. We cannot return portfolios lacking sufficient postage or adequate packaging. We will retain the work of admitted applicants.
- Submit your portfolio with the application material to the Office of Graduate Enrollment Services.

Degree requirements

The MFA degree in imaging arts normally requires a minimum of two years of full-time resident graduate study. A minimum of 90 quarter credit hours of graduate work is outlined below. These minimums may be exceeded by intent or necessity to cover particular areas of study.

The 90 hours do not include undergraduate work required by action of the MFA admission committee in accepting a particular applicant or undergraduate course prerequisites for graduate courses.

The MFA degree encompasses 90 quarter credit hours of course work in the following areas of study:

1. Concentration designed to give depth of experience in the area of the student's primary interest. All students must complete required courses and other course work selected from many flexible alternatives. (40 quarter credit hours)
2. History and Aesthetics and History and Criticism of Imaging Arts and related media (1 5 quarter credit hours)
3. Electives *(19* quarter credit hours)
4. Research Seminar, Graduate Seminar, and Research and Thesis (16 quarter credit hours)

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.

Grades and time limit

The *average* of all grades for graduate credit taken at the university must be at least a "B" (3.0) to qualify for the MFA imaging arts degree. Thesis hours are usually taken over several quarters. Only the letter "R" is recorded, indicating a thesis in process. No letter grade is assigned. Acceptance or rejection of the thesis is made by the candidate's thesis committee and the graduate faculty. All course work, including an accepted thesis, must be completed within seven years of entrance into the program.

Thesis

The thesis exhibition/project should be an original body of work appropriate to the major commitment of the degree candidate. A written thesis 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."

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 one set of no less than 20 slides, CD, or DVD of thesis work completed for the master's degree.

Cultural influences

Rochester is a unique place for anyone seriously interested in a broad pursuit of photographic studies. Fine-art imaging at RIT is keeping pace with the latest visual imaging methods researched and practiced in larger metropolitan areas, in art institutions and in industry. The Rochester area is enhanced with outstanding intellectual and human resources. In addition to those located in the College of Imaging Arts and Sciences, there are resources to be found in two major cultural institutions heavily involved in photographic education and innovation: George Eastman House International Museum of Photography and Film and the Visual Studies Workshop.

The MFA program in imaging arts is unique in that it is the only such program housed in a School of Photographic Arts and Sciences with a support faculty of 40 highly specialized and diverse instructors. The program is designed to reflect this diversity in curriculum and programming.

SPAS Gallery

The SPAS Gallery supports the exhibition of graduate thesis work, student work, and the works of contemporary imagemakers. It maintains an academic year calendar of exhibitions, public lectures, and receptions. Importantly, it also provides real world experience for interested graduate students to learn first hand about gallery operations, installation, and communication.

Graduate Faculty

School of Art

Donald Arday, BFA, Cleveland Institute of Art; MFA, Syracuse University—Administrative Chair, School of Art; Associate Professor

Bob Cole, BA, MS, University of Maryland—Professor

Robert Dorsey, BFA, Rochester Institute of Technology; MFA, Syracuse University—Associate Professor

William Finewood, BA, State University of New York at Geneseo; MFA, Syracuse University—Associate Professor

Robert Heischman, BFA, Miami University; UCFA, Ruskin School of Art—Professor

Glen R. Hintz, BA, Lafayette College; MS, The Medical College of Georgia—Associate Professor

Keith Howard, Painting Diploma, National Art School, Australia; MA, New York University—Associate Professor

Thomas R. Lightfoot, BA, BFA, University of Connecticut; MFA, Institute Allend; MA, Ed.D., Columbia University Teachers College—Associate Professor

James Perkins, BA, Cornell University; ABD, University of Rochester; MFA, Rochester Institute of Technology—Associate Professor

Luvon Sheppard, BFA, MST, Rochester Institute of Technology—Professor

Alan D. Singer, BFA, Cooper Union; MFA, Cornell University—Professor

Carole Woodlock, BFA, Alberta College of Art; MFA, Concordia University—Associate Professor; MST Program Coordinator, Art Education

School of Design

Deborah Beardslee, BFA, Syracuse University; MFA, Virginia Commonwealth University—Associate Professor; MFA Program Coordinator, Graphic Design

Alex Bitterman, BS, M. Arch, State University of New York at Buffalo—Assistant Professor, Industrial Design

Peter Byme, BFA, Alberta College of Art and Design; MFA, York University—Associate Professor; Program Chair, Graphic Design

Nancy A. Ciolek, BFA, MFA, Indiana State University—Associate Professor

Daniel DeLuna, BFA, Ball State University; MFA, Pratt Institute—Assistant Professor, Computer Graphics Design

Chris B. Jackson, BFA, Alfred University; MFA, Rochester Institute of Technology—Associate Professor, Computer Graphics Design

C. Bill Klingensmith, BFA, Youngstown State University; MFA, University of North Carolina—Assistant Professor

Heinz Klinkon, BFA, MFA, Rochester Institute of Technology—Associate Professor, Graphic Design

Patti J. Lachance, BFA, Herron School of Art at Indiana and Purdue Universities at Indianapolis; MFA, Rochester Institute of Technology—Associate Professor; Administrative Chairperson, School of Design

Bruce I. Meader, BFA, MFA, Carnegie Mellon University—Associate Professor

David Morgan, BFA, Brigham Young University; MID, Rhode Island School of Design—Assistant Professor; MFA Program Coordinator, Graduate Industrial Design

Marianne O'Loughlin, BA, **St.** Bonaventure University; BFA, MFA, Rochester Institute of Technology—Associate Professor; Program Chair, New Media Design and Imaging

R. Roger Remington, BFA, Rochester Institute of Technology; MS, University of Wisconsin—Professor, Graphic Design

Marla Schweppe, BA, University of Kansas; MA, Ohio State University—Professor; Director of Visualization; MFA Program Coordinator, Computer Graphics Design

School for American Crafts

Andy Buck, BA, Virginia Commonwealth University; MFA, Rhode Island School of Design — Associate Professor, Wood

Juan Carlos Caballero-Perez, BFA, MFA, Rochester Institute of Technology — Assistant Professor, Metals

Robin Cass, BFA, Rhode Island School of Design; MFA, State University of New York at Alfred — Assistant Professor, Glass

Wendell Castle, BFA, MFA, University of Kansas — Professor Artist-in-Residence, Chair in Contemporary Crafts

Julia Galloway, BFA, New York State College of Ceramics; MFA, University of Colorado — Associate Professor; Chair, School for American Crafts

Richard Hirsch, BS, State University of New York at New Paltz; MFA, Rochester Institute of Technology — Professor, Ceramics

Albert Paley, BFA, MFA, Tyler School of Art, 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 Tánnen, BS, Cornell University; Cert. of Mastery, Boston University — Professor, Wood

Leonard A. Urso, BFA, MFA, State University of New York at New Paltz — Professor, Metals

School of Film and Animation

Cat Ashworth, MA, State University of New York at Buffalo — Associate Professor

Carl (Skip) Battaglia, BA, Boston College; MS, Syracuse University — Professor

Jack Beck, BA, Denison University; MFA, University of Iowa — Associate Professor

Johannes Bockwoldt, MA, Temple University — Visiting Assistant Professor

Adrianne Carageorge, MFA, Ohio University — Associate Processor

Tereza Flaxman, BFA, University of Oregon; MFA, School of Visual Arts — Visiting Assistant Professor

Stephanie Maxwell, BA, University of California at Los Angeles; MFA, San Francisco Art Institute — Professor

Howard Lester, BA, Cornell University; MFA, University of California at Los Angeles — Professor; Administrative Chair, School of Film and Animation

Naomi Orwin, MA, Institute of Transpersonal Psychology; BA, University of Chicago — Assistant Professor

Duane Palyka, BA, BFA, Carnegie Mellon University; MFA, University of Utah — Associate Professor

Johnny Robinson, BFA, MFA, Syracuse University — Assistant Professor

Arnie Sirlin, BA, University of Maryland — Assistant Professor

Malcolm Spaull, BS, St. Lawrence University; MFA, Rochester Institute of Technology — Professor; MFA Coordinator

School of Photographic Arts and Sciences

Imaging Arts Photography Concentration

Patti Ambrogi, MFA, Visual Studies Workshop — Associate Professor

Myra Greene, BFA, Washington University; MFA, University of New Mexico — Assistant Professor

Angela M. Kelly, MA, Columbia College — Associate Professor

Susan Lakin, BFA, Art Center of Design; MFA, University of California — Associate Professor

Dan Larkin, BFA, Rochester Institute of Technology; MFA, Bard College — Assistant Professor

Therese Magan, BA, University of Missouri; MA, Michigan State University; Ph.D., University of New Mexico — Professor; Graduate Program Coordinator

Elaine O'Neil, BFA, Philadelphia College of Art; MS, Illinois Institute of Technology — Professor

Willie Osterman, MFA, University of Oregon — Professor

Elliott Rubenstein, MFA, State University of New York at Buffalo; MA, St. John's University — Professor

Ken White, BA, Princeton University; MA, MFA, University of New Mexico — Associate Professor

Jeff Weiss, BS, University of Michigan — Associate Professor

School of Print Media

Barbara Birkett, BA, Aquinas College; MBA, Rochester Institute of Technology; CPA, Maryland — Associate Processor, Print Media Management

Robert Y. Chung, BS, Eastern Washington State University; MS, Rochester Institute of Technology — Professor, Color Management

Twyla Cummings, BS, MS, Wright State University; Ph.D., Union Institute and University — Associate Professor, Print Media Management; Graduate Program Chair

Mary Anne Evans, University of London; Ph.D., University of Birmingham, UK — Assistant Professor

Franziska Frey, Ph.D., Swiss Federal Institute of Technology — Associate Professor, Materials and Digital Imaging

Michael Kleper, MS, Rochester Institute of Technology — Paul and Louise Miller Professor

C.R. Myers, MS, Rochester Institute of Technology — Assistant Professor, Electronic Prepress

David Pankow, MLS, Columbia University — Professor; Curator, Melbert B. Cary Jr. Graphics Art Collection

Michael Riordan, MS, Rochester Institute of Technology — Assistant Professor, Color Image Processing Systems

Frank J. Romano, BA, City University of New York — Roger K. Fawcett Professor, Electronic Publishing

Patricia Russotti, BS, Empire State College; MS, Ed.S.,Indiana University — AssociateProfessor, Pre-press Imaging

Franz Sigg, BS, MS, Rochester Institute of Technology — Research Associate, Test Targets

Patricia Sorce, BA, Kent State University; MS, Ph,D., University of Massachusetts — Associate Professor, Administrative Chair; Print Media Management

Mark Watts, BFA, MS, Rochester Institute of Technology — Assistant Professor, Electronic Imaging

Scott Williams, BA, Purdue University; Ph.D., Montana State University — Associate Professor

Interdisciplinary Studies

2001-721 **3-DCG Modeling**

This course covers a contrast and comparison of various methods of creating geometry for use in three-dimensional environments including polygons, NURBS and subdivision surfaces for various purposes. Skills learned can be applied to creating elements for computer and video games, creating virtual environments or in visualization. Students have the opportunity to work on projects of their own invention or with real world application. **credit 4 (F, S)**

2001-722 **Interactive 3-DCG Animation**

This course covers first the use of animation in interactive environment including games, visualization, and virtual reality. Students will create animation using key frames, paths, deformation, forward, and inverse kinematics. **Credit 4 (W)**

2001-723 **The College Teacher**

This course is for students at the graduate level who are thinking about entering teaching at the college level. Students will learn about the teacher's role and responsibilities within the college structure. They will learn course development, course presentation, and course evaluation. They will have the chance to develop and present instruction. **Credit 3**

2001-731 **3-DCG Lighting**

Students apply standard lighting methods to lighting three-dimensional models. The interaction of light and pigment, use of light in painting, photography, film, and computer graphics are used as examples. Students apply problem solving techniques to arrive at a lighting solution for various problems. (2001-721) **Credit 4 (F)**

2001-732 **3-DCG Shading**

The course focuses on incorporating two- and three-dimensional groups of textures into realistic materials. Students learn to use texture maps instead of detail in models to increase interaction speeds. Textures are also used in order to incorporate simple models into diverse scenes. Displacement textures are used to create detail in models. Advanced techniques in the use of shading networks are incorporated into the process. (2001-721) **Credit 4** (W)

2001-743 **3-DCG Character Design**

This course covers first the design of characters and then the creation of them using three-dimensional sohare, inverse kinematics, and deformers. Students create interpretant matrices, model sheets, sketches, and maquettes of characters followed by development of the character in software. (2001-721) **Credit 4 (S)**

2001-747 **3-DCG Rendering Output Prototype**

This course covers a contrast and comparison of various methods and resolutions of rendering and outputting information from three-dimensional software. (2001-721, 2001-722) **Credit 4 (W)**

2001-778 **3-DCG Production Pipeline**

The course focuses on implementing a project from the planning stage, through implementation, to completion, and presentation. (2001-721, plus at least one other 3-DCG course) **Credit 4 (S)**

Graduate Study

2037-785 **Forms of Inquiry**

The exploration and organization of forms of inquiry is required for all MFA students. It aims to expose students to a broad range of critical issues related to the conception and production of art, to inspire and provoke critical reflection, and facilitate the development of a preliminary thesis topic. Presentations, discussions, and written assignments will examine concerns as they relate to contemporary art, crafts, and design. **Credit 2 (offered each year)**

2037-790 **Graduate Forum**

Graduate Forum is a course designed to expose students to a broad range of issues related to the conception and production of art. Presentations and discussions will deal with current approaches to aesthetics, criticism, creativity, and perception through the work of contemporary artists and craftspeople. Weekly presentations will be given on specific issues relevant to contemporary practice. In addition, visiting faculty will participate in studio discussions, activities, and critiques. The goal of this course is to place you in a position of awareness related to contemporary practice, the world that you are going to occupy, and the cultural models that influence your beliefs. **Credit 3**

School of Art

Art Education

2011-701 **Methods and Materials I**

The course will explore the process of teaching art in the public/private school classroom and focus on specific information and theories relevant to the teaching of visual art. Students will be encouraged to explore highly structured as well as highly experimental approaches to teaching art. Projects will include lesson planning, unit planning, investigating new technologies, urban education, action research, and other relevant topics, such as: human development, students with disabilities, multiple intelligences, assessment processes, and personal inquiry as reflective practice. (2011-701, course is restricted to art education majors) **Credit 5**

2011-702 **Methods and Materials II**

This course is a continuation of 2011-701. In this course students will further explore the process of teaching art in the public/private school classroom and focus on specific information and theories relevant to the teaching of visual art with the specific goals defining a teaching methodology that meets State and National Standards. Students will be encouraged to explore highly structured as well as highly experimental approaches to teaching art. Projects will include lesson-planning, unit planning, investigating new technologies, urban education, action research, and other relevant topics, such as: human development, students with disabilities, multiple intelligences, assessment processes, and personal inquiry as reflective practice. (2011-701, Course is restricted to art education graduate majors) **Credit 5**

2011-820 **Seminar in Art Education**

This course supports the student who is currently student teaching. In this course students will explore the day-to-day issues they experience in their student teachng experiences. The focus will be on making connections with theory, state and national standards, and reflecting on student experience to address overall goals of the program. Students focus on the following areas to meet NYSED requirements: content/subject matter knowledge, pedagogical knowledge, teaching skills, curriculum development, assessment, and professional skills. The development of a teaching portfolio occurs in conjunction with a culminating project. On-line technology is utilized in addition to slide lectures, videotapes, and other forms of media. **Credit 3**

2011-860 **Practice Teaching**

The student teaching experience is the single most important activity of the M.S.T. program. It is designed to provide the student with experiences and challenges which will help them to further develop into the art teachers they are becoming. Two student teaching placements are arranged for each student for the duration of seven weeks each. Students are assigned a cooperating teacher and a college supervisor for each setting. A student teaching handbook is provided. (Restricted to art education graduate students) **Credit 9**

Illustration

2019-711 **Digital Illustration I Graduate**

Digital Illustration I will introduce grad students to the principles of visualization used to create digital illustrations. Students will apply their ability to conceptualize effective solutions to digital illustration renderings. The course curriculum and assignments encourage a high level of creative conceptual development, with theory and practice in the use of digital techniques. The goal is to advance conceptual problem-solving methodology and the language of visualization for professional illustration production. Color systems, digital terminology, and pre-press file formats will be covered. **Credit 3 (F, W, S)**

2019-723 **Digital Editorial I Graduate**

Digital Editorial I will introduce graduate students to editorial illustration. Importance will be placed on interpretation of editorial subject matter and preparation of digital imagery for print reproduction. Students will apply approaches to creative illustration while creatively interpreting editorial text. Students may use vector and 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. **Credit 3 (F)**

2019-733 **Illustration Portfolio Preparation Graduate**
Portfolio Preparation is the final preparatory course for visual artists. Its purpose is to provide students with information, strategies, and guided instruction to organize and create their final portfolio. The course will include individual critique and analysis of work created in prior studio classes and progress to the definition of a career agenda. Projects will be individually assigned based on the quality of each student's body of work and their career intentions. Presentation methods, formatting, and stylization will also be addressed. The final culminating projects will be finished hard copy and digital portfolios. In addition to the portfolio document, students will be instructed in job seeking strategies including interviewing dynamics, resume writing, and correspondence. **Credit 3 (S)**

2019-742 **Digital Narrative II Graduate**
Digital Illustration Narrative III expands upon the translation of verbal concepts to pictorial narrative introduced in Digital Illustration Narrative I. Particular emphasis will be placed on illustration sequences including story-line illustration, and thematic series pictorials. Importance will be placed on the digital representation of narrative story telling with reference to style, content, and interpretation. Assignments will involve vector and raster-based sohare applications and a variety of input and output devices. Conceptual strategies, production methodologies, narrative composition, and color systems will also be covered. **credit 3 (W)**

2019-761, 762, 763, 764 **Illustration Graduate Elective**
Individual drawing projects related to graduate students' major area of study Opportunity to refine drawing skills on the graduate level. Elective offerings are Adobe PhotoShop, Personal Focus, and Figure in Motion. **Credit 3/Qtr.**

Medical Illustration

2020-710 **Anatomic Illustration-Mixed Media**
Students will learn to use raster painting sohare to modify scanned artwork and create new images from scratch. Students will also use page layout applications to combine digital images with text and other graphic elements. Coursework emphasizes creation of illustrations to support medical education, for advertising, and to editorialize health and medical concepts. **Credit 3**

2020-731 **Human Gross Anatomy I**
A two-quarter sequence devoted to the study of the human body Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. In the fall quarter, dissection focuses on the muscles of the torso, the contents of the thorax and abdomen, and the upper limb. **Credit 4**

2020-732 **Human Gross Anatomy II**
The second half of a two-quarter sequence devoted to the study of the human body Detailed dissection of a human cadaver is supplemented with lectures on the structure and function of the major organ systems. This quarter begins with a detailed dissection of the head and neck and moves on to the pelvis, perineum, and lower limb. (2020-731) **Credit 4**

2020-767 **Molecular Illustration**
Accurate representations of molecular structures are essential to illustrate recent advances in biotechnology, medical genetics, and pharmacology. This course provides a basic overview of molecular biology and introduces the principles of molecular illustration. Students will locate three-dimensional molecular model files on the Internet and manipulate these models to create two-, three-dimensional and animated representations of molecules and biochemical processes. **Credit 3**

2020-781 **Medical Illustration Topics I**
This is an introductory course; designed to acquaint the illustration student with art techniques commonly used in medical illustration and with the medical library and audio-visual television supporting milieu in which the medical illustrator works. **Credit 3**

2020-782 **Medical Illustration Graphics**
A course emphasizing the use of computer sohare and hardware as a resource for generating titles, charts and graphs, schematics, and illustrations as vehicles to meeting instructional and communicative needs. Students will learn the various techniques available and will apply those techniques while designing pamphlets, in-house publications, and poster exhibits. **Credit 3**

2020-783 **Anatomical Studies**
Sketches drawn from human dissection are translated into instructional illustrations using watercolor wash, pen, and ink. Emphasis will be on rapid but accurate sketching and observation in the laboratory, with a representation of form and structure in living tissue for publication. **Credit 3**

2020-784 **Medical Illustration Topics II**
A continuation of Anatomical Studies with students translating sketches drawn from human dissection into full-color instructional illustrations. Techniques studied include watercolor, color pencil, airbrush, and mixed media. Emphasis will be on rapid but accurate sketches leading to the description of living tissue for the preparation of surgical illustration. **Credit 3**

2020-785 **Surgical Procedures I**
The application of creating instructional aids designed to increase learner understanding of surgical procedures and concepts. Sketches are to be drawn while observing the surgery, consulting with the surgeon for accuracy of detail and development. The final preparation of the artwork will match its intended use (e.g., publication, slide graphic, computer graphic, etc.). **Credit 3**

2020-786 **Surgical Procedures II**
A continuation of the concepts begun in 2020-785; specifically, combining anatomical knowledge with surgical observation to construct a concise and accurate surgical series. Students will concentrate on communicating essential surgical concepts to a specific audience, as well as ensuring that their artwork will meet the demands of reproduction. **credit 3**

2020-890 **Research and Thesis-Medical Illustration**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. (Approval required) **Credit 3–14 (offered every quarter)**

Fine Arts Studio

2021-710 **Introduction to Painting: Acrylic Graduate Elective**
A course in the basic materials and processes of acrylic painting. Students will explore the expressive and stylistic possibilities of the medium. Subjects will include various interpretations of still life and model as well as individual projects. Discussion of work will focus on form, composition, and color. **Credit 3**

2021-711 **Introduction to Painting: Oils Graduate Elective**
This course introduces students to oil painting. Along with learning about the properties and techniques of this medium, students will be encouraged to experiment and seek solutions to problems of composition and structure in painting. Preparatory sketches and studies will be encouraged for the production of finished works. Lectures, demonstrations, examples, and slide talks will compliment the growth gained through the students' creation of a variety of paintings from both observation and imagination. **Credit 3**

2021-712 **Introduction to Painting: Figure Graduate Elective**
The fundamentals of representational figure painting in oils or acrylics using traditional materials and process. Color-mixing and painting application techniques related to depicting the figure and its immediate environment will be explored. Observational study of form, space, and quality of light will be stressed. **Credit 3**

2021-721 **Watercolor: Graduate Elective**
Use and control of the technique of water color painting. Exploring watercolor as an illustrative and painting media. **Credit 3**

2021-722 **Contemporary Drawing Graduate Elective**
Emphasis is on drawing and the development of form, space and expression from a variety of sources, including the human figure. Emphasis on basic techniques, materials, and concepts for further study are explored. **Credit 3**

2021-730 **Introduction to Printmaking: Etching Graduate Elective**
Conceptual and technical assignments introduce the basic techniques in etching focusing on line, value, and texture. An investigation of line using the following techniques: line etch, litho crayon, open bite, scraping, and burnishing. Personal expression will be encouraged through variations in the use of line, value, and texture. **Credit 3**

2021-731 **Introduction to Printmaking: Lithography Graduate Elective**
Conceptual and technical assignments that introduce the basic techniques in lithography focusing on line, value, and texture. An investigation of form relationships using the techniques of etching on litho-plates and stones; using pencils, crayons, inks, and transfer imagery to create and encourage personal expression. **Credit 3**

2021-733 **Introduction to Printmaking: Non-toxic Graduate Elective**
The student will explore of a wide range of non-toxic printmaking processes and techniques. In the mastery and application of these processes and techniques the student will achieve personal aesthetic goals. **Credit 3**

2021-741 **Non-toxic Intaglio Printmaking I**
The first of three graduate level non-toxic intaglio courses. The aim of this introductory level is to gain a technical understanding of basic Intaglio-Type and non-toxic alternative techniques for hand etching copper plates. Aspects of health and safety as applied to the intaglio studio along with working methodology will also be explored. (Matriculation into GCNIP) **Credit 4**

2021-742 **Non-toxic Intaglio Printmaking II**
The second of three graduate level non-toxic intaglio courses. The aim of this second level is to gain a technical understanding of Intaglio-Type etch techniques and gain a greater understanding of non toxic alternative techniques for hand etching. Introduction of computer generated methods of making halftones. To learn about the Edinburgh Etch. (2021-741 *or* portfolio review) **Credit 4**

2021-743 **Non-toxic Intaglio Printmaking III**
The last course in a series of three graduate level non-toxic intaglio courses. The aim of this third-level is to gain an advanced technical understanding of Intaglio-Type etch techniques and to either; 1) learn how to make high quality photographic halftones, *2)* learn more advanced hand etching techniques. (2021-741/742) **Credit 4**

2021-761 **Fine Arts Studio Graduate Elective**
Traditional sculptural concepts will evolve through a variety of processes and materials—predominately clay, plaster, cement, stone, paper, and metal. The human figure is presented as a subject for study and for use as a springboard to invention. Credit 3/Qtr.

2021-769 ***Art*** **Gallery Management**
The complex social and cultural role of a fine arts gallery will be explored through supportive gallery operations: the installation of experimental and traditional exhibits, promotion, and marketing for competitions, students initiatives, and special events tailored to the RIT and community art audiences. (Metro site presentations and research plus arranged studio hours in a laboratory: gallery setting.) **Credit *3***

2021-775 **Sculpture Assemblage Graduate Elective**
One of the most basic approaches to creating Sculpture, this course involves assembling or bringing together parts/pieces to form a whole. Spontaneous and immediate contact with unique materials, creative processes, and the degree of sculptural impact may all be characterized as extremely direct. This straightforward confrontation offers no flashy techniques, seductive material or process to hide behind. Instead, at the onset, basic sculptural manipulation must occur. **Credit 3**

2021-776 **Sculpture: Figure Graduate Elective**
This sculpture course investigates the study of human form through the development of sculpted clay figures working directly from living models. Emphasis is placed on exploring the following sculptural elements: the underlying 3-dimensional structure of the human figure; proportions of the human figure; volume, mass and surface anatomy; gesture; support and balance; figurative spatial relationships; expressive qualities of human form; use and control of basic material; and processes related to figure sculpture. **Credit 3**

2021-780, 781, 782 **Fine Arts Studio Graduate I**
Fine Arts Studio: enter into a critical discourse and examination of ideas and relationships in the fine arts. Critiques, guest artists, lectures, and discussion along with studio production. Painting: develop painting skill in oil, acrylic, watercolor, drawing through individual studio investigation under the direction of fine art faculty. Sculpture: sculpture concepts are explored through a variety of processes and materials, including clay, plaster, cement, stone, wood, and metal. These concepts reveal themselves through separate sections devoted to the. human figure, installation, public art, or other contemporary manifestations of sculpture. Printmaking: non toxic printmaking techniques and processes are the means for students to develop along independent lines and directions for contemporary fine art printmaking. All areas: **Credit 3/Qtr.**

2021-730, 791, 792 **Fine Arts Studio Graduate II**
Fine Arts Studio: enter into a critical discourse and examination of ideas and relationships in the fine arts. Critiques, guest artists, lectures, and discussion along with studio production. Painting: develop painting skills in oil, acrylic, watercolor, drawing through individual studio investigation under the direction of fine art faculty. Sculpture: sculpture concepts are explored through a variety of processes and materials, including clay, plaster, cement, stone, wood, and metal. These concepts reveal themselves through separate sections devoted to the human figure, installation, public art, or other contemporary manifestations of sculpture. Printmaking: non toxic printmaking techniques and processes are the means for students to develop along independent lines and directions for contemporary fine art printmaking. All areas: **Credit 3/Qtr**

2021-797 **Art Gallery Practicum**
Operating an art gallery serving a metropolitan community provides small business opportunities in research, marketing, and management. Students will learn how to attract sponsorships, manage a gallery website, supervise office assistants, prepare guidelines for the office staff manual, as well as plan and promote a full calendar year of exhibitions and special events. This course provides each student with actual business responsibilities found in any successful art gallery setting. **Credit 4**

2021-890 **Research and Thesis: Fine Arts Studio**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. **Credit 3-14 (offered every quarter)**

School of Design

Graphic Design

2010-711 **Design Theory and Methods Seminar**
Graduate students in graphic design, computer graphics design, and industrial design will participate in this seminar to explore many 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. **Credit 3**

2010-712 **Graduate Typographic Design**
This course investigates typographic hierarchy- the use of typographic variables to differentiate parts of a message with attention to communication and readability. Typographic grid structure, typographic detail, and formal aspects of typographic design are explored. Project focus is on the process of developing harmonious type and image integration into a cohesive, sequential design application. **Credit 4**

2010-713 **Design History Seminar**
Graduate students in graphic design, computer graphics design and industrial design will be provided with a basis in the history of design which complements the overall graduate core in the School of Design as well as specific coursework in each major field of design study. In a seminar format, the students realize the course objectives through participatory means. 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, places), critical thinking, and contextual historical issues. Students are expected to write critical essays and questions and to participate in weekly discussion groups. **Credit 3**

2010-716 **Image Forms**
This introductory course investigates formal visual aesthetics related to graphic design problem solving. Emphasis is on the process of image analysis, ideation, and synthesis. Applied use of imagery focuses upon clear message making and audience understanding. Image generating tools range from traditional to electronic media as appropriate for specific projects. Projects related to form analysis and articulation are the primary focus of this course. **Credit 4**

2010-717 **Graduate Systems Design**
This course investigates various approaches toward visually and conceptually organizing components of graphic design problems (i.e. language, typography, imagery, color, space, etc.) for the purpose of clear, unified communication. Projects may include the creation of multiple components within a common framework. An emphasis is placed on identifying connections and integrating content between this course and prior design courses taken in the MFA major. **Credit 4**

2010-718 **Graduate Information Design**
This course stresses the importance of reader and user responses to written and visually presented information. Projects stress clarity and accessibility while investigating a variety of formats (i.e. charts, diagrams, business forms, tables, maps, instructional materials, way-finding systems, graphic user interfaces). Advanced typographic and systems design decision making are required activities in this course. **Credit 4**

2010-722 **Graduate Graphic Design Applications**
This course is tailored to the needs of the first-year students enrolled and may include formal aesthetic principles in systematically solving applied problems on thematic, content intensive topics. Actual design assignments can include both digital and/or print applications. Emphasis is placed on the relationship between form and communication. Projects are defined and structured based on specific selected opportunities. **Credit 4**

2010-724 **Graduate Graphic Design Topics**
This course is tailored to the specific needs of the second-year students enrolled. Potential topics may include: design planning, human factors, interface design, writing and design, business practices, etc. This course involves research, processes, and design applications relevant to the selected course topic. **Credit 4**

2010-726 **Design Issues Seminar**
This graduate course experience exposes first-year graduate students majoring in graphic design, computer graphics design, and industrial design within the School of Design to the range of contemporary issues that face their design professions. Topics will include, but not be limited to, issues related to human factors, accessibility, green design, ethical decision-making, audience appropriateness, educating the public about design, the democratization of design, and the role of the designer in society. Selected readings from current periodicals, critical writing, group dialogue, presentations, and guest lectures will be integrated into the course as appropriate. **Credit 3**

2010-861 **Graphic Design Thesis Planning**
This is the first in the sequence of courses focused on the initiation of the MFA thesis project. Students are exposed to strategies to establish project content, playing and scheduling, and research. The product of the course is a fully articulated thesis plan. **Credit 4**

2010-862 **Graphic Design Thesis Development**
This is the second in a sequence of courses focused on the thesis project. Students are exposed to strategies appropriate to the continuation of project content, research, concept development, ideation, and in-process evaluation planning. **Credit 4**

2010-863 **Graphic Design Thesis Implementation**
This is the final course in a sequence of courses focused on the thesis project. Students are exposed to strategies appropriate to the implementation and retrospective evaluation of an intensive design problem. Verbal/written articulation of their design process and the required public exhibition are a focus of this course. **Credit 4**

Computer Graphics Design

2014-701 **Survey of Computer Graphics**
The computer graphics profession is constantly progressing. This course will provide a conceptual framework to designing and implementing multimedia applications, game art and design, instructional multimedia, visualization, interactive animation, and Web page design. Students research ideas, concepts, uses, history, aesthetics, and design principies of computer graphics and interactive media as it relates to the ever-evolving field. The content integrates visual semiotics, information architecture, user interface guidelines, and icon design. Students will complete assigned projects and readings. (Computer graphics design major or permission of instructor) **Credit 4**

2014-711 **Digital Video**
Use of digital video cameras, lights and microphones for motion recording and the use of storyboarding, titling, editing, and software to create and format digital Quick Time movies of DVDs for multimedia productions or motion graphics. (Computer graphics design major or permission of instructor) **Credit 4**

2014-713 **Design Research**
This course will focus primarily on developing students' research skills and exposing them to a range of writing techniques. Emphasis will be placed on an exposure to a wide range of research resources including the more traditional library vehicles, newer developments on the World Wide Web, and relevant archives and special collections. This course will begin to establish each student's thesis direction in very general terms by including the development of a preliminary thesis proposal and establishing an overview of research directions. (Graduate students in JADG, JADU or JADC programs) **Credit 3**

2014-717 **Authoring Multimedia**
Exposure to computer graphic algorithms, design heuristics, design methodology, and program structure of two-dimensional imagery for multimedia design. Projects involve programming in an authoring language. (Computer graphics design major or permission of instructor) **Credit 4**

2014-718 **QTVR and Multimedia Design**
This course is intended to provide a foundation to QTVR (QuickTime Virtual Reality) concepts. Previous multimedia experience and skills will be extended to emphasize multimedia applications that use QTVR as a design tool to interactively explore three-dimensional virtual environments. Attention will be given not only to the mechanics of creating the movies, but also to the design, relationship to other visual elements, and visual communication effectiveness of the movies. (Computer graphics design major or permission of instructor) **Credit 4**

2014-723 **Graphical User Interface**
This course provides an in-depth look at graphical user interface design. Students learn the basic components of a user interface and how to design alternative navigational solutions. (Computer graphics design major or permission of instructor) **Credit 4**

2014-782 **3-D Computer Graphics Design**
This course is an introduction to desktop three-dimensional visualization. It also expands on previous visualization skills and design experiences to include fundamentals for more advanced studies in three-dimensional animation, virtual spaces, and multi-dimensional navigation spaces. (Computer graphics design or permission of instructor) **Credit 4**

2014784 **Digital Typography in Motion**
A study of digital typography and, in particular, digital type in motion as used in interactive applications and motion graphics. (2014-796 or permission of instructor) **Credit 4**

2014-785 **Instructional Multimedia**
Interactive and other software packages will be used to create instructional programs for different age groups. Course work will include subject matter research, developing objectives, creating graphics, sound and interactivity, and program evaluation. Each student will produce an instructional multimedia program. (Computer graphics design major or permission of instructor) **Credit 4**

2014-786 **2-D Computer Animation**
This course will include two-dimensional computer animation techniques, linear and non-linear, and interactive storytelling methods, narrative design, character design and animation, digital sound, and both frame-based and scripting animation methods. These techniques will be used to create interactive, web, and multimedia presentations with animation. (First year computer graphics design major or permission of instructor) **Credit 4**

2014-787 **Advanced Computer Graphics Design I**
This course extends previous multimedia experience and skills to emphasize advanced multimedia applications that use gaming concepts, delivery systems, and software as a design tool for entertaining and informing. Students will work with two-, three-dimensional visual concepts, virtual reality, interactivity, and sound to develop games of their own. (Computer graphics design major or permission of instructor) **Credit 4**

2014-791 **Advanced Computer Graphics Design II**
This course provides the opportunity to expose students to the latest concepts, techniques, and skills in a quickly evolving technological and information oriented society. This course is open ended so that new information, techniques concepts, principles, sohare, and hardware can be introduced in a timely manner. (Computer graphics design major or permission of instructor) **Credit 3**

2014-792 **Vector-based Multimedia Design**
This course extends previous multimedia experience and skills to emphasize advanced multimedia applications that use vector-based concepts as a design tool for creating animation and interactive authoring while maintaining small file sizes. (Computer graphics design major or permission of instructor) **Credit 4**

2014-796 **Special Effects**
Exposure to the development of special effects of Quick Time movies. Computer software and storyboarding are used to create special effects in both animation and live video. Sequencing, storyboarding, digital sounds, titling, animation, video clips, and special effects are integrated. (Computer graphics design major or permission of instructor) **Credit 4**

2014-797 **Advanced Computer Graphics Design III**
This course provides an in-depth look at creating an effective electronic portfolio. Students create, organize and design a portfolio based upon personal strengths and interests, with professional standards, and career expectations in mind. (Computer graphics design major or permission of instructor) **Credit 4**

2014-831 **Thesis Planning**
This course helps the student to research and develop a thesis related to a design problem. A thesis statement, review of the literature, construction of a timeline, and application of organizational skills are integrated into this course. Revision and refinement of the proposal are based on critique and feedback. This course is required before development of a final thesis project. (Required for second year computer graphics design majors) **Credit 2**

2014-890 **Thesis: Computer Graphics Design**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a project report and participation in a graduate thesis show. (Computer graphic design majors only) **Credit 0-14**

Industrial Design

2035-706 **Design Collaborative Graduate**
Advanced product development involving teamwork and collaboration with an industry design group providing technical information, marketing concerns, and outside review of work. **Credit 3**

2035-700 **Furniture Design Graduate**
Experience in the design of furniture for a defined sector of the contract market is acquired through a project exercise involving industry collaboration. **Credit 3**

2035-711 **Advanced Computer Modeling I**
The first of three required graduate-level electronic media courses. The emphasis in this beginning level (Level 1) modeling course is learning sohare tools competency through assigned exercises and creative projects. The objective is student understanding of the nature, location, and use of all tools commonly available at the professional level for electronic surface modeling in degree three and higher B-spline curves and surfaces. Learning simple effect-of motion techniques (turntable animation, fly-around animation) is included. **Credit 3**

2035-712 **Advanced Product Design Graduate**
The application of design methods and skills to advanced level projects in industrial design. **Class 3**

2035-721 **Advanced Computer Modeling II**
The second of three required graduate-level electronic media courses. The emphasis in this second-level (Level 2) modeling course is learning higher software competency -techniques- for modeling complex and difficult shapes through assigned exercises and creative projects. The objective is student understanding of the most efficient use of professionally-preferred tools for electronic surface modeling in degree three and higher B-spline curves and surfaces. (2035-711 or consent of instructor) **Credit 3**

2035-731 **Advanced Computer Modeling III**
The third of three required graduate-level electronic media courses. The goal for this third-level (Level 3) modeling course is learning higher sohare competency directed toward team working. The emphasis is in strategizing the process of modeling complex and difficult shapes to achieve results typically expected by professional project team members, through assigned exercises and creative projects. Included are the methods and techniques for flawless transferring of design intent of these electronic surface models to and from other professional-level surface and solids software. (2035-721 or consent of instructor) **Credit 3**

2035-732 **Exhibit Design Graduate**
Design of trade show and similar exhibits, including gallery exhibits, involving structure, graphics, lighting, and layout of space. Students will develop concepts through plan and elevation drawing as well as perspective renderings for presentation. **Credit 3**

2035-741 **Professional Practice Graduate**
Business and ethical practices in the industrial design profession are examined through case studies and designer interviews. Students discuss matters of professional practice, debate issues of ethical professional behavior, prepare business correspondence, and analyze the function of industrial design in the business environment. **Credit 3**

2035-761, 762, 763 ,764 **Industrial Design Graduate Elective**
The reasoned application of theoretical and practical background to advanced projects in industrial design. **Credit 3/Qtr**

2035-840 **Thesis Research**
Guidance in selecting and planning a thesis project, conducting a search for background material, and writing a thesis proposal. (Second-year graduate industrial design major or consent of instructor) **Credit 3**

2035-890 **Thesis: Industrial Design**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a written report and participation in a graduate thesis show. **Credit 3–14**

School for American Crafts

Ceramics

2040-761, 762, 763, 764 **Ceramic Graduate Elective**
Basic instruction and experience in ceramic design, fabrication, and production of ceramic forms is undertaken. This study provides ceramic technology and terminology and gives experience with clays along with fundamental forming techniques. The development of design awareness is encouraged through lectures and critiques. Materials fee required. **Credit 3/Qtr.**

2040-781 **Graduate Ceramics Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit *9***

2040-782 **Graduate Ceramics Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2040-781) **Credit 9**

2040-783 **Graduate Ceramics Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2040-782) **Credit 9**

2040-784 **Graduate Ceramics Studio IV**
This is the fourth of a four-quarter sequential course covering the advanced aesthetics and techniques in ceramics. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2040-783) **Credit 9**

2040-890 **Ceramics Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report, which addresses the body of work. The work will be exhibited in the graduate thesis show. **Credit 0-18**

Glass

2041-761, 762, 763, 764 **Glass Graduate Elective**
Collaborative work in the student's major area of study and glass fabrication is encouraged. Various techniques, both hot and cold, will be considered in different quarters: casting, slumping, fusing, blowing, engraving, sand carving, cutting, lamp working, and sculptural construction. Course emphasis on personal, independent development encouraging contemporary thought and concept. Materials fee required. **Credit 3/Qtr.**

2041-781 **Graduate Glass Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This program is structured on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2041-782 **Graduate Glass Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2041-781) **Credit 9**

2041-783 **Graduate Glass Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. *(2041-782)* **Credit 9**

2041-784 **Graduate Glass Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in glass. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2041-783) **Credit 9**

2041-890 **Glass Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report, which addresses the body of work. The work will be exhibited in the graduate thesis show. **Credit 0-18**

Metals

2042-761, 762, 763, 764 **Metals Graduate Elective**
This course offers students fundamental, intermediate and advanced fabrication/forming techniques as they apply to hollow ware and jewelry design. Creative designs and innovative artistic concepts are encouraged. Individual and group instruction covers the properties of various metals, the use of the shop equipment, and safety procedures as they apply to metalsmithing. Materials fee required. **Credit 3/Qtr.**

2042-781 **Graduate Metals Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This program is structured on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. There will be a strengthening of ceramic techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2042-782 **Graduate Metals Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-781) **Credit 9**

2042-783 **Graduate Metals Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques 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. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-782) **Credit 9**

2042-784 **Graduate Metals Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in metals. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2042-783) **Credit 9**

2042-890 **Metals Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report, which addresses the body of work. The work will be exhibited in the graduate thesis show. **Credit 0-18**

Textiles

2043-761, 762, 763, 764 **Textile Graduate Elective**
This is the study and appreciation of weaving and textile techniques, soft sculpture, off-loom weaving, and printing. Design approaches are stressed. Materials fee required. **Credit *3/Qtr.***

Wood

2044-761, 762, 763, 764 **Wood Graduate Elective**
This is a course in woodworking techniques and procedures. It enables the student to gain design competency through wood and an individual solution to wood projects based on suggested needs. Materials fee required. **Credit 3/Qtr.**

2044-781 **Graduate Wood Studio I**
This is the first of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This program is structured on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. There will be a strengthening of wood techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2044-782 **Graduate Wood Studio II**
This is the second of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals, and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-781) **Credit 9**

2044-783 **Graduate Wood Studio III**
This is the third of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is a continuation of the program developed on the basis of the individual student's needs, interests, and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-782) **Credit 9**

2044-784 **Graduate Wood Studio IV**
This is the fourth of a four-quarter sequential courses covering the advanced aesthetics and techniques in wood. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests, and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials, and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. (2044-783) **Credit 9**

2044-890 **Wood Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report, which addresses the body of work. The work will be exhibited in the graduate thesis show. **Credit 0-18**

School of Film and Animation

2065-701 **History and Aesthetics of Film**
An extended comparative survey of the history and aesthetics of film that will explore the four basic forms of the medium: fiction, documentary, animated, and experimental. Emphasis is on determining the unique characteristics of the medium and how those characteristics are used as a means of interpretation and expression. **Credit 4/Qtr. (F, W, S)**

2065-711 **Film and Animation Core**
Major emphasis is placed on the individual's learning to generate and intensify his or her personal statement through creative projects. Some of the projects are assigned, while the candidate selects others. Work is critiqued weekly by the instructor. (Restricted to JPHC major) **Credit 4/Qtr (F, W, S)**

2065-716 **Digital Audio Tools/Animation**
Students learn technical and aesthetic concerns, which organize the design, recording, and editing of sound in animated motion pictures. Student projects focus on recording and editing sound in digital form, and shaping the sound for expressive and narrative purposes. (JPHC major or permission of instructor) **Credit 2 (F)**

2065-721 **Animation and Graphic Film *1***
An introduction to the techniques and practice of graphic and animated film production. This course provides training and practical experience in a wide variety of approaches to single-frame motion picture production. Students produce a number of short film exercises utilizing both existing and original artwork. Some techniques covered in the course are: direct modification of the film surface; cel, ink and paint animation; and kinestasis. Screenings of professionally made films will illustrate each technique. Proficiency in drawing is not required. **Credit 4 (F, S)**

2065-727 **Scriptwriting for Animation**
This course explores the principles of dramatic structure and storytelling in both fiction and nonfiction animated film and video. Students prepare short scripts suitable for production and prepare finished storyboards from those scripts. **Credit 4 (F)**

2065-731 **Video Tools and Technology**
An intensive tools and technology course that will allow the student to work in the digital video format. Examines the technical concerns of single and double system portable video production and editing. Production skills in camera work, editing, and sound recording will be covered. (Must have completed required bridge work) **Credit 4 (F, W)**

2065-732 **Basic Sound Recording**
Learn the techniques of production sound recording, how to use professional recording gear and proper recording and mixing techniques to realize a fully mixed soundtrack to professional quality standards. This course includes Fundamental information about sound and sound recording equipment and establishes the foundation for future sound work in advanced production classes. **Credit 3 (F, S)**

2065-733 **Graduate Screen Writing**
This course explores the writing of fiction for theatrical and non-theatrical films and television. Training concentrates on the elements of dramatic construction. A brief exploration of non-fictional writing, examining preparation, information gathering techniques, and methods of investigation will also be assessed. Both nonfiction and fiction are treated as expository, storytelling forms. Students are responsible for writing a film or television script on a subject of their own choosing and for completing several brief written exercises in areas such as character, dialogue, suspense, subtext, and plot. Class discussion is based on assigned readings, in-class exercises, and in-class reading of student work. (2065-342 *or* equivalent) **Credit 3**

2065-734 **Graduate Screen Writing II**
A workshop in writing a short film script. This course focuses on story proposal, script treatment, writing, and rewriting a short script. (2065-733 or permission of instructor) **credit 4 (W,S)**

2065-737 **2-D Computer Animation I**
Students in this course create animated sequences and projects using a commercial animation software package for a popular microcomputer. In addition to mastering specific software, students learn the principles of digital computer operation and how those principles apply to the problems of animation with computers. *(2065-721)* **Credit 4**

2065-738 **2-D Computer Animation III**
This course focuses on the integration of computer animation into film and video. Students produce a finished animated project on film or videotape with sound, which can be used as a portfolio piece. Emphasis is placed upon various postproduction strategies which involve such techniques as combining computer animation with live action, the addition of film and video special effects and combining computer animation with existing film or video imagery. (2065-721) **Credit 4 (S)**

2065-741 **Graduate Drawing for Animation: Dynamics**
This advanced course focuses on drawing of drawn animation. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Students explore the use of acceleration and deceleration squash, and stretch, maintaining volume, anticipation, secondary action, overlapping action, paths of motion, follow through, and exaggeration. A variety of examples of drawn animation will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-742 **Graduate Drawing for Animation Sequence**
This advanced course focuses on structuring the shots in a scene. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Flexibility is provided for students at different stages of development. Students learn how to break a scene into shots and storyboard the sequence. They learn to compose the frame for action and juxtapose one shot against the next. Students learn to use exposure sheets to plan out animation, and animate short sequences using acquired skills. A variety of examples drawn animation will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3 (S)**

2065-743 **Graduate Drawing for Animation Characters**
This advanced course focuses on character development for animation. It is one of three different courses in drawing for animation offered, which do not need to be taken in sequence; each course provides a different focus. Students produce character sheets. They explore different perspectives of the character drawing from imagination and use the characters in sequential frames of motion. A variety of drawn animation examples will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-745 **Acting for Film and Video**
A course in basic acting technique with emphasis on the special problems peculiar to film and video production. The class is taught in conjunction with *2065-746,* Directing the Actor. Class meetings are organized around the presentation of scenes prepared by student actors and directors. **Credit 3 (F, S)**

2065-746 **Directing the Actor**
A course in basic directorial techniques with emphasis on the special problems peculiar to film and video production. This class is offered concurrently with 2065-745. Class meetings are organized around the presentation of scenes prepared by student directors. **Credit 3 (F, S)**

2065-747 **Introduction to 3-D Computer Animation**
This course is an introduction to three-dimensional computer animation. Topics will include modeling using NURBs and polygons, basic texture mapping and lighting, keyframe animation, forward and inverse kinematics, and rendering. Professional animation software such as Alias/Wavefront's Maya package will be used throughout. By the end of the course, students will be able to model basic characters and objects and to create a simple animation and render a sequence of frames. **Credit 4**

2065-748 **Intermediate 3-D Computer Animation**
This course gives students the skills to develop their own digital characters. Topics will include advanced modeling, facial expressions, character rigging, nonlinear animation, and the use of "Paint Effects" to create hair and vegetation in software such as Alias/Wavefront's Maya. By the end of the course, students will be able to create and rig their own characters, with facial expressions and hair. They create a short animation introducing their character and demonstrating a range of emotions. (2065-747) **Credit 4**

2065-750, 751, 752, 753 **Special Topics-Graduate**
Advanced topics of current or special interest designed to broaden and intensify the student's ability to use animation as a means of communication and expression. **Credit 3-9**

2065-756, 757, 758 **Film and Animation Workshop**
Each faculty member offers a different opportunity for students to explore the multiplicity of ways that photography or filmmaking can be used as a vehicle for expression and communication. Visual research, group critiques, field trips, studio and laboratory practice are used. **Credit 4**

2065-761 **Image Movement Music**
A seminar-level course co-sponsored by the College of Imaging Arts and Sciences at RIT, the Eastman School of Music (University of Rochester), and the Graduate Department of Dance at SUNY College at Brockport. Lecture/demonstration held during the first six-weeks of the course are designed to provide all students with a basic, practical knowledge of current and experimental performance and production techniques in film, video and animation, and contemporary art, music, dance/choreography and related arts. During the latter four-weeks of this course, students will work jointly and individually, under faculty advisement, on creative or research projects involving combinations of image, movement, and sound/music. Weekly three-hour classes will be held alternately at three schools. Transportation will be provided. (Graduate status) **Credit 3**

2065-762 **Stop-Motion Animation**
Explore techniques for producing stop motion animation. Gain familiarity with the use of a variety of materials, which may include clay, puppet, foam, latex, and more. Develop techniques for making armatures and skeletons and creating joints. Learn how to measure movement from frame to frame. Research and write about a stop motion technique or animator. (2065-331 or 2065-721) **Credit 4**

2065-764 **Business of Film and Video**
This course examines the business aspects of designing, developing, and producing film or video projects. Emphasis is on development of production projects with interactive problem solving experiences in which the instructor and students work as a production team. Special attention will be given to the role of the producer, estimation and management of production costs, problems of location productions, and the legal issues involved in filmmaking. **Credit 3**

2065-766 **Advanced Modeling for Animation**
Advanced Modeling for Animation takes a detailed approach to the construction of complex three-dimensional forms, object deconstruction, problem- solving, modeling methodologies, and the advantages and disadvantages of various construction methods. Lighting and texturing techniques will be incorporated into three-dimensional objects as they relate to an extension of the modeling process. Each modeling solution is tested in the lab and discussed in lecture with the required notion that animation is the end goal for each model. Students will perform three-dimensional modeling exercises and create three-dimensional projects including a complex object and a humanoid character. (2065-747 or 2065-457 or instructor permission) **Credit 4**

2065-767 **Directing for Animation**
A seminar in solving directorial problems for animators. Topics will include character and movement development, working with actors and models, identifying and understanding scene construction, directorial responsibility, and the relationship between images in sequence. Both the application of acting techniques for creative development and the aesthetic demands of "visual music" will be emphasized. (2065-347) **Credit 3**

2065-768 **Lighting for Film and Video Production**
This course will present the fundamental principles of lighting for film and video production. The current methods and practices of lighting used in the motion picture industry will be explored through demonstrations, lectures, and "hands on" lab assignments. (2065-311, 2065-731 or 2065-431) **Credit 3**

2065-769 **Digital Video Post-production**
Explore techniques for editing video in a non-linear technique. Students will be exposed to non-linear editing, titling, special effects, audio, and video. Students will produce a series of projects exploring different capabilities on a non-linear editing system. In addition students will be exposed to the various aesthetic theories of editing. (2065-731) **Credit 4**

2065-771, 772, 773 **Graduate Seminar I, II, III**
The seminar provides an opportunity for all MFA students to develop a sense of community and to openly discuss matters of concern, to discuss each other's animations or films, to meet with visiting artists on campus and to participate in a thesis sharing from time to time. (Restricted to JPHC majors) **Credit 2/Qtr (F, W, S)**

2065-776 **Dramatic Structure in Film and Television**
This course explores the theories of dramatic structure from Aristotle to the present and applies these theories to current and classic dramatic works. The course also explores writing for film and television, including feature film genres, one-hour drama, mini series, soap opera, and sitcom. A segment on the business of writing covers reader's reports, adaptation of material from other media, and acquisition of rights. **Credit 3 (F)**

2065-781, 782, 783 **Alternative Processes**
An advanced course in the production and presentation of still or moving images using historical and contemporary visual imaging processes. Emphasis is on extending the students' experience in image making by incorporating alternatives to conventional animation or filmmaking into their work. Processes to be covered include lighting, inverse kinematics, digital cinematography, particles, procedural animation, compositing, montage, and combinations of techniques. **Credit 4/Qtr (F, W, S)**

2065-786, 787, 788 **Contemporary Issues**
A study of current issues relevant to fine art photography and filmmaking, how they relate to broader historical/lcultural issues and how they might suggest future directions. **Credit 2/Qtr**

2065-791 **Particle Effects**
This course gives students the skills to insert three-dimensional computer special effects into animation and live action footage. The students explore three-dimensional computer particle animation and dynamic simulation using Maya software. Students will create short animations using particle effects, soft bodies, and rigid bodies to simulate nature effects like fire, rain, water and physics-based dynamic, and collision events. MEL scripting is an integral part of this course. (2065-747) **Credit 4 (F)**

2065-792 **Gesture Drawing for Animators**
This course will consist of intensive anatomy and quick sketch workshops using live models and references from videos, Internet, and print sources. Live models, both human and animal, will be scheduled for a portion of each class. Students will study kinesiology, the effect of movement on muscle and bone, and comparative anatomy. As a final project students will create original imaginary characters based on their class assignments. Most of the course work will be in class drawing sessions. Graduate students will create additional materials such as maguqettes and animation cycles or Maya models. (2013-211) **Credit 3**

2065-793 **Node-based Digital Compositing**
Node-based compositing is the industry standard for film and HD video image compositing. This course, currently offered only in the spring quarter, covers the basics of node based compositing trees, color correction, garbage and hold-out mattes, keying, resolution proxies, motion tracking, macros, and expressions. (2065-731) **Credit 4 (S)**

2065-799 **Independent Study**
Learning experiences not provided by formal course structure may be obtained through the use of an independent study contract. (Approval required) **Credit 1–9**

2065-812 **Advanced Sound Recording**
This course discusses and demonstrates how to accomplish complex audio post-production procedures like ADR, Foley recording, and mixing for film and video. This course is heavily based on the evaluation of the students' performance on three deadlines for a group project that the entire class participates in. (2065-732) **Credit 3 (W)**

2065-818 **Advanced Storyboard and Layout**
This course involves creation of in-depth storyboard, production design, and art direction for various media. Students will work on pre-designed characters as well as their own projects. Differing styles of layout, boarding, and workbook will be explained. *(2065-443)* **Credit 3 (S)**

2065-822 **Advanced Stop Motion Animation**
Explore advanced techniques for producing stop motion animation. Gain familiarity with the use of a variety of materials, which may include clay, rubbers, aluminum, and more. Develop techniques for making armatures using wire and steel joints. Learn character performance in gesture and expression. Practice methods of miniature lighting and photography, uses digital effects. *(2065-372)* **Credit 3 (S)**

2065-841 **Research Seminar**
This seminar serves as a planning stage for preparing a research thesis proposal and for an ongoing critique and discussion of the research in progress. Issues related to exhibitions, publications, distribution, and gallery also are covered. (Restricted to JPHC majors) **Credit *2* (F, W, S)**

2065-890 **Research and Thesis: Film and Animation**
This thesis is designed and proposed by the candidate. It is considered his or her culminating experience in the program, involving research, a creative body of work, an exhibition or suitable presentation, and a written illustrated report. (Approval required) **Credit 1–12**

School of Photographic Arts and Sciences

2066-701, 702, 703 **History and Aesthetics of Photo**
This required seminar surveys and examines the development of the medium beginning with pre-history. Students will explore the first applications of photographic documentation, portraiture, art, and science and will study photography in the context of modernist and post-modernist critical discourse. **Credit 3/Qtr.**

2066-711, 712, 713 **Photography Core**
Students engage in a rigorous group critique process to develop a mature body of work, which combines experimental and analytical learning methods. They develop aesthetic and technical strategies for the production and presentation of artwork. They also address pendent theoretical research and contemporary art concepts and methodologies, which inform practice. This course is required each quarter in the first year of graduate studies. **Credit 4/Qtr**

2066-732 **Professional Development**
To prepare students for their professional life beyond graduate school. This includes a life in academia as well as an artistic one. This student will gain practical knowledge in portfolio preparation, visual display rant writing, and contract negotiations for their art making practice. In preparation for academia, students will learn about and prepare teaching philosophies, resumes, and a professional portfolio. (2066-711) **Credit 4 (W)**

2066-750, 751, 752, 753 **Special Topics Workshop**
Advanced topics of current or special interest designed to broaden an¿ advance the student's ability to use photography and related media. Recent topics include, Women and Visual Imaging, Warhol and Beuys, Art and Censorship and Digital Media Cafe. **Credit 4/Qtr**

2066-754 **Museum Studies**
Students study advanced topics related to museum and gallery practice through internships, research and projects, which are formally proposed by the student. Emphasis is placed on the function and administration of museums, galleries and the conceptual nature of curating and planning exhibits. (Graduate Status) **Credit 1-9**

2066-756, 757, 758 **Photographic Workshop**
Each faculty member offers a different opportunity for students to explore the multiplicity of ways that photography and related media can be used as a vehicle for expression and communication. Visual research, group critiques, field trips, studio, laboratory practice and critical readings are used. Workshops may be taught as a theme class or on an individual basis to provide students with critical feedback on projects. Recent theme classes include: Digital Media Cafe, Web Seminar, Electronic Arts Seminar, and Imaging the Self. **Credit 4/Qtr**

2066-762 **Dadaism, Surrealism, and Photography**
This seminar examines the work of a group of artists, known as the Dadaists, who rejected the social order and values that produced World War I. The student will, in turn, explore surrealism, the art movement that moved beyond the "destructive program of Dada" and replaced it with a more creative approach to human values and life. **Credit 3**

2066-763 **Beyond the Family Album**
Beyond the family album is a fine art photography course that balances the production of original art work with primary and secondary research, within an intensive critique and seminar format. The narrative of the conventional family album will be a core subject for discussion and study. The concept of 'album' will go beyond the conventional book form to embrace photographic imagery, installation, text, digital forms, and the use of family mementos. Interdisciplinary critical readings and visual art projects concerning issues of identity, and representation of family life in the public and private sphere will form the underpinnings of primary research, against which visual and written projects will be produced. Graduate students will create an original body of artwork on the topic and contribute written and visual material to a class research archive. (MFA or permission) **Credit 4**

2066-765 **Photography Extensions**
Strip photography, slit/scan photography and stroboscopy are used to probe and artistically manipulate spatial and temporal dimensions in order to create unseen poetic expressions of a space/time continuum. Perceptual principles and technical problems associated with the production and exhibition of such images are studied. **Credit 4**

2066-768 **Conservation Procedures**
The principles of photographic conservation and archival practice in a museum context will be presented through lecture, practical demonstration and field visits to local museums. Included are the methods for examining photographs, stabilizing them and restoring them. Special emphasis will be given to proper techniques for display and storage of photographs, together with instruction on how to gain access to information and materials pertinent to those activities. **Credit 4**

2066-770 **Photography in the Desert Southwest**
An extended workshop for students to photograph and travel in the Four Corners region of the American southwest with an instructor leading a camping tour through New Mexico, Utah, Colorado and Arizona. Federal and state campgrounds are exclusively used. Students participate in day trips and hikes or make their own daily itinerary. No darkroom facilities are available during the trip. Maps and reading assignments introduce students to the geology, climate, history, and cultures of the Southwest. (Basic photography experience) **Credit 3-9**

2066-771 **Graduate Seminar**
Graduate Seminar is designed to engage students in dialogue with guest speakers and faculty on their professional work. Each class involves a professional presentation by a different speaker to be followed by discussion. Activities that foster the emerging career of the artist are stressed. **Credit 2**

2066-772 **Teaching Photography**
A graduate course concerned with the art and craft of teaching photography in formal and informal settings, and in accordance with accepted learning principles. **Credit 4 (not offered every year)**

2066-774 Landscape as Photo
This seminar surveys the major artistic, mythological, political, and economic issues influencing the development and use of landscape photography in America from the 1840s to the 1990s. The student will be introduced to a diverse group of historical and contemporary image makers. (Open as an elective pending enrollment by majors) **Credit 3**

2066-775 Early Photo Processes
This is a non-laboratory technical course that surveys the structure and deterioration mechanisms of major historical photographic processes. It examines the technical basis of preservation strategies within a museum archive, and presents an approach to preservation that is integral with collection management and curatorial function. (No prerequisites required) **Credit 3**

2066-778 Modernism: Photography, Art, and Culture
Modernism is a term used to describe how life in Europe and America from the 1880's to the 1960s was transformed by 20th century science, technology, and principles of practices of art and culture through the past century. Students will study how pioneers Picasso and Duchamp abandoned the conventions of their perspective and construction of the figure then replaced these traditions with new methods of representation. (No prerequisites) **credit 3**

***2066-781, 782, 783* Alternative Processes**
An advanced course in the production and presentation of still or moving images using historical and contemporary visual-imaging processes. Emphasis is on extending the students' experience in image making by incorporating alternatives to conventional photography into their work. Processes to be covered include various light sensitive emulsions and the production of the visual book. **Credit 4**

***2066-786, 787, 788* Contemporary Issues**
A study of current issues relevant to fine art photography and related media, how they relate to broader historical/cultural issues and how they might suggest future directions. Emphasis is placed on the integration of critical theoretical discourses and studio practice. **Credit 2**

2066-799 Independent Study
Learning experiences not provided by formal course structure may be obtained through the use of an independent study contract. **Credit 1–12**

2066-841 Research Seminar
The seminar serves as a planning stage and forum for preparing the research thesis proposal and for an ongoing critique and discussion of the research in progress. Additionally, this course will review the thesis process, provide guidelines, and resources for thesis preparation and presentation of the written thesis research paper. Over the course of the quarter, the research proposal will be completed and submitted to thesis advisors for critique and approval. **Credit 2**

2066-890 Research and Thesis
The thesis is designed and proposed by the candidate to a committee of graduate faculty. It is considered his or her culminating experience in the program, involving the development of independent research leading to new work. There are three components to the thesis: the thesis exhibition, the thesis paper, and the public defense. The defense is a defense of both the paper and the exhibit. **Credit 1–12**

School of Print Media

2080-707 Estimating and Analyzing in Graphic Arts Systems
Course content covers the application of information from other management and technical courses to comprehensive situations in estimating. Its aim is to provide the student with an understanding of the relationships between estimation, pricing, and the supply and demand forces which occur in the marketplace and to expose students to several printing specialties so they may appreciate the various cost advantages and disadvantages involved in the use of particular technologies. Class sessions include lectures, discussions, labs, and project presentations by students. In addition to normal reading assignments, the student will be required to prepare and deliver an oral report or a written term paper on a topic related to an estimating, pricing, time-study, or some other cost-related problem of special interest to the student. **Credit 4**

2080-712 Operations Management in Graphic Arts
Designed to give the student a broad perspective of the many topics related to managing a printing facility. Topics include an examination of the systems approach to production management, the use of statistics and other quantitative techniques in methods and decision analysis, the cost-volume-price relationship in printing production, and the effect of organizational structure on decision making, line-staff relationships, and management personnel. **Credit 4**

2080-717 Markets for Print and Graphic Media
This course focuses on understanding the traditional and emerging markets within the graphic media industry. Additionally, attention is given to the environmental and economic factors associated with a printing company's strategic direction. The learned concepts are applied to graphic media business situations. **Credit 4**

2081-701 Research Methods in Graphic Arts
The theory and applications of the principles of scientific research in the graphic arts will be covered, including a systematic study of the scientific method, hypothesis generation, the nature of theory, types of research design, and measurement. The study of problems in the graphic arts includes ink and paper, reproduction methods, and quality control. **Credit 4**

2081-709 Trends in Print Technology
An examination of the environmental and social forces that have affected the development of printing technology to the present time, as well as those forces, present and predicted, that will affect the state of printing technology in the future. **Credit 4**

2081-711 Tone and Color Analysis
This course addresses principles and practices of color measurement for color matching and color image rendering in graphic arts imaging. Emphases are placed on the analyses and rendering of spot colors and pictorial images with the use of ICC-based color management systems. Topics include densitometry, CIE colorimetry, color management systems, graphic arts technology standards, and process control. There are lab assignments on color measurement and tone, and color analyses. A self-directed project is required. The instruction is a combination of lectures (live and video-taped), demonstrations, discussions of lab assignments, and when appropriate, guest speakers. **Credit 4**

2081-716 Graduate Materials and Processes I
This course presents a multi-dimensional model for comparisons of all major print reproduction processes and evaluation of their suitability for any given application. Students will learn the basic theory of image reproduction embodied in available analog and digital printing processes, and learn to identify the process origins of print samples. Additionally, students will learn which consumables are involved in the various processes. Students will need to complete a final project. **Credit 4**

2081-717 Graduate Materials and Processes II
This course presents a multi-dimensional model for comparisons of all major print reproduction processes. Students will develop a sophisticated understanding of the capabilities and suitable applications for each process. A press run for some of the processes will be carried out. The same test targets and images will be used for each run. Students will see how to prepare the files for the different presses. An introduction to image quality will show the students how substrates, inks, toners, and presses/printers all interact and how the final prints can be evaluated. Students will need to complete a final project. (2081-716) **Credit 4**

2081-721 Digital Print and Publishing
This course provides students with an opportunity to learn the principles and applications of digital printing. Technical aspects of the major digital print engines and comparison of digital printing to conventional printing processes will be presented. The strategic use of digital printing will be emphasized from a digital workflow standpoint. Variable data personalization and on-demand printing will be studied from both technical and marketing perspectives. **Credit 4**

2081-723 Contemporary Publishing
An overview of contemporary book, magazine, and newspaper publishing with emphasis on comparative editorial, production, circulation, and marketing strategies. Advantages and disadvantages of the various kinds of publishing are discussed relevant to meeting the needs of society. Cost structures of the various publishing industries are explored, as are strategies of new acquisitions. **Credit 4**

2081-728 **Database Publishing Applications**
This course presents the various processes, methods, and techniques related to the effective application of databases to the publishing process. Topics include the use of database output as the content for print, electronic media and on-line viewing, as well as the use of databases (such as digital asset management systems, font management systems, etc.) as enablers within the digital publishing process. Course projects range from elementary database construction to sophisticated variable data publishing. The course includes a survey of the spectrum of database applications that enable variable information printing and on-demand publishing. A final project incorporating one or more database publishing methods is required. (Basic Macintosh computer skills and competency in using page-layout applications such as InDesign or QuarkXPress) **Credit 4**

2081-740 **Technology Practicum**
This lab/lecture practicum provides students with the opportunity to participate in an on-campus experience that will familiarize them with the software and hardware associated with high-volume printing and finishing workflows. The Practicum will challenge students to design and produce cross media publishing projects with print media and new media applications. (2081-711, 2081-721, and 2081-728) **Credit 2**

2081-742 **Document Processing Languages**
This course will introduce the student to the concepts underlying modern document processing systems. Students will be evaluated by examination and will be required to complete a term research project. **Credit 4**

2081-747 **Cross Media Workflow I**
This course is designed to expose students to all the elements needed to master a cross media workflow project. It will introduce students to concepts and laws around copyright and intellectual property and will explore ways companies create and utilize digital asset management systems. Emerging industry and ISO standards for each of the fields will be presented. Hands-on exercises, conducted outside of class, will complement lectures to broaden the understanding of the various topics. **Credit 4**

2081-748 **Cross Media Workflow II**
Lectures, demonstrations, and lab exercises will allow students to experience the workflows involved in modern cross-media publishing. Hands-on projects will give students experience in creating a large- scale, cohesive product which combines components from digital and traditional printing processes coupled with digital media. (2081-716, 2081-717 & 2081-742) **Credit 4**

2081-763 **Advanced Color Management**
This course will further the scientific methodology in process control for repeatable color and extend the scope of ICC-based color management practices by integrating a number of image capture devices in color-managed digital workflows. Students are expected to work in a team environment, to engage in planning, and conducting press run analyses, and to publish a technical publication using the state-of the-art printing facilities at RIT. (2081-711 or 2081-577) **Credit 4**

2081-767 **Media Industry Analysis**
This course provides students with an understanding of the major industries closely allied with the printing industry; advertising, publishing, and packaging. The intent is to give students in-depth knowledge of; (1) the structure of each of these industries; (2) the channels and methods through which and by which each distributes its products and services; and (3) the major customer/clients of its products and services. Particular attention will be devoted to investigating the business models for the use of print to create value in advertising, publishing, and packaging. (2081-706) **Credit 4**

2081-840 **Research Projects**
Individual research projects in which independent data are collected by the student, followed by analysis, and evaluation. A comprehensive written report is required. Consent of advisor is required. **Credit variable 1-5**

2081-890 **Thesis**
An experimental survey of a problem area in the graphic arts. **Credit 4**

2081-890-99 **Continuation of Thesis/Research Project**
Continuation of Thesis/Research Project involves the completion of established thesis or research project requirement established between the student and thesis/research advisor. **Credit 0**

College of Liberal Arts

www.rit.edu/~690www/

Andrew M.T. Moore, Dean

The College of Liberal Arts offers master of science degrees in the following areas: applied experimental engineering psychology; communication and media technologies; science, technology and public policy; and school psychology.

The master of science program in applied experimental and engineering psychology emphasizes the role of human behavior in the use of technology. The departments of psychology, industrial and systems engineering, and information technology all contribute to the teaching of specialty courses in the program. The master of science degree in communication and media technologies prepares students not only to analyze and anticipate communication problems, but also to create and implement solutions to them. These objectives are achieved through a curriculum that combines advanced courses in communication theory, research and audiences, law and ethics, and professional or applied technologies.

Graduates of the master of science degree in science, technology and public policy will be well grounded in qualitative and quantitative theories and methodologies, and in sound ethical principles. The curriculum is designed to provide students with the skills to collect, organize, and analyze relevant science and technology policy data.

The (specialist level) master of science degree in school psychology is designed for graduate students who desire a career focusing on the psychological evaluation of, and intervention for, children in school settings. Students who complete the two-year academic program and the 1,200-hour hll·year internship have excellent placement opportunities as psychologists who evaluate and counsel children in school and agency settings.

Elective graduate courses complement the professional emphasis of the degree programs by exploring the broader human 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 provides a number of graduate courses that serve as electives for some of the master's degree programs offered by other RIT colleges.

Programs

Master of Science degrees in:

Faculty

Members of the faculty are students' advisers, as well as teachers: Their backgrounds in the field, in the classroom, and in research are the basis for academic standards and expertise that anticipate graduates' career requirements.

Department of Communication

Master of Science in Communication & Media Technologies

Rudolph R. Pugliese, Graduate Coordinator
(585) 475-5925, rrpgsl@rit.edu
www.rit.edu/cmt

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 (CMT) is an interdisciplinary advanced program of study combining liberal arts courses in communication with course work in an applied or professional program. CMT 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.

CMT graduates are prepared for careers as communication experts in such venues as commerce, industry, education, entertainment, and government, as well as for graduate work toward a doctoral degree.

Admission requirements

Applications for admission are accepted for all four academic quarters, but most full-time students begin their program of study in the fall. Admission to the program is based on the following criteria:.

- graduate application,
- successful completion of the baccalaureate degree at an accredited college or university accompanied by official transcripts,
- a cumulative undergraduate grade point average of 3.0 or above,
- a minimum TOEFL score of 600 for speakers of English as a second language,
- three letters of reference from academic advisers, major professors, and/or supervisors or managers, and
- the submission of a writing portfolio.

All credentials must be submitted and reviewed before the student completes 16 quarter credit hours of graduate work in the program.

Curriculum

Earning the CMT degree requires completion of a minimum of 45 quarter credit hours of graduate course work, distributed as follows: four required communication courses (16 quarter credit hours) plus three or four communication electives (12–16 quarter credit hours) offered by the department of communication; three or four courses (12–16 quarter credit hours) in applied professional or technical course work from one of RIT's other colleges; and five to nine thesis/project credit hours earned in the department of communication. A full-time CMT student will create a graduate advisement committee by the end of the first quarter of study. The committee will be comprised of at least one faculty member from the department of communication and one faculty member from an appropriate applied technical program from another RIT college. 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/research project appropriate to their course of study and to their career goals.

Required communication courses (16 credits)	**Qtr. Cr. Hrs.**
0535-701 History of Media Technologies	4
0535-702 Communication Theory	4
0535-703 Research Methods in Communication	4
0535-704 Communications Law and Ethics	4
0535-800 Proiect/Thesis	5–9

Communication electives (12-16 credits)

Students are required to select three communication electives from the choices below; a fourth elective is optional. History of Media Technologies and Industries, and Communication Theory and Audiences are prerequisites for all communication electives.

	Qtr. Cr. Hrs.
0535-705 Electronic Communication and Society	4
0535-706 Crafting the Message	4
0535-707 International Media	4
0535-708 Teaching and Training Technologies	4
0535-709 Online Advertising and Public Relations	4
0535-710 Visual Communication	4
0535-725 Special Topics in Communication	4

Applied professional or technical courses (12-16 quarter credit hours)

Students are required to select three applied professional or technical courses from the choices below; a fourth applied or technical course is optional.

College of Imaging Arts and Sciences	**Qtr. Cr. Hrs.**
2081-709 Trends in Printing Technology	4
2081-723 Contemporary Publishing	3
2081-742 Document Processing Languages	4

College of Computing and Information Sciences	Qtr. Cr. Hrs.
4002-718 Current Themes in information Technology	4
4002-733 Fundamentals of Computer Communication	4
4002-741 Fundamentals of Web-Based Multimedia	4

College of Business	Qtr. Cr. Hrs.
0105-761 Marketing Concepts	4
0105-766 Marketing in Global Business	4
0105-767 Marketing Communications	4
0105-772 Marketing on the Internet	4
0102-740 Organizational Behavior and Leadership	4
0102-741 Leading Chancle in a Quality Organization	4
0102-742 Introduction to Technology Management	4
0102-762 Managing New Process and Product Development	4

Master's thesis/project

A thesis or project is required of all CMT students. The thesis/project topic should complement the student's academic graduate interests and scholarly training. Topic selection and method(s) for implementing the thesis/project occur in consultation with the student's graduate advisement committee.

Proposed plan of study

Fall Quarter

- History of Media Technologies and Industries
- Communication Theory and Audiences
- Communication elective or applied professional/technical course

Winter Quarter

- Research Methods in Communication
- Communication elective
- Communication elective or applied professional/technical course

Spring Quarter

- Communications Law and Ethics
- Communication elective
- Communication elective or applied professional/technical course

Summer Quarter

- Communication elective or applied professional/technical course
- Thesis/Project

Public Policy Department

Master of Science in Science, Technology and Public Policy

James J. Winebrake, Department Chair
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www.rit.edu/~ppolicy

RIT's public policy program offers an innovative, interdisciplinary master of science degree in science, technology, and public policy, with an emphasis on engineering, science, and technology policy. The program builds on RIT's strengths as a technological university, enabling students to interact with faculty members and researchers who are working on scientific developments and technological innovations that drive new public policy considerations.

The program is located in the College of Liberal Arts but draws significantly from disciplines and courses of study located in the other colleges, especially the colleges of Business, Science, Engineering, and Applied Science and Technology. The program is geared toward graduates who will make significant contributions in the private, public, and not-for-profit sectors.

All students take a set of policy core courses that emphasize analysis, problem solving, and interdisciplinary approaches. Students work with an adviser to choose electives that focus their policy studies in a particular area, such as environmental policy, telecommunications policy, or energy policy. Typical students include those with science or engineering backgrounds looking to broaden their career opportunities in the government or business setting, 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.

Admission requirements

Two options are available to students interested in the MS degree in science, technology and public policy.

Students may enter the program from the public policy BS program and earn a combined BS/MS in five years. To be admitted into the graduate portion of the BS/MS track, a student must meet the following criteria:

- Completion of all requirements of the BS curriculum
- A GPA of at least 3.0

Students seeking admission to the MS program from other RIT programs, or from outside the university, should meet the following requirements:

- Successful completion of the baccalaureate degree at an accredited college or university
- Minimum 3.0 overall GPA
- Two writing samples, one of which should be a statement of interest

- GRE scores, unless a waiver request is approved
- Calculus and statistics courses (Students may be required to take a data analysis or statistics course and an introductory calculus course, if not taken previously.)
- Two formal letters of reference
- Minimum TOEFL of 570 (paper-based) or 230 (computer . based) for students who do not speak English as their native language
- Fulfill general criteria for graduate admission as listed in this bulletin

Curriculum

A minimum of 48 quarter credit hours are required for completion of the MS in science, technology and public policy.

The BS/MS student may obtain 12 quarter credit hours of graduate work in the fourth year of the BS curriculum. Thus, a BS/MS student would need to take only 36 hours in the fifth year.

Students transferring into the MS program from other BS degree programs at RIT or from outside the university may be required to complete an additional three-course policy analysis sequence (Policy Analysis I, II, and III) or demonstrate that they have equivalent skills for completion of the degree.

The graduate curriculum has a required five-course core: Readings in Public Policy (0521-700), Advanced Theory and Methods in Policy Analysis (0521-701), Evaluation Research (0521-702), Public Administration and Management (0521-709), and Science, Technology, and Policy (052 1-704). In addition, students will choose five courses within their area of specialization. Students also are required to successfully complete a master's thesis, although nonthesis options are available.

Course offerings

Required core courses:

- Seminar: Reading in Public Policy
- Seminar: Advanced Theory and Methods in Public Policy
- Seminar: Evaluation Research
- Science, Technology, and Policy
- Public Administration and Management

Elective courses

The student may choose five elective courses chosen based on student interests, career goals, and offerings. Courses may be offered in various colleges throughout the university, including the colleges of Business, Science, Engineering, and Applied Science and Technology. Course selection is done jointly with a faculty adviser and typically is aimed at developing a specialized area of interest for the student (e.g., biotechnology policy, environmental policy, energy policy, communications policy). Example elective courses include:

- Technological Innovation and Public Policy
- Energy Policy
- Information and Communication Policy
- Qualitative Policy Analysis
- Special Topics in Public Policy
- Science, Technology and Policy
- Introduction to Technology Management
- Telecommunication Policy
- Environmental Policy
- Information Technology and Strategic Opportunity
- Risk Assessment and Management
- Applied Survey Design and Analysis
- Social and Political Environment of Business

Psychology Department

Master of Science in Applied Experimental and Engineering Psychology

Kathleen Chen, Program Chair
(585) 475-2405, kccgss@rit.edu

The master of science program in applied experimental and engineering psychology emphasizes the role of human behavior in the use of technology. The departments of psychology, industrial and systems engineering, and information technology all contribute to the teaching of specialty courses in the program.

Engineering psychology examines the capacities and limitations of the human to sense, store, and process information, and the use of this information in performance. This knowledge is applied to the design, use, and maintenance of human/machine systems. Students will be trained in the application of experimental psychology to contemporary problems in industry, design, and technology.

Engineering psychologists are interested in why performance might be changed through the use of technology. For instance, a new interface for controlling the radio in a vehicle may cause errors because a control is too sensitive for human-motor performance or because the driver is confused as to how to use a button. Psychological and motor processes both are involved in the operation of such an interface, and the distinction of these processes can help identify design solutions.

The MS program in applied experimental and engineering psychology prepares students to function as effective engineering psychologists in an industrial, governmental, or consulting organization. The program also provides a foundation for further advanced academic study in engineering psychology, human factors, or experimental psychology.

Admission requirements

Applicants to this program are expected to have 20 quarter hours (or 15 semester hours) of course work in undergraduate psychology, including one course in experimental psychology and another in statistics. The admission decisions will be based on:

1. a minimum GPA of 3.0 for undergraduate work,
2. the graduate Record Examination taken within the last five years,

3. two letters of reference from professors or supervisors,
4. a biographical statement describing the applicant's experience and goals for the program, and
5. a completed application for graduate admission to RIT.

Thesis

The thesis requires eight credit hours. A thesis adviser will be assigned to the student. Selection of a topic and research proposal must be completed in the spring quarter of the first year of the program, with the assistance of the adviser. Ongoing research activity is expected in the spring and summer quarters of the first year of the program.

At the completion of the thesis, the student will present and defend the research before a thesis committee. A bound copy of the thesis and a written paper in short format suitable for publication or conference presentation will be submitted to the department.

Required Experimental Core Courses	Qtr. Cr. Hrs.
0514-784 Graduate Statistics	4
0514-785 Advanced Perception	4
0514-786 Research Methodology	4
0514-787 Advanced Cognition	4

Required Engineering Psychology Courses	
0514-788 Topics in Engineering Psychology	4
4004-745 Foundations of Human-Computer Interaction (IT dept.)	4
0303-731 Advanced Topics: Ergonomics/Human Factors (ISE dept.)	4
0303-734 Systems Safety Engineering (ISE dept.)	4

Electives

Students select two from the following; prerequisites are in brackets:

	Qtr. Cr. Hrs.
Visual Basic for Programmers (IT dept.) [4002-218 or equivalent]	4
4004-748 Usability Engineering (IT dept.) [4004-745 and 4004-741]	4
4004-749 Usability Testing (IT dept.) [4004-748 and Statistics]	4
4004-755 Advanced Topics in HCI (IT dept.) [4004-745]	4
0303-530 Engineering Design (ISE dept.)	4
0303-732 Biomechanics (ISE dept.) [0304-331, 332, 0303-730 or equivalent]	4
2014-701 Introduction to Computer Graphics (CIAS-Computer Graphics Design) [permission of the instructor]	4
2014-717 Authoring Multimedia (CIAS-Computer Graphics Design) [permission of the instructor]	4
2014-723 Graphical User Interface (CIAS-Computer Graphics Design)	4

Cooperative education

The MS degree program in applied experimental and engineering psychology has an optional cooperative education component. It is generally taken in the summer quarter of the first year of the program. The goal of co-op education is to provide students experiential learning that integrates with classroom education. It allows students to apply psychological principles to problems in a variety of work environments.

Master of Science in School Psychology

Scott P. Merydith, Program Chair
(585) 475-6701, spmgsp@rit.edu

The College of Liberal Arts offers a nationally accredited graduate program leading to the MS degree and advanced certificate in school psychology. The program prepares students for provisional certification as school psychologists in New York state. It is designed to provide students with a strong background in psychological foundations and to develop their professional skills and competencies in counseling, evaluation, and consultation.

School psychologists work with young children (birth to age five); elementary, junior high, and high school students; teachers and administrators; parents; and professionals. They offer services that lead to the amelioration of existing student difficulties and attempt 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 community.

Admission requirements

Admission to the program is based on the following criteria:

- Successful completion of the baccalaureate degree at an accredited college or university
- An undergraduate cumulative grade point average of 3.0 or above
- Completion of at least 18 semester hours (27 quarter hours) in behavioral sciences with a grade of B or above
- Prerequisite undergraduate courses:
  General Psychology
  Elementary Statistics
  Child or Developmental Psychology
  Abnormal Psychology
- Minimum Graduate Record Examination (GRE) scores:
  Verbal 470
  Quantitative — 600
  Foreign students — minimum TOEFL score of 580
- Letters of reference and an essay about student's goals and related experience, which show evidence of a professional commitment and the potential for developing effective relationships with children, youth, and adults
- An individual interview

All credentials must be submitted and reviewed before the student completes 12 quarter credit hours of graduate work in the program. Applications are due by March 1. Later applications will be reviewed on a space-available basis.

Curriculum

Required Psychological Foundation and Professional Courses (20 credits)	Qtr. Cr Hrs.
0514-701 Advanced Developmental Psychology	4
0514-702 Psychology of Teachinq/Learning	4
0514-723 Developmental Psvchopathology	4
0514-739 Children and Trauma	4
0515-701 Cultural Diversity in Education	4
Required Statistics and Research Methodology (11 credits)	
0514-728 Inferential Statistics I	2
0514-759 Research Methods I	2
0514-890 Thesis	
or	
0514-891 Project (1 per quarter for 3 quarters)	3
0514-810 Research Methods II	2
0514-811 Inferential Statistics II	2
Required Specialized Courses (44 credits)	
0514-724 Interpersonal Intervention Skills	4
0514-726 Psychoeducational Assessment I	4
0514-730 Seminar– Professional and Legal Issues	4
0514-731 Psychoeducational Assessment II	4
0514-732 Psychoeducational Assessment Ill	4
0514-733 Applied Behavioral Analysis	4
0514-734 Psychoeducational Assessment IV	4
0514-742 Biological Basis of Behavior	4
0514-744 Advanced Counseling	4
0514-745 Alternative Assessment Techniques	4
0514-749 Advanced Consultation	4
0514-744 Advanced Counseling	4
Required Field Experience (21 credits)	
0514-712–717 Practicum I, II, III, IV, V, and VI	12
0514-777 Internship I, II, and III	9
Total	**96**

Proposed plan of study

First Year	Fall Quarter	Psychoeducational Assessment I Interpersonal intervention Skills Applied Behavioral Analysis Practicum I
	Winter Quarter	Psvchoeducational Assessment II Advanced Consultation Advanced Development Psychology Practicum II
	Spring Quarter	Psychoeducational Assessment III Advanced Counseling Developmental Psvchopathology Practicum Ill
Second Year	Fall Quarter	Psvchoeducational Assessment IV Alternative Assessment Techniques Research Methods I Inferential Statistics I Practicum IV
	Winter Quarter	Biological Basis of Behavior Psychology of Teaching/Learning Research Methods II Inferential Statistics II Practicum V
	Spring Quarter	Cultural Diversity in Education Children and Trauma Seminar– Professional and Legal Issues Practicum VI Proiect/Thesis (1 credit hour continuation)
Third Year	Fall Quarter	Internship I Project/Thesis (1 credit hour registration continuation)
	Winter Quarter	Internship II Project/Thesis (1 credit hour registration continuation)
	Spring Quarter	Internship III

Degree requirements

A minimum of 96 quarter credit hours are required for completion of the program. Before registering for the interns students must pass a portfolio review. A cumulative grade point average of 3.0 or above is required.

Graduate Faculty

Department of Communication

Bruce A. Austin, BA, Rider College; MS, Illinois State University; Ph.D., Temple University — Professor, Communication

Susan Barnes, BFA, Pratt Institute; MFA, Ph.D., New York University — Associate Professor, Communication

Grant C. Cos, BA, University of Massachusetts; MA, Emerson College; Ph.D., Kent State University — Assistant Professor, Communication

Diane S. Hope, BS, State University of New York at Brockport; MS, Ph.D., State University of New York at Buffalo — Professor, Communication

Keith B. Jenkins, BA, University of Arkansas; MA, Ph.D., Florida State University — Assistant Professor, Communication

David R. Neumann, BA, Ithaca College; MA, Ph.D., Bowling Green State University — Professor, Communication

Rudolph R. Pugliese, BA, State University of New York at Oneonta; MA, State University of New York at Brockport; Ph.D., Temple University — Professor, Communication

Patrick M. Scanlon, BA, State University of New York at Albany; Ph.D., University of Rochester — Professor, Communication

Humanities

Frank Annunziata, AB, Manhattan College; MA, City College of the City University of New York; Ph.D., Ohio State University — Professor, History

Bruce A. Austin, BA, Rider College; MS, Illinois State University; Ph.D., Temple University — Professor, Communication

Charles D. Cobs, AB, Rutgers University; MA, Ph.D., University of Iowa — Professor, Fine Arts

Rebecca O. Edwards, BA, College of the Holy Cross; Ph.D., University of Rochester — Assistant Professor, History

Timothy H. Engstrom, BA, MA, Ph.D., University of Edinburgh — Professor, Philosophy

Tina Lent, BA, MA, University of California at Los Angeles; Ph.D., University of Rochester — Associate Professor, Fine Arts

David B. Suits, BA, Purdue University; MA, Ph.D., University of Waterloo — Assistant Professor, Philosophy

Public Policy Program

James J. Winebrake, BS, Lafayette College; MS, Massachusetts Institute of Technology; Ph.D., University of Pennsylvania — Department Chair; Professor, Science, Technology, and Public Policy

Franz Foltz, BS, MS, Pennsylvania State University; Ph.D., Rensselaer Polytechnic Institute — Assistant Professor, Science, Technology, and Society

Ron Hira, BS, Carnegie Mellon University; MS, Ph.D., George Mason University — Assistant Professor, Public Policy

M. Ann Howard, BS, Cornell University; JD, Rutgers University — Associate Professor, Public Policy/ Science, Technology, and Society

School Psychology

Brian Barry, BA, St. John Fisher College; MSSc, Ph.D., Syracuse University — Associate Professor, Psychology

Suzanne Graney, AA, Finger Lakes Community College; BA, State University of New York at Geneseo; Ph.D., University of Oregon — Assistant Professor, School Psychology

Jennifer Lukomski, BA, Williams College; MA, Gallaudet University; Ph.D., University of Arizona — Assistant Professor, Psychology

Scott P. Merydith, BA, M.Ed., Ph.D., Kent State University — Associate Professor, Psychology

Murli M. Sinha, AB, Bihar University; MA, Patna University; MA, City College of City University of New York; Ph.D., Cornell University — Professor, Sociology

Note: Prerequisites are within parentheses at the end of the course descriptions

Liberal Arts Elective Courses

0507-701 **History of American Educational Thought**
A historical analysis of change and continuity in American educational history from colonial through contemporary America. Special emphasis will be given to the development of the field of deaf education in the United States. Lectures, seminar discussions, and readings offer comprehensive coverage of the salient intellectual themes of American deaf educational history. **Class 4, Credit 4 (offered annually)**

740-740 **Graduate Science and Technology Policy Seminar**
Students in this course will apply basic policy skills, concepts, and methods to a contemporary science and technology policy topic. Topics may vary from year to year or term to term. (Graduate standing in public policy; or 0508-441, 0508-484 or 0521-400; or permission of the instructor) **Class 4, Credit 4 (offered annually)**

790-790 **Graduate Biodiversity and Society**
This course explores the problems, issues, and values stemming from the current massive loss of biodiversity. This course also explores why preserving or conserving biodiversity is considered to be important, and what mechanisms have been identified for its maintenance. (Graduate standing in public policy or environmental science; or permission of instructor) **Class 4, credit 4**

0509-705 **Philosophy of Art and Aesthetics**
The four-hour meetings of this seminar are based largely on discussions, and participation of all students is required. Familiarity with some philosophy and with the general history of 20th-century western art is helpful. The questions discussed are philosophical questions about art and aesthetic experience: Can art be defined? What is the relationship between art and beauty, art and truth, art and knowledge, art and judgment, art and politics, art and interpretation, art and contemporary philosophical theory? Readings will cover a wide range of philosophical reflection, from its early roots in Plato to the contemporary postmodern. **Class *4,* Credit 4 (offered annually)**

0509-706 **Philosophy of Mind**
Philosophy of mind is the philosophical discipline that explores what a mind is and how it fits in the natural world. In doing this, philosophy of mind raises further questions such as: What do we mean by the mind? How do we attribute mentality? How are mental and physical properties related? What is consciousness? Can computers think? How is rationality connected to mental states like beliefs and desires? In this course we discuss and critically assess answers to these and related philosophical questions. **Class 4, Credit 4 (offered annually)**

0509-707 **Philosophy of Vision and Imaging**
Appeals to sight, to the rhetoric of seeing, and to various media and technologies of imaging have had an enormous impact on philosophy and on human culture generally. This course will introduce students to the philosophy of vision and imaging by critically investigating four interrelated sets of concerns: (1) The relation between appeals to vision and the imaging technologies that mediate what and how we see; (2) The relation between imaging technologies and the acquisition and representation of knowledge; (3) The relations between imaging technologies and human identity and agency; (4) The relations between imaging theories/practices and ethical, political, ideological, and social contexts. No prerequisite. **Class 4, Credit 4 (offered occasionally)**

School Psychology

0514-701 **Advanced Developmental Psychology**
This course will cover the major theoretical approaches to the understanding of human development. Areas of study will include, but not be limited to, cognitive development, language development, development of personality, social development and moral development. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4 (offered annually)**

0514-702 **Psychology of Teaching and Learning**
This course is designed to furnish students with an understanding of the basic psychological processes underlying the educational process, and to apply them to concrete situations that may arise for persons who teach. Instruction and remedial techniques are reviewed. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4 (offered annually)**

0514-703 **Cultural Diversity in Education**
The aim of the course is to understand the historical and structural origins of the present schooling system in the United States. The functions of schools, from an ideological as well as technical view-point, will be analyzed. In addition, different forms of school organizations will be compared, as in the public vs. private dimensions. The functionalist theoretical approach will be presented as well as the conflict perspective to frame the discussion and analysis of opposing sociological systems of thought. The role of education in promoting or inhibiting socio-economic mobility will also be analyzed. The course attempts to understand how role expectations are actually carried within the school system and how its different actors react to technical as well as aloe constraints. (See requirements for admission for prerequisites or receive permission of the instructor.) **Class 4, Credit 4 (offered annually**

0514-712 **Practicum I**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placementlinternship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr.**

0514-713 **Practicum II**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr.**

0514-714 **Practicum III**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placementlinternship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr.**

0514-715 **Practicum *N***
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr.**

0514-716 **Practicum V**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placementlinternship. (Matriculation in the school psychology program) **Class *2,* Credit 2/qtr.**

0514-717 **Practicum VI**
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placementlinternship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr.**

0514-723 **Developmental Psychopathology**
This course focuses on maladaptive behavior of children and youth. Models of deviant behavior are presented, with attention to physiological, learned and environmental bases of behavior. Assessment and treatment approaches are discussed. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 4**

0514-724 **Interpersonal Intervention Skills**
This course will concentrate on the development of individual counseling and consultation skills for the school psychologist. Students will acquire an understanding of the basic models and stages of the counseling and consulting processes. Throughout this class, emphasis will be on building fundamental active listening skills and helping clarify problem situations. Extensive laboratory work will involve role-play. Readings, classroom and laboratory activities have been designed to ensure that the students will view counseling and consultation processes as systematic. (Matriculation in school psychology program) **Class 4, Credit 4**

0514-726 **Psychoeducational Assessment I**
This introductory course in a series of assessment courses will study assessment generally, types of tests and their uses, strengths and weaknesses of specific instruments, principles of reliability and validity, scales and norms. Students will acquire an understanding of the quantitative and qualitative aspects of measurement. There will be extensive laboratory experience with a variety of instruments which measure academic achievement and sensory-motor perception. Emphasis will be placed on the clinical use of tests in schools and other settings. (Matriculation in the School Psychology Program or permission of instructor) **Class 4, Credit 4**

0514-728 **Inferential Statistics I**
This course will train students in understanding and using inferential statistical concepts. Special attention will be placed upon use of computer applications, conceptual understanding of statistical tests, proper selection of statistical test, and proper interpretation and reporting of results. Topics include a brief review of descriptive statistics, confidence intervals, hypothesis testing, power, effect size, one-sample z and t tests, two-sample t tests, and one-way ANOVA. (See admission requirements for prerequisites or receive permission of instructor) **Class 4, Credit 2**

0514-730 **Seminar in Professional and Legal Issues**
Historic foundations and current critical professional issues, roles and functions of the school psychologist are emphasized in the course. Legal and ethical issues that bear on the role of the psychologist in the school are considered. (Matriculation in the School Psychology Program plus 32 quarter credit hours successfully completed in the program or permission of instructor) **Class 4, Credit 4**

0514-731 **Psychoeducational Assessment II**
This course concentrates on development of theory and applied skills in intellectual assessment. Students learn to select and administer individual intelligence tests, to interpret results, to form test-base d recommendations for intervention, and to provide written and oral reports. Assessment of persons who are culturally different or disabled is emphasized. (Matriculation in school psychology program and a grade of B or better in *0514-726)* **Class 4, Credit 4**

0514-732 **Psychoeducational Assessment III**
This course uses interview, behavioral observation, rating scales and projective measures for assessment of child and adolescent personality and adaptive behavior. Students gain experience administering, interpreting and reporting results of measures currently used in the practice of psychology in the schools. (Matriculation in the school psychology program plus a grade of B or better in 0514-726 and 731 *or* permission or instructor.) **Class 4, Credit 4**

0514-733 **Applied Behavior Analysis**
This course offers training in the behavioral assessment of students in educational settings. Students apply various techniques for recording and analyzing behavior and programs for behavior management. (Matriculation in the school psychology program or permission of instructor) **Class 4, Credit 4**

0514-734 **Psychoeducational Assessment IV**
This is an applied course in the diagnostic evaluation of exceptional children and adolescents. Students select, administer, and integrate test data, and report results and recommendations for intervention to parents, teachers, and to multidisciplinary evaluation teams. A overview of relevant information on theory of exceptionality and current status of diagnosis and treatment of exceptional children and adolescents is provided. (Matriculation in the school psychology program and a grade of B or better in 0514-726, 731, 732) **Class 4, Credit 4**

0514-742 **Biological Basis of Behavior**
This course is designed to review the neurophysiological and neuropsychological bases of behavior as it pertains to developmental disorders. Students will identify functional neuroanatomy, neuroimaging techniques, and various neurological and neuropsychological disorders. Students will apply findings and research to contemporary problems and issues facing school psychologists. **Class 4, Credit 4**

0514-744 **Advanced Counseling**
This come focuses on the development of counseling skills used with children and adolescents in individual and group settings. Students are given the opportunity to integrate theory, research, and processes relative to individual and group work. Treatment plans are developed. Techniques for facilitating group counseling are emphasized. Crisis intervention is reviewed. (A grade of B or better in 0514-724) **Class 4, Credit 4**

0514-745 **Alternative Assessment**
The prime focus of this course is on the assessment of academic problems in the classroom with special emphasis on the collection of data that allow the planning of interventions. Students will learn alter- native direct methods of academic or behavioral assessment for both performance and skill deficits. Alternative assessment techniques include curriculum based assessment, curriculum based measurement, and analogue assessment. Emphasis will be on the integration of these assessment techniques, collaborative problem solving, systematic observation, the principles of applied behavior analysis and the psychology of learning for the purposes of intervention development. (0514-726, 731, 732, 733, 749 or permission of instructor) **Class 4, Credit 4**

0514-749 **Advanced Consultation**
This course concentrates on the development of consultation skills for the school psychologist. Students acquire an understanding of the basic models of consultation and the stages of the consultation process. Emphasis is on the collaborative problem solving process where the skills of problem identification and analysis will be honed. Extensive laboratory work involves observations of trained consultants, role-play, and first-hand experiences through case consultation. Readings focus on pertinent research in school based consultation. (Matriculation in the school psychology program plus a grade of B or better in 0514-724 *or* permission from the instructor) **Class 4, Credit 4**

0514-752 **Children** & **Trauma**
This course examines the nature, incidence, demographic distribution, sequelae and appropriate treatment of trauma in children's lives. After defining trauma, it explores how experiences such as parental or sibling death, serious illness or injury, familial alcoholism, emotional, physical and sexual abuse, divorce or parental abandonment, community violence and natural disasters affect children. **Class 4, Credit 4**

0514-757 **Special Topics**
This course is designed to allow the student to focus on given specific topic or area of research relevant to school psychology. Such topics or activities may include selected readings, assessment techniques, direct intervention skills, or indirect intervention skills. This course may be offered from 02 to 04 credit hours depending on the specific topic covered. No prerequisite. **Class 4, Credit variable (offered occasionally)**

0514-759 **Research Methods I**
This course explores various types of research methods as well as important methodological issues and concepts. Methodologies studied include experimentation, quasi-experimentation, participant observation, archival methods, content analysis, surveys, interviews, and simulations. Methodological issues covered include philosophical paradigms, research ethics, reliability, threats to internal validity, external validity, demand characteristics, the volunteer subject problem, issues in sampling, and realism. Students will read original and contemporary works on research methodologies, as well as examples of such methodologies, and will write weekly summaries, applications, and criticisms. Course activities rely heavily on seminar-style discussions and presentations. (Matriculation in the school psychology program or permission of the instructor) **Class 4, Credit 2**

0514-810 **Research Methods II**
This course assists graduate students in the school psychology program in beginning their masters' theses or projects. Students will write a thesis/project proposal and give a presentation of this proposal. The proposal will consist of an abstract, a preliminary introduction that includes a literature review, a proposed methods (for thesis students) section, or description of activities (project students) section, a proposed data analysis (thesis students) or product summary/outline (project students) section, a preliminary discussion section, a reference section, and appendices (if applicable). The proposal will be presented at the end of the term. Course activities will consist of library research, thesis/project planning, and writing under the (typically group) supervision of the instructor. **Class 4, Credit 2**

0514-811 **Inferential Statistics II**
This course will train students in understanding and using inferential statistical concepts. Special attention will be placed upon use of computer applications, conceptual understanding of statistical tests, proper selection of statistical tests, and proper interpretation and reporting of results. Topics include two-way ANOVA, repeated measures ANOVA, MANOVA, correlation, simple regression, reliability analysis, and non-parametric statistics. **Class 4, Credit 2**

0514-890 **Thesis**
Students will register for this course under the thesis in school psychology. The thesis option will be available to students only with prior written approval of program faculty. Students must make clear their intent to enroll in the thesis option during the quarter prior to registration. Students will submit a proposal to a faculty member who agrees to serve as the student's committee chair. The proposal will describe the basic research question to be investigated and how the student will gain access to subjects. Proposals will be reviewed by the program faculty who will give permission to register for thesis credit. **Credit 1/quarter for three quarters**

0514-891 **Project**
This course is used to fulfill the project requirement under the non- thesis option in school psychology. The project may take the form of an original program designed to meet the needs of a specific school related population or a paper on some important or controversial topic. The candidate must obtain prior approval before registering for this course. A formal written paper and an oral presentation of the project are required. **Credit 1/quarter for three quarters**

Applied Experimental and Engineering Psychology

0514-784 **Graduate Statistics**
This course introduces students to advanced inferential parametric and non-parametric data-analysis techniques commonly used in psychological research. The focus is on the conceptual understanding of these statistics, how different statistical procedures are applied in different research methods, how to perform analyses, how to interpret the results in the context of the research question, and how to communicate these results. No prerequisite. **Class 3, Lab 1, Credit 4 (offered in fall quarter)**

0514-785 **Advanced 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 instruction. The course is designed to provide students with a deeper understanding of topics in perception. The course will examine: temporal and spatial frequency perception; after effects, visual illusions and their relationship to cortical function and pattern perception; color perception; depth and motion perception; higher order perception such as face and object recognition; and music and speech perception. The goal is to cover current research and theories in perception, looking at current developments and their antecedents. There will be lab time for students where they will examine empirical findings in perception and develop their research skills in the field. **Class *3,* Lab 1, Credit 4 (offered fall quarter)**

0514-786 **Research Methodology**
This course is a hands-on approach to research methodology and scientific writing in the field of psychology with a focus on experimental design. The goal of the class is to provide students with a sufficient background to be able to conduct their own psychological research. One objective is to assist students in finalizing their thesis research proposal. Students will gain experience as both participants and investigators. They will participate in brief instructor-run experiments as well as design, execute, and analyze experiments in class, and present their findings to the group. Students will also discuss and critique current research papers. Finally, students will develop their thesis research proposal during the course. Fellow students along with the instructor will critique each proposal, allowing students to generate a feasible and promising research plan for their thesis. **Class *3,* Lab 1, Credit 4 (offered in winter quarter)**

0514-787 **Advanced Cognition**
This course will survey theoretical and empirical approaches toward understanding the nature of the mental processes involved in attention, learning and memory, problem solving and decision making, language, planning, and motor control. The course attempts to present a balance between historically significant findings and current "state-of-the- art" research. Toward this end, fundamental readings and modern arguments have structured the nature and direction of scientific debate in these fields will be discussed. Critical evaluation of the research at the crux of each debate will be emphasized. Students will be guided in critical thinking about possible new cognitive experiments that would put current theories to the test and provide grounds for supporting, modifying, or rejecting them. The course also interweaves material on laboratory research and practical applications in these areas. **Class 3, Lab 1, Credit 4 (offered in winter quarter)**

0514-788 **Topics in Engineering Psychology**
This course will do critical examinations of current problems in a selected areas of engineering psychology. Areas may include time-sharing and workload assessment, product design, usability, human-computer interaction, accidents and safety, and task analysis. Areas may vary each time the course is offered. Students may register for this course more than once. No Prerequisite. **Class 3, Lab 1, Credit 4 (offered in fall quarter)**

Science, Technology and Public Policy

0521-700 **Seminar: Readings in Public Policy**
This course provides an in depth inquiry into the seminal literature influencing key contemporary public policy debates. Students engage in critical reflection and original thought on theoretical and applied public policy problems. Emphasis is placed on policy issues in selected science and technology fields. (Matriculation in the public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (offered fall quarter)**

0521-701 **Seminar: Advanced Theory and Methods**
This course will cover the major theoretical and applied analytical methods and techniques in both quantitative and qualitative analysis. An emphasis will be placed on integrating empirical and normative concerns. Methods covered vary by quarter, but may include optimization, cost-benefit analysis, systems modeling, and multi-criteria decision analysis. (Matriculation in the public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (offered winter quarter)**

0521-702 **Seminar: Evaluation Research**
The focus of this course is on evaluation of program outcomes. Students will explore the questions and methodologies associated with meeting programmatic outcomes, secondary or unanticipated effects, and an analysis of alternative means for achieving program outcomes. Critique of evaluation research methodologies will also be considered. (Matriculation in the public policy master's program or permission of the instructor is required) **Class 4, Credit 4 (offered spring quarter)**

0521-703 **Thesis Research**
The master's thesis in science, technology, and public policy requires the student to select a thesis topic, advisor and committee; prepare a written thesis proposal for approval by the faculty; present and defend the thesis before a thesis committee; and submit a bound copy of the thesis to the library and to the program chair. (Matriculation in the public policy master's program, acceptance of a thesis proposal, and satisfactory completion of a minimum of 16 graduate credits are required) **Class 4, Credit 8 (offered quarterly)**

0521-706 **Qualitative Policy Analysis**
This course examines multiple methodologies and techniques used for the qualitative analysis of public policy. The course examines methods known for their descriptive richness, interpretive insights, heightened concern for research subjects' views, and sociocultural relativism. Specific techniques include: interviewing, field methods, participant observation, ethnography, focus groups, Delphi panels, and case studies. (Graduate Standing) **Class 4, Credit 4**

0521-708 **Technological Innovation and Public Policy**
Technological innovation, the incremental and revolutionary improvements in technology, has been a major causal factor for economic growth and social and political change. This course will introduce generic models of innovation that span multiple sectors including: energy, environment, biotechnology, and information technologies. The course will then analyze how governments choose policies to spur innovation. **Class 4, Credit 4 (offered annually)**

0521-709 **Public Administration and Management**
This course provides an introduction to the fields of public administration and public management. This survey course covers topics such as bureaucratic behavior, program implementation, and recent innovations in management of public organizations. (Graduate standing) **Class 4, Credit 4 (offered annually)**

0521-710 **Information and Communications Policy**
This course examines how federal and international policies are developed to influence innovation of Information and Communication Technology. In particular the course will examine such topics as privacy, freedom of speech, intellectual property rights, access to information technology, and regulation of the Internet. (Graduate standing) **Class 4, Credit 4 (offered occasionally)**

0521-749 **Special Topics**
This course will examine current topics in public policy and may be used with consent of advisor as a policy elective for the public policy MS degree. The course will examine a special problem or area relevant to the other courses in the degree. **Class 4, Credit 4 (offered occasionally)**

0521-751 **Energy Policy**
This course provides an overview of energy resources, technologies, and policies designed to ensure clean, stable supplies of energy for the future. The course evaluates the impacts of fossil fuel, renewable energy, and hydrogen technologies and how public policies can be used to influence their development. The development of U.S. energy policy is of particular concern, although a global perspective will be integrated throughout the course. No prerequisite. This course is a professional elective for the science, technology, and public policy MS degree program and students in other graduate programs looking for policy electives (e.g., Environmental Science). **Class 4, Credit 4 (offered annually)**

Communication & Media Technologies

0535-700 **Film and Society**
An inquiry concerning the relationship between motion pictures and society that will use historical, humanistic, and social science research to achieve an understanding of movies as a social force, industry and art form. **Class 4, Credit 4 (offered occasionally)**

0535-701 **History of Media Technologies**
An introduction to the history of media technologies including print, telephone, broadcasting, and digital media. The course will also cover the inventors, landmark events, regulations and ethics of communication media along with their effects on and relationships with people and culture. **Class 4, Credit 4**

0535-702 **Communication Theory**
This course focuses on theories of communication as they relate to technology. Theories based in both the humanities and in the social sciences that explain or predict the effects of communication technology on audiences will be presented. **Class 4, Credit 4**

0535-703 **Research Methods in Communication**
An introduction to and overview of the methods and ethics of scholarly communication research including quantitative and qualitative approaches. The course focuses on methods of locating, critically analyzing and conducting communication research, and leads to the development of a research proposal suitable for a thesis or project. (0535-701,702) Class **4, Credit 4**

0535-704 **Communication Law and Ethics**
This course focuses on issues presented by communication technologies to the practice of law and study of standards of ethics. Legal challenges presented by communication technologies will be examined in the following contexts: intellectual property, technology rights, patents, privacy and information networks, access to information, defamation, indecency, obscenity, and pornography. Special attention will be paid to the difficulty of applying national laws to inter- national media. (0535-701 and 0535-702) **Class 4, Credit 4**

0535-705 **Electronic Communication and Society**
An inquiry about the Internet and how it exerts a powerful influence on communicative practices and society. Positioned at the intersection of technology, identity, and culture, the Internet has altered the ways in which people communicate in a wide range of contexts, including education, marketing, civic discourse, politics and popular culture. Utilizing theories about the relationship between communication technology and culture, this course will explore the current and potential future impact of electronic communication in social settings. **Class 4, Credit 4**

0535-706 **Crafting the Message**
This course will focus on the creation of written and visual messages appropriate to a targeted audience and a specific medium including print, broadcast, interactive, digital and on-line technologies. Case studies of effective and unsuccessful messages from advertising, politics, public service, education, entertainment and development will be examined. Students will have the opportunity to create and execute a variety of messages using various writing styles and images, and with varying purpose. (0535-701, 702) **Class 4, Credit 4**

0535-707 **International Media**
This course will evaluate media technology use in the international setting and in various countries and regions of the world. Major theories about the media, international communication developments, an d governmental challenges and restrictions are considered. Comparative and cross-cultural studies of the uses and effects of media technologies within various countries with special focus on global implications of the World Wide Web and computer technologies on international cooperation, trade and culture will be explored. (0535-701,702) **Class 4, Credit 4**

0535-708 **Communication Education**
This course examines various aspects of teaching communication in higher education. Students will explore teaching and learning styles, the role of technology in higher education, and assessment methods. Students will create teaching resources and gain experience teaching in a college classroom. **Class 4, Credit 4**

0535-709 **Online Public Relations and Advertising**
This course is a study of the practices in public relations and advertising. Topics include identification of publics and selection of media, planning and evaluating campaigns, designing promotional materials, as well as employee, member, community and media relations. Special attention will be paid to online advertising including the creation, measurement, accounting and targeting of internet advertisements, e-newsletters, e-mail, sponsorships, interactive advertising and consumer tracking. (0535-701, 702) **Class 4, Credit 4**

0535-710 **Visual Communication**
This course focuses on the use of still or moving images in mediated communication. Examples from print, television, internet, photography and film will be examined in light of traditional and emerging media. Rhetoric of image based technologies is examined. **Class 4, credit 4**

0535-712 **Computer-Mediated Communication**
A graduate seminar examining the evolving forms and functions of computer-mediated communication, including e-mail, discussion groups, newsgroups, chat, instant messenger, and web pages. Grounded in rhetorical, mass media, and interpersonal theory the seminar explores electronically-mediated communication in its many contexts and manifestations in an effort to understand the evolving forms and functions of CMC and its impact on communicative behaviors and public discourse. Course objectives are met through readings, written papers, online observations, lectures, and class discussions. **Class 4, Credit 4 (offered occasionally)**

0535-725 **Special Topics: Master's Level**
This course is a focused, in-depth study and analysis of a selected advanced topic in communication and associated issues. Specific topics vary according to faculty assigned and are published when the course is offered. This course is an elective for communication and media technology majors. **Class 4, Credit 4**

0535-800 **Communication Thesis and Project**
The graduate thesis/project will be guided and approved by the student's graduate advisement committee. Students may elect to conduct original research reported in a graduate thesis or to apply theory and research in an applied project. A minimum of 5 credits and no more than 9 credits can be earned as thesis/project credits.

College of Science

www.rit.edu/~670www/

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 career or further study toward a more advanced graduate degree in a chosen discipline.

Whether the focus is on the foundations of matter, applications of mathematics, the role of the chemist in the health care environment, the specialized properties of advanced materials, or the science and technology of advanced imaging systems, the College of Science graduate faculty provide a valuable and integrated understanding of today's biological, environmental, clinical, industrial, and research issues.

Ian Gatley, Dean

Programs

Master of Science degrees in:

Doctor of Philosophy degree in:

= *Online learning option available*

Department of Biological Sciences

www.rit.edu/672www/

Master of Science in Bioinformatics

Gary Skuse, Director
(585) 475-2532, grssbi@rit.edu

The master of science degree in bioinformatics is offered on a part-time or full-time basis in order to fulfill the needs of traditional students, as well as those currently employed in the Greater Rochester area. Graduates develop a strong foundation in biotechnology, computer programming, computational mathematics, statistics, and database management, and will be prepared for careers in the biotechnology, bioinformatics, pharmaceutical, and vaccine industries. For those trained at both the bachelor's and master's levels, the job market is rich with opportunities.

Most of the individuals now employed in bioinformatics were not specifically trained in this field. Instead, they chose it because the shortage of people with both biology and computer science/information technology expertise offered unusual opportunities for career growth and rewards. At present, most bioinformatics employees have formal training in biology or biotechnology and only limited familiarity with computational tools.

Based on consultation with individuals within the industry nationwide, we expect the credential most in demand in the future will be the master of science degree, particularly when coupled with industry-sponsored research as thesis work. That research will provide exposure to real-world problems — and their solutions — not otherwise attainable in an academic setting.

The objective of the program is to provide students with the capability to enter the bioinformatics workforce and become leaders in the field. This objective is being addressed through a curriculum designed to fulfill the needs of students with diverse educational and professional backgrounds. Individuals entering an MS program in bioinformatics typically have degrees in biology, biotechnology, chemistry, statistics, computer science, information technology, or a related field. The MS program at RIT accommodates this diversity in two ways. First, there is a comprehensive bridge program for students who need to supplement their education before entering the MS program. Second, the MS 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 will be prepared to become professional bioinformaticists upon graduation.

Admission

Individuals with baccalaureate degrees in biology, biotechnology, biochemistry, chemistry, computer science, information technology, statistics, or related disciplines are invited to apply. Admission decisions will be based on a composite of prerequisites, including an undergraduate grade point average of 3.2 or better, with an average of 3.4 in the field of study. GRE scores may be required in some cases.

English language requirement

All applicants who do not speak English as their primary language are required to take the Test of English as a Foreign Language (TOEFL) and achieve a minimum score of 570 (230 computer-based).

Degree requirements

A minimum of 50 quarter credit hours, including eight core courses, is required for completion of the program. The two tracks are illustrated below. A choice of professional graduate electives is available so that each student may pursue areas of personal or professional interest. In addition, every student is required to complete a research project that addresses a relevant and timely topic in bioinformatics, culminating in a thesis. Graduate electives may be chosen from any relevant RIT graduate courses.

Curriculum

Computational science degrees	Qtr. Cr. Hrs.
1001-700 Cell and Molecular Genetics	4
1001-701 Cell and Molecular Genetics II	4
4002-762 introduction to Bioinformatics Computing	4
4002-763 Advanced Bioinformatics Computing	4
1001-722 Bioinformatics Seminar	2
1001-725 Ethics in Bioinformatics	3
1001-794 Molecular Modeling and Proteomics	4
1016-715 Statistical Models for Bioinformatics	4
Graduate electives	11
1001-890 Thesis	10
Total	50

Life science degrees	Qtr. Cr. Hrs.
4003-709 Programming Language Concepts	4
4002-720 Data Object Development	4
4002-762 Introduction to Bioinformatics Computing	4
4002-763 Advanced Bioinformatics Computing	4
1001-722 Bioinformtics Seminar	2
1001-725 Ethics in Bioinformatics	3
1001-794 Molecular Modeling and Proteomics	4
1016-715 Statistical Models for Bioinformatics	4
Graduate electives	11
1001-890 Thesis	10
Total	50

Master of Science in Environmental Science

(585) 475-7577

Our natural world is under relentless assault, and the long-term future and quality of life on this planet hangs in the balance. Deforestation, global climate change, water and air pollution, ozone depletion, loss of biodiversity, and the accumulation of toxic wastes are outcomes of human behaviors that stem from a general belief that the environment is infinitely renewable. It is not.

Environmental science careers in the 21st century will necessarily focus on sustainable development, which, according to a 1987 United Nations report titled Our Common Future, is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Environmental scientists must understand the complexity of problems that pit environmental preservation against economic development and social stability. They must use integrated and holistic approaches to finding solutions to these problems.

Built on the concept that environmental issues are inherently interdisciplinary, the program is offered jointly by the department of biological sciences in the College of Science and by the department of science, technology, and society in the College of Liberal Arts. The curriculum is designed to provide students with a deep understanding of the complex set of circumstances that impact environmental issues, and how environmental decisions and policies attempt to find a balance between environmental conservation and economic development. Consistent with RIT’s long history of experiential, hands-on education, coupled with the development and use of innovative high technology, the program offers students a unique opportunity to prepare for careers in environmental science by working on real-world environmental problems under the guidance of talented and skilled environmental scientists.

Admission requirements

Admission to the program will be granted to qualified graduates who hold a bachelor’s degree in environmental science, biological sciences, or a related field of study. The admission decision will be based on:

- a minimum GPA of 3.0 (overall and in science/math),
- a minimum TOEFL of 550 (213 computer-based),
- a brief statement outlining career goals and objectives, and
- three letters of recommendation.

Curriculum

The master's program includes a core curriculum and electives chosen to reflect the student's background and career goals. A minimum of 51 quarter credit hours beyond the bachelor's degree is required. Required courses include:

	Qtr. Cr. Hrs.
1001-475 Conservation Biology	4
1006-701, 702, 703 Environmental Science Problem Solving I, II, Ill	12
1006-710 Graduate Readings Seminar	3
1015-720 Environmental Chemistry	3
0307-712 Fundamentals of Statistics II	4
1006-879 Environmental Science Research	5
Environmental science graduate elective	4
Environmental policy graduate elective	4
Environment and Society graduate elective	4
Graduate electives	8

Five-year combined BS/MS programs

The BS/MS program in environmental science allows undergraduate environmental science students the opportunity to acquire an MS degree with only one extra year of study. Undergraduate majors are considered for entrance into the BS/MS combined program at the end of their third year of undergraduate study.

External research credit

The environmental science program recognizes that the employment experience of a number of environmental scientists, employed in the environmental community includes independent, creative research. This experience may be applied toward the completion of the MS degree in environmental science on either a full- or part-time basis.

Thesis or project

All students enrolled in the environmental science graduate program must propose, conduct, and report on an original research project.

Equipment

Monitoring, mapping, and field equipment

ArcView 8 (ArcGIS) and IDRISI Kiliminjaro GIS software, Garmin GPS receivers, pocket PCs with ArcPad software, soil sampling equipment, soil analysis equipment, water sampling devices, multimeters, individual probes, wet labs for water quality analysis, ponar dredges, plankton samplers, macroinvertebrate nets/samplers, and a library of field reference texts

Other equipment

Fluorimeter, Raman Spectrometer, W-Vis, GC-MS, ICP, atomic absorption, polarimeter, TGA's Micro-extruder, centrifuge, electrochem equipment, gas chromatography, HPLC detectors, viscometer, ESR (built in-house), incubators, infrared spectrophotometers, capillary electrophoresis, DSC's, DMA, Asher, 300 MHz NMR, drying oven, leaf area index meter, digital clinometer, and a Wiley mill.

Facilities for research

The environmental science program provides a wide range of research opportunities. Many environmental science faculty members are engaged in field-based projects. We also have excellent laboratory facilities in support of field research, including wet laboratories and computer facilities (traditional and geographic information systems).

Additional information

More information may be obtained by contacting the director of environmental science, **(585) 475-7577,** or the website, www.rit.edu/~envsci/.

Department of Chemistry

Terence* C. *Morrill,, Department Head
(585) 475-2497, tcmsch@rit.edu
www.rit.edu/chemistry

Master of Science in Chemistry

Thomas Smith, Chair, Chemistry Graduate Committee
(585) 475-7982, twssch@rit.edu

The master of science degree in chemistry is offered on a part-time or full-time basis. The program options are designed to fill the needs of both the practicing chemist in the Greater Rochester industrial community and full-time graduate student.

The department of chemistry has research- and teaching-oriented faculty, as well as excellent equipment and facilities that enable full-time graduate students to carry on a program of independent study that develops the ability to attack scientific problems at the research level. The research can result in either a thesis or a project report.

Through course work and research experience, the program strives to increase both the breadth and depth of the graduate student's background and provide an opportunity for the student to attack scientific problems on his or her own initiative with minimal supervision.

Admission requirements

Admission to the program will be granted to qualified graduates who hold a bachelor's degree in chemistry from an accredited college or university. Applicants with a bachelor's 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.

The admission decision will be based on:

- College transcripts
- GRE scores (chemistry exam is recommended)
- Letters of reference

As a supplement to the normal application process, it is strongly recommended that students visit RIT. All candidates for financial

aid must have a personal interview with the department head. International students can complete the interview by phone. An applicant with a bachelor's degree from an approved undergraduate school and the background necessary for specific courses is permitted to take graduate courses as a nonmatriculated student. If the student is formally admitted to the graduate program at a later date, courses taken for credit usually can be applied toward the master's degree. However, the number of credits that will be transferred to the degree program from courses taken at RIT as a nonmatriculated student will be limited to a maximum of nine.

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.

All students who do not speak English as their primary language are required to submit TOEFL scores. Foreign students , may be required to take the Michigan Test, given by the RIT English Language Center. If a student's score is below standard, he or she must follow the recommendations of the center for additional course work. Successful completion of this work is a program requirement for the master of science degree in chemistry. This may mean that the student will need additional time and financial resources to complete the degree program.

Curriculum

The program offers concentrations in the traditional disciplinary areas of organic, analytical, inorganic, and physical chemistry. In addition, interdisciplinary concentrations in polymer chemistry, materials science, biochemistry, and environmental chemistry are available. Customized program options are available to accommodate specific student interests and needs relating to graduate study in chemistry.

Each student, together with an adviser, will arrange a program best suited to his or her interests and needs. This program will be subject to the approval of the department head and the chair of the graduate committee.

A deliberate effort will be made to strengthen any areas of weakness indicated by the student's undergraduate records and the placement examinations. To qualify for the MS degree, a candidate must satisfy the following requirements:

1. A minimum of 45 quarter credit hours beyond the bachelor's degree. Courses in chemistry will generally be chosen from 700- and 800-level courses and should include one or more courses in analytical, organic, and physical chemistry. The core requirement is one course each in organic, physical, and analytical chemistry, plus one course in inorganic chemistry, if an appropriate undergraduate course was not taken. Specifically, each student must select core courses (subject to approval by the student's adviser and the graduate committee) that include the following: analytical chemistry, 1008-621 and 1008-711; organic chemistry, 1013-737 or 1013-739; and physical chemistry, 1014-741, 1014-742, 1014-743, or 1014-744. The inorganic core course is 1012-764. As part of the required credits, each student must have one or two quarter credit hours in seminar 1010-870 and three to four quarter credit hours from outside of the department of chemistry. A maximum of nine quarter credits may be taken in undergraduate-level courses.

2. Nine credit hours in research (minimum) for the MS thesis option. A minimum of four and a maximum of eight credit hours are required with the project option. *The program also offers a course-work-only MS option. With this option, the student must complete a four credit hour capstone course.*

3. Passage of an oral defense of the MS thesis. Students enrolled in the program full time are expected to complete 45 credit hours of course work, including up to 21 quarter credit hours of research leading to the submission of an independent research thesis. A full-time student normally takes six to nine graduate credits per quarter, including thesis work. Typically, all requirements are met within two years. No more than eight credit hours of research are allowed in the nonthesis MS option.

Part-time study

The department of chemistry encourages practicing chemists in the Greater Rochester industrial community to pursue a program toward the master of science degree in chemistry without interrupting their employment. Consequently, most of the courses in the graduate program in chemistry are scheduled in the late afternoon or early evening.

Part-time students in the program may take the course-work-only option with the capstone project, 1010-800. Students employed full time normally take one course each quarter. At this pace, course work can be completed within four to five years.

Five-year combined BS/MS programs

The BS/MS program combines the BS chemistry programs with the MS chemistry program, and enables undergraduate chemistry majors to acquire an MS degree with only one extra year of study. Undergraduate chemistry majors may be considered for entrance into the combined BS/MS chemistry program after completion of their sophomore year. Students in the combined program take graduate-level electives and typically complete an MS thesis or project. Students in the combined BS/MS chemistry program receive both the BS and MS degrees after five years of full-time study.

Equipment

The department of chemistry has modern instrumentation in the areas of spectroscopy (NMR, IR, W-vis, fluorescence, atomic absorption, fluorimetry), chromatography (gas chromatography, gas chromatography-mass spectrometry, high-performance liquid chromatography, capillary electrophoresis, etc.), and materials characterization (rheometry, thermal gravimetric analysis, differential scanning calorimetry, hot-stage micro-

scopy, contact angle goniometry). A full listing of departmental instrumentation is available on the chemistry department's webpage at www.rit.edu/~chemwww/resources/instrumentation /instruments.html.

External research credit

The department of chemistry recognizes that the in-plant experience of a number of chemists employed in local industry includes independent, creative research. A maximum of 16 hours of research credit, conducted during employment, may be applied towards the completion of the master of science degree in chemistry on either a full- or part-time basis.

Cooperative education option

The cooperative education option accommodates students at the master's level who have or are able to obtain industrial employment. Quarters of work can be interspersed with quarters of full-time academic work. If industrial employment permits research, up to 16 of the 45 required credits may be obtained through the external research credit option. If industrial employment does not permit research, then research credits may be obtained within the department of chemistry.

Additional information

More information may be obtained from the chair of the graduate committee, (585) 475-7982, the department of chemistry, (585) 475-2497, or the website, www.rit.edu/chemistry.

Department of Medical Sciences

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www.rit.edu/~676www

Master of Science in Clinical Chemistry

James C. Aumer, Interim Director, Clinical Chemistry Program
(585) 475-2526, jcascl@rit.edu

The clinical chemistry program is designed for full- or part-time graduate study. Required courses are offered regularly during the late afternoon or evening in order to accommodate the work schedules of part-time students.

The program is designed to provide a focused educational experience for individuals preparing for careers in clinical chemistry. The design of the program provides technical and managerial proficiencies in either the diagnostic laboratory or a related industry.

Admission requirements

Individuals holding a bachelor's degree in chemistry, biology, medical technology, nuclear medicine technology, or a related field from an accredited college or university are invited to apply.

All students who do not speak English as their primary language are required, upon arrival at RIT, to take the Michigan Test, given by the RIT English Language Center. If a student's score is below standard, he or she must follow the recommendations of the center for additional course work. Successful completion of this work is a program requirement for the master of science degree in clinical chemistry. This may mean the student will need additional time and financial resources to complete the degree program.

Curriculum

The master's program includes a core curriculum and electives that are chosen to reflect the student's background and career goals. A minimum of 50 quarter credits beyond the bachelor's degree is required. Required courses include:

1009-702	Biochemistry: Biomolecular Conformation and Dynamics
1009-703	Biochemistry: Metabolism
1013-736	Spectrometric ID of Organic Compounds
1023-705	Mechanisms of Disease
1023-820,	821, 822 Advanced Clinical Chemistry I, II, Ill
0102-740	Organizational Behavior and Leadership
1016-715	Statistical Models for Bioinformatics
1023-877	External Clinical Chemistry Research
or	
1023-879	Internal Clinical Chemistry Research

All students are required to carry out and defend original research as part of the program requirements. Research is carried out under the direction of a faculty member and is reviewed and defended before a graduate committee appointed by the program director.

Students in the clinical chemistry program come from diverse educational backgrounds and have a variety of professional goals. The program focuses on the activities of the diagnostic clinical laboratory, developmental research in pathology, and diagnostic testing, as well as industrial activities related to clinical laboratory products and instruments.

Additional information

For more information, see our website or contact the Office of Graduate Enrollment Services.

Department of Mathematics and Statistics

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Master of Science in Applied Mathematics

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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 department of mathematics and statistics offers an interdisciplinary master of science degree program in applied mathematics. The objective of the program is to provide the student 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, implementable solutions. Since this is an interdisciplinary program, students have the opportunity to choose from a wide variety of courses.

Admission requirements

The applicant should have a baccalaureate degree with a cumulative grade point average of 3.0 or above (or its equivalent) from an accredited institution. The degree could be in mathematics or any related field. The prerequisite courses are multivariable calculus, differential equations, matrix theory, probability, and statistics. Knowledge of a programming language also is required.

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 the student completes these requirements, he or she is considered a nonmatriculated student. The graduate coordinator evaluates the student to determine eligibility for conditional and provisional admission.

All students who do not speak English as their primary language are required to take the Test of English as a Foreign Language (TOEFL) and achieve a minimum score of 550 (paper-based) or 213 (computer-based). 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 GRE scores are not required, submitting them enhances the chances of a student's acceptance into the program.

Student's advisory committee

Upon admission to the program, the student chooses an adviser and forms an advisory committee, whose responsibilities are to help the student formulate a concentration, select appropriate courses, and oversee the academic aspects of the student's program.

Curriculum

The master's degree program in applied mathematics consists of 48 quarter credit hours of study. There are four "core courses,'' for a total of 16 quarter credit hours. These courses, usually taken by the student in the first two quarters of the program, provide a focus on some of the ideas of applied mathematics. They are determined by the department to provide a foundation for further study and cover numerical linear algebra, stochastic processes, boundary value problems, and combinatorics. Core courses are offered every year.

The concentration and the corresponding course of study are formulated by the student in consultation with his or her advisory committee. The student completes a total of 24 quarter credit hours by taking a set *of six* specialized courses offered in the department of mathematics and statistics, as well as other departments. Some of the possible concentrations are dynamical systems, operations research, imaging science, biomathematics, bioinformatics, and discrete mathematics.

The program of study culminates in thesis or project work. The thesis option requires that the student present original ideas and solutions to a specific mathematical problem. The project option involves applying or adapting existing methodologies to solve a problem or an expository paper on the methodology in a particular area. Both a proposal for the thesis or project work and the results must be presented and defended before the advisory committee.

Cooperative education option

The optional cooperative education (co-op) program enables the student to alternate periods in school with full-time, paid professional employment. Students may sign up for the co-op program after their first quarter.

Part-time study

The program is ideal for practicing professionals who are interested in applying mathematical methods in their work and enhancing their career options. All courses are scheduled in the late afternoon or early evening. The graduate program may normally be completed in two years (six quarters) of part-time study.

Nonmatriculated students

A student with a bachelor's degree from an approved undergraduate school, and with the background necessary for specific courses, may take graduate courses as a nonmatriculated student with the permission of the graduate coordinator and the instructor. Courses taken for credit may be applied toward the master's degree if the student is formally admitted to the graduate program at a later date. However, the number of credits that will be transferred to the degree program from courses taken at RIT as a nonmatriculated student will be limited to a maximum of 12 quarter credits.

Center for Materials Science and Engineering

Master of Science in Materials Science and Engineering

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The program, under the joint auspices of the colleges of Science and Engineering, offers graduate studies leading to the master of science degree in materials science and engineering, with a

variety of options designed to satisfy individual and industry needs in the rapidly growing field of materials. The overall thrust of the program is to establish a positive relationship between academia and industry by building a sound academic base in the field.

A large number of highly qualified scientists and engineers in the Rochester area are engaged in the research and development of materials. This reservoir of talent is utilized to ensure the breadth and quality of the program.

The objectives of the program are threefold:

- With the advent of whole 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.

Admission requirements

The program is open to individuals with a bachelor's degree in chemistry, physics, chemical engineering, electrical engineering, mechanical engineering, or a related field from an accredited college or university. 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 he or she meets the general requirements mentioned above.

A person not meeting the general requirements may petition for admission to the program. In such cases, the necessary background courses will be taken at the undergraduate level. However, undergraduate credits that make up deficiencies may not be counted toward the master's degree.

To be considered for admission, it is necessary to file an application for admission to graduate study, accompanied by the appropriate transcripts of previous study, and two letters of recommendation.

All applicants for whom English is not their primary language are required to take both the Test of English as a Foreign Language (TOEFL) and the Test of Written English (TWE) examinations. A minimum score on the TOEFL of 575 (paper-based) or 230 (computer-based), and 4.0 on the TWE, is required. In addition, upon arrival at RIT, these students are required to take the Michigan Test of English Language Proficiency, administered by the RIT English Language Center. Individuals scoring below an established minimum, will be referred to the English Language 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 may require additional time and financial resources to complete the degree requirements. Successful completion of this course work is a requirement for the master of science degree in materials science and engineering.

Curriculum

A special feature of the program is the offering of five required core courses. 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 core courses are offered every year, and the elective courses are scheduled on a periodic basis.

There is an emphasis on experimental techniques in the program, with one required experimental course and additional optional experimental courses available. These are organized into appropriate units covering many aspects of analysis of materials. This aspect of the program should enhance student confidence when dealing with materials-related problems.

A minimum of 45 quarter credit hours, which includes five core courses (1028-701 through 1028-705) and the seminar course (1028-890), is required for completion of the program.

The remaining 24 quarter credit hours are completed either as a combination of the research thesis and elective courses, as a combination of external research and elective courses, or as elective courses. The elective courses may be selected from advanced courses offered by the Center for Materials Science and Engineering or, upon approval, from courses offered by other RIT graduate programs. Transfer credit may be awarded based on academic background beyond the bachelor's degree or by examination, based on experience.

Part-time study

Practicing scientists and engineers are encouraged to pursue the program on a part-time basis; therefore, all of the courses are offered in the early morning, late afternoon, or early evening. (This may not apply to courses offered off campus at selected industrial sites.) Students employed full time in industry are normally limited to a maximum of two courses, or eight credit hours, each quarter. A student who wishes to register for more than eight credit hours while employed full time must obtain the permission of his or her adviser.

Advanced certificate

An advanced certificate in materials science and engineering is available primarily for part-time students. It requires completion of 24 quarter credit hours of course work.

Five-year combined BS/MS programs

A combined BS in chemistry and an MS in materials science and engineering, a BS in microelectronic engineering and an MS in materials science and engineering, or a BS in electrical engineering and an MS in materials science and engineering

(state approval pending) are available. These degree programs can be completed in five years. Consult with the director of the Center for Materials Science and Engineering for more details.

Thesis option and the external research option

The inclusion of a research thesis as a formal part of the master of science degree program in materials science and engineering is optional. The research thesis option carries a minimum of nine and a maximum of 16 quarter credit hours, subject to the review and approval of the project.

The external research option allows participants to continue their studies in their work environment, thus enhancing job satisfaction. In-plant work experience in materials-related areas may include independent study and creative research. This external research option may be applied, for a minimum of four and a maximum of eight quarter credit hours, toward the completion of the master of science degree.

Maximum limit on time

The required credits for the master's degree must be completed within seven years of the oldest credits applied toward the degree.

Chester F. Carlson Center for Imaging Science

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The Chester F. Carlson Center for Imaging Science was established in 1985 for the interdisciplinary study of all aspects of imaging. The center offers bachelor of science, master of science, and doctoral degrees in imaging science and a master of science degree in color science. The Chester F. Carlson Building contains extensive laboratories supporting the center's teaching and research mission. The Color Science Building houses the Munsell Color Science Laboratory and the Franc Grum Color Science Learning Center.

Master of Science in Color Science

Roy S.. Berns, Coordinator
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Color science is broadly interdisciplinary, encompassing physics, chemistry, physiology, statistics, computer science, and psychology. The curriculum, leading to a master of science degree in color science, educates students using a broad interdisciplinary approach. This is the only graduate program in the country devoted to this discipline and it is designed for students whose undergraduate majors are in physics, chemistry, imaging science, computer science, electrical engineering, experimental psychology, physiology, or any discipline pertaining to the quantitative description of color.

Graduates are in high demand and have accepted industrial positions in electronic imaging, color instrumentation, colorant formulation, and basic and applied research. Companies that have hired RIT graduates include Benjamin Moore, Canon Corp., Eastman Kodak Co., Hallmark, Hewlett Packard Corp., Microsoft Corp., Pantone, Qualcomm Inc., Ricoh Innovations Inc., Samsung, and Xerox Corp.

The color science major provides graduate-level study in both theory and practical application. The program gives students a broad exposure to the field of color and affords them the unique opportunity of specializing in an area appropriate for their background and interest. This objective will be accomplished through the program's core courses, selection of electives, and completion of a thesis or graduate project.

The degree program in color science revolves around the activities of the Munsell Color Science Laboratory within the Center for Imaging Science (www.cis.rit.edu/research/mcsl). The Munsell Laboratory is the preeminent 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, and computer graphics; and consumer digital camera and digital-cinema camera optimization.

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.

Admission requirements

Prior to being admitted to the master of science degree program, the coordinator of the program must be satisfied that an applicant's previous education, ability, and practical experience indicate a good chance of success. Scientific reasoning, technical writing, and oral communication skills are particularly important. Admission requirements include:

- Graduate application
- Earned baccalaureate degree
- Graduate Record Examination (GRE)
- Official undergraduate transcript
- Two professional recommendations
- An on-campus interview (when possible)
- GPA of 3.0 or higher
- Foundation course work with GPA of 3.0 or higher (if required)
- TOEFL score of at least 587 (paper-based), 240 (computer-based), or 94 (Internet-based) (international students)

Financial aid

The scholarships and assistantships available for qualified color science applicants include the Macbeth-Engel Fellowship, Grum Memorial Scholarship, Saltzman Memorial Scholarship, Munsell Color Science Laboratory Assistantship, and research assistantships associated with ongoing grants and contracts. Students receiving fully funded assistantships tend to have undergraduate cumulative grade point averages of 3.5 and higher and exceptional GRE scores. Applicants whose native language is not English have TOEFL scores above 600 (paper based), 250 (computer based), or 100 (Internet-based) and TSEA scores above 250. Partial assistantships also are awarded. Applicants seeking financial assistance from the center must submit all application documents to the Office of Graduate Enrollment Services by February 15 for the next academic year.

Prerequisites: The foundation program

The color science program is designed for the candidate with an undergraduate degree in a scientific or nonscientific discipline. Candidates with adequate undergraduate work in related sciences start the program as matriculated graduate students.

Candidates without adequate undergraduate work in related sciences must take foundation courses prior to matriculation into the graduate program. Such students may be required to take as many as 36 credits in these subjects. A written agreement between the candidate and the program coordinator will identify the required foundation courses.

Foundation courses must be completed with an overall B average before a student can matriculate into the graduate program. A maximum of nine graduate-level credit hours may be taken prior to matriculation into the graduate program.

The foundation courses listed below are representative of those often required.

- 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
- One course in introductory psychology

Curriculum

All students must earn 45 credits as a graduate student, 36 of which must be taken at RIT, to earn the master of science degree. For full-time students, the program requires four to six quarters of study at the graduate level. Part-time students generally require two to four years of study at the graduate level. The curriculum is a combination of required courses in color science, elective courses appropriate for the candidate's background, and either a research thesis or graduate project. Students must enroll in either the research thesis or graduate project option at least one year before completion of required course work.

Core courses

All graduate students in the MS program are required to complete the following core courses:

		Qtr. Cr. Hrs.
1051-720	Vision	4
1050-702	Applied Colorimetry	4
1050-721	Color Measurement Laboratory I	3
1050-703	Color Appearance	3
1050-722	Color Measurement Laboratory II	3
1050-813	Color Modeling	4
1050-801	Color Science Seminar	3

Elective courses

Appropriate elective courses should be selected to bring course work to 36 credit hours for the research thesis option or 41 credit hours for the graduate project option. Approval by the color science coordinator is required. (Some courses might require special permission for enrollment.) The following is a partial list:

		Qtr. Cr. Hrs.
0307-801, 802	Design of Experiments I, II	3
0307-834	Multivariate Statistics for Imaging Science	4
4005-761	Fundamentals of Computer Graphics	4
1051-728	Design and Fabrication of Solid State Cameras	4
1051-739	Principles of Solid State Imaging	4
1051-749	Color Reproduction	4
1051-782	Introduction to Digital Image Processing	4
1051-790	Image Rendering	4
1051-816	Color Systems	4

Typical full-time schedule of courses

Fall

		Qtr. Cr. Hrs.
1051-720	Vision	4
1050-721	Color Measurement I Lab	3
1050-801	Color Seminar	1
1050-753	Computing for Color Science	4

Winter

1050-702	Applied Colorimetry	4
1050-722	Color Measurement II Lab	3
1050-801	Color Seminar	1
Graduate	elective	4

Spring

1050-703	Color Appearance	3
1050-813	Color Modeling	4
1050-801	Color Science Seminar	1
Graduate	elective	4

During the second year, full-time students enroll in research and thesis, to total nine credits.

Research thesis option

Students without research experience are encouraged to select the research thesis option (nine credits). The thesis is performed during the second year of study. Topics are chosen that complement the candidate's undergraduate education and career interests. The technical advisory board of the Munsell Color Science Laboratory, as well as the program coordinator, can aid in the selection of a thesis topic. Full-time students receiving full-time assistantships are required to perform a research thesis.

Graduate project option

Students with research experience may select the graduate project option (four credits). The project has the same intellectual level as a research thesis but is less lengthy. It might take the

form of an experiment, demonstration, research project, or critical review. The graduate project is normally performed during the last quarter of study. Part-time students often select this option.

Munsell advisory board

The Munsell Color Science Laboratory advisory board ensures that research activities surrounding the degree program are relevant to current industrial needs. The board's members have expertise in color vision, color measuring instrumentation, psychophysics, color imaging, instrument-based color matching, lighting, art, and applied color technology. The advisory board is an excellent resource for students in the selection of both a thesis topic and future placement.

Master of Science in Imaging Science.

Joel Kastner, Coordinator
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The objective of this program is to prepare men and women holding a bachelor's degree in science or engineering for positions in research in the imaging industry, or in the application of various imaging modalities to problems in engineering and science. Formal course work includes consideration of the physics and chemistry of radiation-sensitive materials and processes, the applications of physical and geometrical optics to electro-optical systems, the mathematical evaluation of image forming systems, and the statistics of experimental design and quality control. Technical electives at the graduate level may be selected from courses offered in imaging science, color science, engineering, computer science, science, and mathematics. Both thesis and project options are available. In general, full-time supported students are required to pursue the thesis option, with the project option targeted to part-time 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 chemistry and physics of radiation-sensitive materials and processes, digital image processing, remote sensing, nanoimaging, electro-optical instrumentation, medical diagnostic imaging, color imaging systems, and astronomical imaging. Interdisciplinary efforts are possible with the colleges of Engineering and Science.

The degree requirements can be completed on a full- or a part-time basis. An online version of the MS program is available in the areas of color science, remote sensing, medical imaging, and digital image processing. Interested students should consult the website (www.cis.rit.edu) or contact the graduate coordinator.

Admission requirements

Admission will be granted to graduates of accredited degree-granting institutions whose undergraduate studies have included at least courses in the major areas of study - 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.

Applicants must demonstrate to the Graduate Admissions Committee of the Center for Imaging Science that they have the capability to pursue graduate work successfully. Normally this will include the submission of a statement of purpose, presentation of undergraduate academic records, letters of evaluation from individuals familiar with the applicant's capabilities, and any other pertinent data furnished by the applicant. While previous high academic achievement does not guarantee admission, such achievement or other unusually persuasive evidence of professional promise is expected.

Applicants seeking financial assistance from the center must have all application documents submitted to the Office of Graduate Enrollment Services by February 15 for the next academic year. Those seeking funding from the center are also required to take the GRE. Students whose native language is not English must demonstrate proficiency in English, as evidenced, for example, by a minimum TOEFL score of 600 (paper-based), 250 (computer based), or 100 (Internet-based). Students whose native language is not English are advised to obtain as high a TOEFL score as possible if they wish to apply for a teaching or research assistantship. These candidates also are encouraged to take the TSE-A (Test of Spoken English) in order to be considered for financial assistance.

Grades

The grade point average for all courses taken at the university and credited toward a master's degree must be at least a B (3.0). Research thesis credits do not carry a letter grade and are not included in the average.

Curriculum

Imaging science is available as a full- or part-time master's degree program. All students must earn 45 credits as a graduate student, 37 of which must be taken at RIT, to earn the master of science degree.

The curriculum is a combination of required core courses in imaging science and elective courses appropriate for the candidate's background and interests. Seven tracks (concentrations) have been established: digital imaging processing, medical imaging, electro-optical imaging systems, remote sensing, color imaging, hard copy materials and processes, and nanoimaging. Additional tracks may be created for interested students. Students must enroll in either the research thesis or graduate paper/project option at the beginning of their studies.

Candidates who wish to enter the program but lack adequate preparation may have to take bridge courses in mathematics, chemistry, or physics before matriculating with graduate status. All graduate students in the MS program are required to complete five of the seven doctoral program core courses, with the only required course being Fourier Methods for Imaging (1051-716).

All non-imaging science courses must be approved by the CIS master of science coordinator as acceptable for CIS credit.

Research thesis option

Full-time students who elect this option begin their thesis work during the first year of study. Part-time students may defer the beginning of their thesis work until their second or subsequent years. Full-time students receiving funding assistance are required to choose the research thesis option. Students who elect this option will take 36 credit hours of course work (including the core) and nine credit hours of thesis/research, three of which are associated with the graduate research seminar course (1051-706, 707, 708).

The thesis is to be based on experimental evidence obtained by the candidate in an appropriate field, as arranged between the candidate and his or her adviser. The minimum number of thesis credits required is nine. The thesis requirement may be fulfilled by experiments in the university's laboratories. In some cases, the requirement may be fulfilled by work done in other laboratories. An example might be the candidate's place of employment, under the following conditions:

1. The results must be fully publishable.
2. The candidate's adviser must be approved by the graduate coordinator.
3. The thesis must be based on the candidate's independent, original work, as it would be if the work were done in the university's laboratories.

A student's thesis committee is composed of a minimum of three people: the student's adviser and two additional members who hold at least an MS in a field relevant to the student's research. Two committee members must be from the graduate faculty of the center.

Graduate paper/project option

Students with demonstrated practical or research experience, approved by the graduate coordinator, may choose the graduate project option (5 credit hours) in addition to 40 hours of core and elective courses. This option takes the form of a systems course (a different course for each track) and an associated project/paper. The graduate paper is normally performed during the final quarter of study. Both part- and full-time students may choose this option, with the approval of the graduate coordinator.

Typically, two years is required for the master of science if the degree is pursued on a full-time basis. Whether a student pursues the thesis or project/paper option, all degree requirements must be completed within seven years of the first course taken for the degree.

Doctor of Philosophy in Imaging Science

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The doctor of philosophy degree in imaging science signifies high achievement in scholarship and independent investigation in the diverse aspects of imaging science. Candidates for the doctoral degree must demonstrate proficiency by:

- successfully completing course work, including a core curriculum, as defined by the student's plan of study;
- passing a series of examinations; and
- completing an acceptable dissertation under supervision of the student's research adviser and dissertation committee.

Admission requirements

Because imaging science encompasses a wide variety of scientific disciplines, students with diverse backgrounds are accepted into the program. Undergraduate preparation leading to a bachelor of science degree in engineering, computer science, applied mathematics, or one of the natural sciences is usually required, but exceptional students from other fields may be accepted. All students admitted to the doctoral program in imaging science must have completed courses in the following areas:

- Calculus
- University physics (one year)
- Modern physics
- Computer language

Admissions decisions are made by a committee comprised of graduate faculty of the Center for Imaging Science. To be admitted, students must have a record of academic achievement from their undergraduate institutions, as indicated by official transcripts; demonstrate proficiency on the Graduate Record Examination (GRE); and request letters of recommendation from two people well-qualified to judge their abilities for graduate study.

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 February 15 for the next academic year. Students whose native language is not English must demonstrate proficiency in English, as evidenced, for example, by a minimum TOEFL score of 600 (paper based), 250 (computer based) or 100 (Internet based). Students whose native language is not English are advised to obtain as high a TOEFL score as possible if they wish to apply for a teaching or research assistantship. These candidates also are encouraged to take the TSE-A (Test of Spoken English) in order to be considered for financial assistance.

Due to the variety of backgrounds of incoming students, it is recognized that some will not have the requisite preparation in all areas and will have to complete some undergraduate requirements during the course of their graduate study.

Students with a master of science degree in a related field (e.g., physics, chemistry, or electrical or computer engineering) may be granted up to 36 quarter credits toward the doctoral degree in imaging science based on their earlier studies. These credits may be granted after successful completion of the comprehensive examination and approval of their study plan. The required research credits may not be waived by experience or examination.

Curriculum

All students must complete a minimum of 72 credit hours of course work. The courses are defined by the student's study plan and must include the completion of the core sequences, plus at least two three-quarter sequences in topical areas. Some examples of topical areas are remote sensing, digital image processing, digital graphics, electro-optical imaging systems, medical imaging, and microlithographic imaging technologies.

Students may take a maximum of 16 credits in other departments and also must complete 27 credits of research, three credits of which are associated with the research seminar course (1051-706, 707, 708), with a maximum of nine credits per quarter.

The core curriculum includes courses that span and integrate a common body of knowledge essential to an understanding of imaging processes and applications. The core courses are:

Core Courses	Qtr. Cr. Hrs.
1051-706, 707, 708 Imaging Science Research Seminar	3
1051-716 Fourier Methods for Imaging	4
1051-718 Digital Imaging Mathematics	4
1051-719 Radiometry	4
1051-720 Vision	4
1051-733 Optics	
1071-713 Probability, Noise and System Modeling	4
1051-782 Digital Image Processing	4

Admission to candidacy

Admission to candidacy will proceed through the following steps:

- Adviser selection
- Submission and approval of preliminary study plan
- Passing a written comprehensive exam
- Study plan revision based on outcome of comprehensive exam and adviser recommendation
- Research committee appointment
- Candidacy exam based on thesis proposal

If the faculty decision, following the comprehensive exam, is not to permit the candidate to continue in the doctoral track, the adviser and graduate coordinator will counsel the student about options that may include pursuit of an MS degree. If the faculty decision is to permit the candidate to continue in the doctoral track, the program continues with the study plan revision, research committee appointment, candidacy/proposal exam, and, finally, dissertation defense.

Research committee

By the end of the quarter following admission to candidacy, the student, in consultation with the adviser, must present a request to the graduate coordinator for the appointment of a research committee. The committee will include the adviser, one member of the faculty, a person competent in the field of research, and an 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. The research committee will supervise the student's research, beginning with a review of the research proposal and concluding with the dissertation defense.

Research proposal

The student and the research adviser select a research topic for the dissertation. The proposed research must be original and publishable. Although the topic may deal with any aspect of imaging, the research is usually concentrated in an area of current interest within the center.

Residency

All students in the program must spend at least three consecutive quarters (summer quarter excluded) as resident full-time students to be eligible to receive the doctoral degree. A full-time academic workload is defined as a minimum of nine academic credits per quarter or an equivalent amount of research, as certified by the graduate coordinator.

Time limitations

All candidates for a doctoral degree 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 requirements after admission to candidacy.

Exceptions to residency requirement and time limitations

If circumstances warrant, the residency requirement may be waived via petition to the graduate 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. The time limitation may be waived only via petition to the dean and graduate council.

Final examination of the dissertation

The research committee must notify the graduate coordinator requesting permission to administer the final examination of the dissertation. The letter must indicate that each member has received the dissertation and concurs with the request. The examination is scheduled by the graduate coordinator but may not be held sooner than two weeks after permission has been granted.

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 coordinator of the examination result.

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Eli Saber, BS, State University of New York at Buffalo; MS, Ph.D., University of Rochester — Associate Professor, Electrical Engineering: signal, image and video processing; communications

Andreas Savakis, BS, MS, Old Dominion University; Ph.D., North Carolina State University — Associate Professor, Digital Image Processing, Computer Vision

Bruce Smith, BS, MS, Ph.D., Rochester Institute of Technology — Professor, Microelectronic Engineering

Thomas W. Smith, BS, John Carroll University; Ph.D., University of Michigan — Professor, Analytical/ Polymer Chemistry: synthesis and device applications of block polymer systems and nano composites

Carlson Associate

Robert MacIntyre, BS, Boston University; MA, University of Rochester

Note: Prerequisites are within parentheses at the end of the course description

Biological Sciences

1001-700 **Cell and Molecular Genetics I**
This course will introduce cellular and molecular biology to graduate students with limited background in the biological sciences. The approach taken entails the use of empirical data to support the basic concepts presented. Upon completion of this course, students will not only be familiar with cellular and molecular biology, but will also be acquainted with the theoretical foundations of modern laboratory techniques. Topics covered in this course include cellular evolution, small molecules, energy and biosynthesis, macromolecules, protein functions, genetic mechanisms, recombinant DNA technologies, the nucleus, regulation of gene expression, membrane structure and function, and intracellular protein trafficking. (1001-251, 252, 1011-211-213, 1011-205-207, or equivalent) **Class 3, Credit 3 (F)**

1001-701 **Cell and Molecular Genetics II**
This course will introduce cellular and molecular biology to graduate students with limited background in the biological sciences. The approach to be taken entails the use of empirical data to support the basic concepts presented. Upon completion of this course, students will not only be familiar with cellular and molecular biology, but will also be acquainted with the theoretical foundations of modern laboratory techniques. Topics covered in this course include energy conversion in mitochondria and chloroplasts, cell signaling, the cytoskeleton, the cell cycle, cell division, intercellular interactions, germ cells and development, cellular differentiation, immunity and cancer. (1001-700) **Class 3, Credit 3 (W)**

1001-722 **Bioinformatics Seminar**
Sufficient opportunities will be afforded for students and faculty to develop and share professional interests while discussing current trends and developments in bioinformatics. Material for this course will be drawn from the current scientific literature including, but not limited to, journals such as *Bioinfrmatics, Genome Research,* and the *Journal of Computational Biology,* among others. Students from outside the Bioinformatics MS program may take this course with permission of the instructor. **Class 2, Credit 2 (F)**

1001-725 **Ethics in Bioinformatics**
This course will be focused on individual and organizational responsibilities in bioinformatics research and product development and commercialization. Students from outside the Bioinformatics MS program may take this class with permission of the instructor. **Class 3, Credit 3 (W)**

1001-767 **Environmental Microbiology**
This is an advanced course in the principles of soil microbiology, groundwater microbiology, wastewater microbiology, composting microbiology, and bioremediation. The class will also focus on practical applications of microorganisms isolated from various types of environments. Examples of commercial use of microorganisms will also be presented. The lab consists of a series of experiments looking at the microbial flora of soils, plant surfaces, air particles, and water. Students will attempt to isolate microorganisms from soil samples that are capable of degrading organic compounds. Students will use various methods to determine degradative capabilities of soil microorganisms such as carbon dioxide evolution and oxygen depletion. Students will do an independent lab project selecting an oil contaminated site and attempt to isolate various oil degrading bacteria. (1001-404) **Class 3, Lab 3, Credit 4 (S)**

1001-794 **Molecular Modeling and Proteomics**
This course will explore two facets of protein molecules: their structure and their expression. The structure component will build upon information from the bioinformatics course and will add further sophistication with analysis of intermolecular interactions and ligand/receptor pairing. Software that permits molecular docking experiments will be employed. Tissue-specific protein expression will be addressed in lectures with description of microarray technology and, in the laboratory, with two-dimensional protein gel electrophoresis. Each student will be assigned a project designed to integrate salient principles in each course and provide an opportunity for each student to give an oral presentation to his or her peers. (4002-763) **Class 3, Lab 3, Credit 4 (S)**

1001-890 **Bioinformatics MS Thesis**
Each student's experience in this course will be different. The individual student's thesis project will be tailored to fit his or her interests under the guidance of a faculty mentor. That mentor will be identified as the individual within our faculty who has professional interests most closely aligned with those of the student. Typically a mentor will be identified and a thesis proposal will be prepared and approved by the student's thesis advisory committee before the start of the second year of study. Thesis work and the preparation and defense of the written thesis will take place during the second year of study. **Credit variable (F, W, S)**

Environmental Science

1006-701 **Environmental Science Problem Solving I**
The first course in a three-quarter sequence where students identify and implement solutions to significant environmental problems. The projects will be solicited from the community. As a minimum, students will be expected to spend one hour in meeting with other members of the group and nine hours working on the problem solving activities each week, during each academic quarter. During the weekly group meeting, scientific, mathematical, engineering, government, and social concepts will be discussed, as they pertain to the project. This weekly meeting will also provide an ongoing check of progress by the group members. The students will be expected to attend an organizational/orientation class. They will prepare a written report of their activities and they will make an oral presentation about their project during each quarter. (Permission of instructor) **Class 2, Lab 2, Credit 4 (F)**

1006-702 **Environmental Science Problem Solving II**
This is a continuation of 1006-701. (1006-701 or permission of instructor) **Class 2, Lab 2, Credit 4 (W)**

1006-703 **Environmental Science Problem Solving II**
This is a continuation of 1006-702. (1006-702 or permission of instructor) **Class 2, Lab 2, Credit 4 (S)**

1006-750 **Ecological and Environmental Application**
Aerial photography, satellite imagery, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) are extremely useful tools in ecological and environmental applications such as biological monitoring, environmental assessment, habitat restoration, change analysis, resource management, and risk assessment. This course will: 1) introduce students to spatial analysis, theories, techniques and issues associated with ecological and environmental applications; 2) provide hands-on training in the use of spatial tools while addressing a real problem; 3) provide experience linking GIS analyses to field assessments and monitoring activities; and 4) enable students to solve a variety of spatial and temporal ecological and environmental problems. (1006-350 or 1006-450, or permission of instructor) **Class 3, Lab 3, Credit *4* (S)**

1006-759 **Special Topics: Environmental Science**
Special topics courses are courses that are of current interest and/or logical continuations of courses already offered. These courses are structured as ordinary courses and may have specified prerequisites, contact hours, and examination procedures. **Class variable, Credit variable (F, W, S, SU)**

1006-799 **Independent Study**
Independent study is a faculty directed study of appropriate topics on a tutorial basis. Independent study enables an individual to pursue studies of existing knowledge available in literature. **Class variable, Credit variable (F, W, S, SU)**

1006-870 **Graduate Seminar**
Students are required to participate in a weekly environmental science seminar. **Class 1, Credit 1 (F, S)**

1006-879 **Environmental Science Research**
Students will be engaged in conducting research at RIT under the guidance of an RIT faculty member or senior environmental scientist from the community. Students are required to complete a total of 5 quarter credit hours of research (external or at RIT). **Credit variable 1-5 (F, W, S, SU)**

Chemistry

1008-711 **Instrumental Analysis**
Theory, applications and limitations of selected instrumental methods in qualitative, quantitative and structural analysis are discussed. Possible topics include electrochemistry, surface analysis, NMR spectroscopy, mass spectroscopy, ICP and other modern instrumentation. A term paper and oral presentation will be required based on an analytical technique agreed upon by instructor and student. (1014-441) **Class 3, Credit 3 (F, W-X*)**

1008-780 **Theory of Microsensors and Actuators**
This course gives a broad background to the theory and development of sensors at molecular and ionic levels. The mechanistic details of operation of the sensors and actuators limited to selected examples will be considered. Fundamental aspects related to chemical, biochemical, piezo resistive, magnetic, thermal and luminescent sensors will be discussed with an orientation towards development of innovative products. Control systems based on ion selectivity for biomedical applications will be dealt with rigorously. Special topics to be covered will be neuro transmitters, neural network and directional selectivity using conducting polymers. (Baccalaureate degree in chemistry or permission of instructor) **Class 4, Credit 4 (F, W)**

1008-785 **Lab Techniques for Microsensors and Actuators**
This course is designed on practical aspects of fabrication measurement. It will discuss the construction and characterization of a few sensors and actuators. The practical limitation of the microsensors will be evaluated. (Baccalaureate degree in chemistry or permission of instructor) **Lab variable, Credit 2-4**

1009-702 **Biochemistry: Biomolecular Conformation and Dynamics**
This is the first course in our graduate sequence in biochemistry. Molecular transport and enzymatic catalysis are related to the three dimensional structures of biomolecules and the laws of thermodynamics. Also provides an introduction to membrane structure as preparation for the next course in the sequence *1009-703* Biochemistry: Metabolism. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor) **Class 3, Credit 3 (F-X*, W-X*)**

1009-703 **Biochemistry: Metabolism**
Metabolic processes involved in energy consumption and production as well as the synthesis and degradation of biomolecules are discussed. Metabolic pathways are described in terms of thermodynamic principies, cellular localization and regulation mechanisms. Finally, the metabolic basis of several diseases is presented. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor. **Class 3, Credit 3** (W, **S-X*)**

1009-704 **Biochemistry: Nucleic Acids**
Nucleic acid structures, including the classical Watson-Crick model for **DNA** are introduced. The flow of genetic information by replication (DNA to DNA), transcription (DNA to RNA) and translation **(RNA** to protein) as well as gene expression and regulation in prokaryotes are discussed. The methodology of new techniques, such as DNA sequencing and recombinant **DNA,** and their role in medicine and forensics are presented. The genetic aspects of viruses and oncogenes are also reviewed. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor) **Class 3, Credit 3 (F, S-X*)**

1009-705 **Biochemistry: Experimental Techniques**
An introduction to the theory and practice of modern experimental biochemical laboratory techniques and concepts. The weekly one-hour lecture provides a theoretical framework for the various experimental techniques and includes a discussion of the properties of biomolecules and how those properties are exploited in the separation and characterization of the molecules. Practical laboratory techniques include the preparation of buffers, centrifugation, gel exclusion chromatography, electrophoretic methods, and UV/visible and fluorescence spectrophotometry as applied to the isolation and characterization of proteins and nucleic acids, the manipulation of genetic material in E. coli will also be examined. (Baccalaureate degree or permission of instructor) **Class 1, Lab 6, Credit 3 (F)**

1010-772 **Special Topics**
Advanced courses which are of current interest and/or logical continuations of the courses already being offered. These courses are structured as ordinary courses and have specified prerequisites, contact hours and examination procedures. Recent courses taught as Special Topics include nuclear chemistry, polymer morphology, advanced chromatographic methods and applications of computer interfacing. **Class variable, Credit variable**

1010-800 **Capstone Project**
A capstone course for non-thesis students that fulfills the graduate project requirement of the MS Chemistry program. Guidance and credits to be arranged with faculty project advisor before approval by the department will be given for registration. **Credit variable 1–8 (F, W, S, SU)**

1010-870 **Chemistry Seminar**
Matriculated students are required to attend the weekly chemistry seminar series and to present a one-hour seminar on a topic in chemistry. **Credit 1**

1010-877 **External Research**
Industrial internship research. **Credit 1–16**

1010-879 **Research and Thesis Guidance**
Hours and credits to be arranged. Chemical research in a field chosen by the candidate, subject to approval of the department head and advisor. *(*1010-879-99 Continuation of Thesis, Credit 0) **Credit 1–16**

1010-899 **Chemistry Independent Study: Graduate Credit variable**

1011-707 **Introduction to Intellectual Property**
This is an introductory course on the fundamentals of intellectual property covering trade secrets, copyrights, confidentiality issues, and patents. Students will write an invention disclosure and patent application based on knowledge gained in this course. In addition, students will understand intellectual property issues in corporate settings and in particular industries. (No prerequisites and thus it can not be counted as an upper level chemistry elective for BS or MS chemistry students) **Class 3, Credit 3 (W-X*)**

1012-764 **Modern Inorganic Chemistry**
This course introduces the more sophisticated tools with which an inorganic chemist investigates inorganic molecules and materials. These physical methods are applied to inorganic reactions that distinguish the chemistries of the elements and to current research directions in the field. An oral presentation is required. Literature project required for graduate credit. (1014-441) **Class 4, Credit 4 (offered every year) (S)**

1012-765 **Preparative Inorganic Chemistry Laboratory**
In this laboratory, the chemistries of different elements in the periodic table are examined, and advanced synthetic and characterization methods are utilized. (Inorganic chemistry or permission of instructor) Class **1, Lab 7, Credit 3 (W)**

1013-736 **Spectrometric Identification of Organic Compounds**
This course discusses the theory and application of proton, carbon and 2-D nuclear magnetic resonance, infrared and mass spectrometry as applied to organic structure determination. (1013-433) **Class 4, Credit 4 (W-X*)**

1013-737 **Advanced Organic Chemistry**
Advanced topics in organic synthesis, novel reagents and synthetic strategies such as retrosynthetic analysis are covered. In addition, previously studied reactions will be revisited with the added focus on stereospecificity. Protecting groups are covered in depth as well as sigmatrophic rearrangements. Several classics in total synthesis are included with a strong emphasis on syntheses published in the current chemical literature. Time permitting, a survey of the most widely used organo-palladium couplings will be introduced. (1013-433) **Class 4, Credit 4 (F-X*)**

1013-739 **Advanced Organic Chemistry**
This course covers topics in physical organic chemistry including techniques for elucidation of mechanism: kinetics, linear free, energy relationships, isotope effects, thermodynamics, molecular orbital theory, electrocyclic reactions. (1013-433, 1014-443) **Class 4, Credit 4 (offered alternate years) (S)**

1013-832 **Stereochemistry**
This course provides advanced treatment of steric relationships, conformational analysis and stereoisomerism in organic compounds. (1013-433) **Class 4, Credit 4 (offered upon sufficient request)**

1013-833 **Heterocyclic Chemistry**
This course is a general treatment of heterocyclic chemistry and the syntheses and relative reactivities of heterocyclic compounds as demonstrated by their chemical reactions. (1013-433) **Class 4, Credit 4 (offered upon sufficient request) (F)**

1014-730 **Magnetic Resonance Imaging**
This course is an introduction to the principles of magnetic resonance imaging (MRI). The course covers spin physics, Fourier transforms, basic imaging principles, Fourier imaging, imaging hardware, imaging techniques, image processing, image artifacts, safety and advanced imaging techniques. (1008-311, 1014-442, Calculus) **Class 4, Credit 4 (S-X*)**

1014-740 **Basics of Pulsed NMR**
This course is an introduction to the principles of pulsed nuclear magnetic resonance (NMR) spectroscopy. Lectures on instrumentation, pulse sequences, Fourier transforms and artifacts are presented. (1008-311) **Class 1, Credit 1 (F)**

1014-741 **Advanced Chemical Thermodynamics**
This course is a study of the basic fundamentals of thermodynamics, including an introduction to statistical mechanics and their use in deriving the interrelationships of thermodynamic functions. Thermodynamic properties of gases are calculated based on spectroscopic data. Theory of solutions and phase equilibria are discussed. (1014-443, 1016-306) **Class 4, Credit 4 (offered alternate years) (W-X*)**

1014-742 **Survey of Physical Chemistry**
This course is a study of the fundamental principles of physical chemistry. Kinetic molecular theory, quantum mechanics, spectroscopy, thermodynamics and kinetics are presented. This course provides a high-level, comprehensive survey of essential topics in physical chemistry. **Class 3, Credit 3 (W-X*)**

1014-743 **Advanced Chemical Kinetics**
Methods of investigating the kinetics of chemical reactions and the theories used to interpret their results are presented with a focus on homogeneous reactions in gas and liquid phases. Discussions of references from recent chemical literature are provided. (1014-443) **Class 4, *Credit* 4 (offered alternate years) (W-X*)**

1014-744 **Advanced Quantum Mechanics**
This course provides a review of basic quantum theory and models; variation and perturbation methods, atomic and molecular orbital theory, emphasis on relationship of spectroscopy and quantum chemistry. *(1014-442)* **Class 4, Credit 4 (offered altemate years) (S, X*)**

1014-747 **Principles of Magnetic Resonance**
This course is a series of lectures designed to introduce the principles of magnetic resonance spectroscopies with emphasis on pulsed nuclear magnetic resonance (NMR) spectroscopy. Topics covered include classical and quantum mechanical theory, Fourier transform techniques, pulse sequences, instrumentation, instrumental techniques and modern applications such as 2-D NMR and solid-state NMR. (1014-443; 1014-740) **Class 4, Credit 4 (offered altemate years) (W-X*)**

1014-750 **Chemical Energetics**
This course is designed to explore the fundamental concepts of energy flow using a systems approach. Foundation will be offered with respect to how molecular systems communicate using the flow of energy. This foundation will then be expanded and applied to the understanding of how energy transfer may be harnessed to achieve device function. Molecular wires, optical and thermal switches and sensors will all be built from the understanding of function on the molecular level. Application will be the focus of the course. The course is designed for the individual with only a basic exposure to chemistry who desires to know how molecules can be exploited to provide work. (Baccalaureate degree in chemistry or permission of instructor) **Class 4, Credit 4 (F)**

1015-720 **Environmental Chemistry**
Environmental sources, reactions, transport, effects and fate of chemical species in air, soil, water and living systems are studied. (1014-443) **Class 3, Credit 3 (offered alternate years) (S-X*)**

1015-721 **Atmospheric Chemistry**
The chemical composition of the Earth's atmosphere with emphasis on the role of the biosphere and the changes induced by human activity will be studied. Special emphasis will be placed on urban pollution, acid rain, stratospheric ozone depletion, and climate change. (1014-443) **Class 3, Credit 3 (offered alternate years) (S)**

1029-701 **Organic Chemistry of Polymers**
The synthesis and chemistry of high molecular weight organic polymers is broadly surveyed. Chemistry relating to the formation of carbon chain polymers and polymers containing heteroatoms in-chain is detailed. Kinetics, thermodynamics and mechanisms of step growth and chain growth polymerization reactions are reviewed with particular attention being given to stereospecific and living polymerization processes, block and graft copolymers, functional polymers and polymeric reagents. (1013-433) **Class 4, Credit 4 (F-X*)**

1029-702 **Polymer Chemistry: Chains and Solutions**
Although most polymeric materials find utility as solids, polymer fabrication and characterization techniques are generally liquid phase processes. This course is concerned with the fundamental physical chemistry of polymers in liquid solutions. Topics to be addressed include: polymerization kinetics and chain structure, molecular weight distributions and determination, polymer solution thermodynamics and transport phenomena, and solution phase transitions. The study of polymeric solids is the focus of 1029-703. (Baccalaureate degree in science or engineering, or permission of instructor) **Class 4, Credit 4 (S-X*)**

1029-703 **Polymer Chemistry: Properties of Bulk Materials**
This course is designed to give the student with a chemistry or materials science background a thorough grounding in the main concepts which describe bulk polymer structure, behavior and properties and to give the student practical tools to predict them. Basic to the under- standing of polymer behavior is the fact that it is time-dependent. To emphasize this idea, the course is designed to build up to a study of the thermo-mechanical behavior of viscoelastic materials. (Baccalaureate degree in a science or engineering, or permission of instructor) **Class 4, Credit 4 (F-X*)**

1029-704 **Polymer Characterization Laboratory**
Many students in the Chemistry and Materials Science and Engineering graduate programs are involved in polymer research. This course gives these students an opportunity to acquire proficiency in using the tools of polymer characterization. Techniques for studying 1) molecular weight distributions, 2) spectroscopic analysis of chemical structure, *3)* thermal stability, *4)* morphology and phase transitions, and 5) mechanical properties will be introduced and mastered. Techniques may concentrate on particular research topics. (Baccalaureate degree in a science or engineering discipline, or permission of instructor) (offered alternate years) **Lab 6, Credit 2 (S)**

1029-705 **Preparative Polymer Chemistry Laboratory**
Students will carry out about eight experiments. About half of the experiments conducted will be step-growth polymerizations; the other half will be chain-addition polymerizations. The polymers produced will include: Nylon 6-10, Nylon 11, a polyurethane, polystyrene, high density polyethylene, and a copolymer of styrene and methyl methacrylate. More specifically, the types of polymerizations and reactions introduced will be crosslinking of polymers, interfacial and bulk step-growth polymerizations, cyclopolymerization, radical, ionic, and coordinative chain polymerizations. Instructors may add and/or delete polymer related experiments of their choice. The students in this course will also analyze the polymers produced and use literature data confirm structural features. *(*1013-437) **Lab 6, Credit 2 (offered alternate years) (F)**

Applied Mathematics

1016-706 **Advanced Differential Equations**
This course provides a study of first order, linear high order and systems of differential equations and their applications in the physical sciences. Mathematical modeling will be used to illustrate the concepts. Applications and computer projects will be used to involve students in intense problem solving experiences. Topics such as existence, uniqueness, theory and methods of solutions, linear systems, stability, Sturm-Liouville problems and asymptotic methods of solution will be studied. (1016-306 or equivalent, 1016-331 desirable) **Class 4, Credit 4**

1016-711 **Numerical Analysis**
This course is a rigorous study of floating point arithmetic, numerical techniques for finding roots of nonlinear equations, interpolations and approximation of functions, approximations of definite integrals and numerical solutions to initial boundary value problems for ordinary differential equations with a study of the errors produced. This course requires independent study of certain topics that are not covered in the class lectures. Software packages such as MATLAB will be utilized. (1016-306, 1016-331, and graduate standing) **Class 4, Credit 4 (F)**

1016-712 **Numerical Linear Algebra**
This course is a rigorous study of theoretical concepts and computational issues in linear algebra. Topics include an analysis of gaussian elimination with pivoting, its error and its stability, iterative methods for solving linear systems, matrix factorizations, eigenvalues, singular value decomposition, Krylov subspace methods and application to least squares, systems of nonlinear equations and partial differential equations. This course requires independent study of certain topics that are not covered in the class lectures. Sohare packages like MATLAB will be utilized through several computing projects. (1016-331, and graduate standing, 1016-432 recommended) **Class 4, Credit 4 (W)**

1016-715 **Statistical Models for Bioinformatics**
Organic evolution over thousands of years has provided us with one of the most complicated statistical models imaginable. This course will investigate some of the statistical models that have proved useful in analyzing biological information. Examples include Markov models, such as the Jukes-,Cantor and Kimura evolutionary models and hidden Markov models, and multivariate models used for discrimination and Classification. (1016-415 or permission of instructor) **Class 4, Credit 4 (F)**

1016-720 **Complex Variables**
This course introduces the student to the basic elements of calculus of complex valued functions of a complex variable. The major emphasis is on integration, with the goal of using these results to evaluate certain types of real integrals. The course includes the concept of analyticity, complex integration, Cauchy's integral theorem and integral formulas, Taylor and Laurent series, residues, real integrals by complex methods, and conformal mappings. (1016-305 or equivalent) **Class 4, Credit 4 (F, W, SU)**

1016-725 **Stochastic Processes**
This course is an introduction to stochastic processes. Important random processes that appear in various applications are studied. It covers basic properties and applications of Poisson processes and Markov processes as well as applications in renewal theory, queuing models, and optimal stopping. (Advanced Calculus, Probability, Matrix Algebra) **Class 4, Credit 4**

1016-764 **Topics in Logic, Set Theory and Computability**
This course surveys logic and set theory and their connections to computer science and the foundations of discrete mathematics. Starting with the abstract construction of integers and real numbers, it proceeds to axiomatic set theory and logic stressing questions of completeness, consistency, decidability and recursive enumerability. The course includes a survey of NP (non-deterministic polynomial) and NP complete problems. The student should gain a greater awareness of the paradoxical, the impossible and the slow. (1016-411 and 1016-532 and graduate standing, or permission of instructor) **Class 4, Credit 4 (F)**

1016-766 **Optimization Theory**
This course provides a study of the theory of optimization of linear and nonlinear functions of several variables with or without constraints. Applications of this theory to solve problems in business, management, engineering, and the sciences are considered. Algorithms for practical applications will be analyzed and implemented. Students taking this course will be expected to complete applied projects and/or case studies. (1016-331 or equivalent, 1016-465 desirable) **Class 4, Credit 4 (S)**

1016-767 **Combinatorics**
This course introduces the fundamental concepts of combinatorics and graph theory. Topics to be studied include counting techniques, generating functions, recurrence relations, the inclusion-exclusion principle, special graphs. Applications such as design of experiments, traffic routing, tournaments will be considered. (Graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

1016-768 **Graph Theory**
This course studies advanced concepts in graph theory and their applications. After a review of basic terminology, the topics of coverings, matching, connectivity, and coloring will be studied. Applications to areas such as optimal routing, transport networks, network design, tournaments, and scheduling will be considered. The interplay between graph theory, counting techniques, and algebra will also be studied. (1016-767) **Class 4, Credit 4 (S)**

1016-785 **Number Theory**
This course is an introduction to the standard results and techniques of Number Theory. Topics include induction, divisibility, congruences, Mobius inversion, quadratic reciprocity, and primitive roots. Cryptography and other applications will be discussed. Projects may be required. (1016-265 or permission of instructor) **Class 4, Credit 4 (W)**

1016-802 **Methods of Applied Mathematics I**
This course provides an introduction to some classical topics in mathematical analysis. Models arising in physics and engineering are introduced. Topics include: dimensional analysis and scaling; partial differential equations, classical techniques; Fourier series; integral transforms; orthogonal functions; wave phenomena in continuous systems. (Advanced Calculus, Differential Equations) **Class 4, Credit 4**

1016-803 **Methods of Applied Mathematics II**
This is a continuation of 1016-802 and deals with further applications of differential equations. Topics include: classification of partial differential equations; Laplace's equation; diffusion equations and their applications in physics and engineering. (1016-802) **Class 4, Credit 4**

1016-804 **Numerical Methods for Stochastic Processes**
This course covers the algorithmic and numerical aspects of analyzing stochastic processes. Emphasis here is on computing the solutions to the systems represented by stochastic processes and identifying their probabilistic interpretations. Topics include: queuing models; examples from communications networks and manufacturing systems; reliability models; simulation; approximation methods. (1016-725, 1016-801) **Class 4, Credit 4**

1016-807 **Boundary Value Problems**
This course is an introduction to methods of applied mathematics that are used in the solution of problems in physics and engineering. Models such as heat flow, vibrating strings and membranes will be formulated from physical principles and solution methods such as separation of variables, Fourier series, and integral transforms will be studied. (1016-306 and graduate standing) **Class 4, Credit 4 (W)**

1016-808 **Partial Differential Equations**
This is a continuation of 1016-807 Boundary Value Problems and deals with advanced methods for solving partial differential equations arising in physics and engineering problems. Topics to be covered include first order linear and nonlinear equations, second order equations, Green's functions, integral equations, transform methods, and wave phenomena. (1016-802) **Class 4, Credit 4 (S)**

1016-812 **Wavelets and Applications**
A mathematical introduction to the theory and applications of orthogonal wavelets and their use in analyzing functions and function spaces is provided. Topics include a brief survey of Fourier series representation of functions, Fourier transform and the Fast Fourier Transform (FFT) before proceeding to the Haar wavelet system, muluresolution analysis, decomposition and reconstruction of functions, Daubechies wavelet construction, and other wavelet systems. Applications such as data compression, noise reduction, and image processing will be studied. (1016-432) **Class 4, Credit 4 (S)**

1016-859 **Topics in Applied Mathematics**
This course covers some topics that are not covered in the regular courses and are not offered in other departments. This course may be used t0 study other areas of applications in the student's concentration. A wide variety of topics may be offered. Some examples are: reliability models; biological models; calculus of variations; computational probability; and dynamical systems. (Consent of the adviser and the instructor) **Class 4, Credit 4**

1016-879 **Thesis/project Work**
This is the capstone of the program in which the student works on a problem in applied mathematics under the guidance of the advisory committee. A formal written proposal of the problem to be studied must be presented before embarking on the project. A written report and an oral defense of the project/thesis are required at the completion of the work. This course may be repeated for a maximum of 12 quarter credit hours. (Consent of the adviser)

1016-899 **Independent Study**
A topic of special interest to the student and related to the student's area of concentration may be taken for independent study with the approval of the adviser and the instructor who will offer the course. The student submits a proposal for independent study to the advisory committee for consideration and approval. (Consent of the adviser and the instructor) **Credit variable (maximum of 4 credits /quarter)**

Clinical Chemistry

1023-705 **Mechanisms of Disease**
Mechanisms of cellular injury, the healing process, atherosclerotic heart disease, hypertension, infectious disease, and many other disease states are presented. **Class 4, Credit 4 (S)**

1023-820 **Advanced Clinical Chemistry I**
Electrolytes, acid-base physiology, renal function, trace metals, lipids, carbohydrate metabolism, enzymes, and various standard methods are covered. **Class 4, Credit 4 (offered alternate years)**

1023-821 **Advanced Clinical Chemistry II**
A study of the concepts and applications of therapeutic drug monitoring, pharmacokinetics, toxicology, inherited disorders of metabolism, liver function tests, protein measurement, hepatitis, porphyrias, vitamins, pediatric clinical chemistry, geriatric clinical chemistry and gene probes. **Class 4, Credit 4 (offered alternate years)**

1023-822 **Advanced Clinical Chemistry III**
A survey of endocrinology and of the immunoassay methods used in performing endocrine assays. The endocrine systems covered include the thyroid, the adrenals, calcium metabolism, growth hormone, the human reproductive system, and the fetal-placental unit. Basic principles of clinical trials will also be presented. **Class 4, Credit 4 (offered alternate years)**

1023-870 **Clinical Chemistry Seminar**
A seminar offered for 1 credit to graduate students presenting final research outcomes to their graduate committee. **Credit 1**

1023-872 **Special Topics: Clinical Chemistry**
In response to student and/or faculty interest, special courses that are of current interest and/or logical continuations of regular courses are presented. These courses are structured as ordinary courses with specified prerequisites, contact hours and examinations. **Class variable, Credit variable (offered upon sufficient request)**

1023-877 **External Clinical Chemistry Research**
Research carried out in a laboratory outside of the College of Science. Prior to the initiation of external research, a proposal from the student as well as a commitment of support and direction from the laboratory are evaluated. **Credit variable**

1023-879 **Clinical Chemistry Research**
Research carried out in the College of Science laboratories under the direction of RIT faculty members. The amount of credit awarded for such projects is determined after evaluation of a research proposal. **Credit variable**

1023-899 **Clinical Chemistry: Independent Study**
Individual projects or studies carried out under the direction of a faculty member. Study objectives and design are developed through faculty-student interaction with evaluation and credit to be awarded determined after review of a study proposal. **Credit variable**

1023-999 **Clinical Chemistry Graduate Co-op**
Cooperative work experience for MS clinical chemistry students. **Credit 0**

Materials Science and Engineering

1028-701 **Introduction to Materials Science**
The course provides an understanding of the relationship between structure and properties for development of new materials. Topics include atomic and crystal structure, crystalline defects, diffusion theories, strengthening mechanisms, ferrous alloys, cast irons, structure of ceramic and polymeric materials, and corrosion principles. (Graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

1028-702 **Introduction to Polymer Science**
A study of the chemical nature of plastics detailing the relationships between polymerization conditions, structure and properties in both the solid and fluid states. **Class 4, Credit 4 (W)**

1028-703 **Solid State Science**
Survey of topics in the physics of solids. Included are crystal symmetry, structure and binding; mechanical, thermal, and electrical properties of insulators, semiconductors and conductors, including band theory. **Class 4, Credit 4 (W)**

1028-704 **Introduction to Theoretical Methods**
Treatment of waves and fields; selected topics of interest in electrodynamics and fluid mechanics; statistical mechanics; Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac distributions, and their applications. (Graduate standing or permission of instructor) **Class 4, Credit 4 (F)**

1028-705 **Introduction to Experimental Techniques**
Introduction to laboratory equipment for hardness testing, impact testing, tensile testing, x-ray diffraction, and thermal treatment of metallic materials. Experiments illustrating the characterization of high molecular weight organic polymers are conducted. **Class variable, lab variable, Credit 4 (S)**

1028-706 **Experimental Techniques: Thin Films**
Production of thin films of metals and dielectrics by physical vapor deposition. Lectures cover vacuum systems, evaporation, sputtering, nucleation and growth of thin films, analysis and characterization of thin films, and application of thin films. Laboratories cover use of vacuum systems in evaporation and sputtering and some methods of characterizing the thin films thus produced. (Permission of instructor) **Class variable, Lab variable, Credit 4**

1028-707 **Experimental Techniques: Microscopy and Spectroscopy**
An in-depth look at various techniques used to characterize thin film materials. Lectures will cover resistivity measurements, ellipsometry, reflectance techniques, optical microscopy, electron microscopy, and scanning probe microscopy. The lab provides hands-on training in these techniques and is conducted in the cleanroom housed in the Center for Microelectronic Engineering. Students will be required to perform an in-depth study on a material of their choice using these techniques or to research an associated technique not covered in lecture. (Permission of instructor) **Class variable, Lab variable, Credit 4**

1028-708 **Experimental Techniques**
Provides an in-depth integrated approach to the analysis, investigation and development of materials, concentrating on specific types or classes. (1028-701 or equivalent) **Class variable, Lab variable, Credit 4**

1028-710 **Material Properties and Selection**
Study of the principles of material behavior as applied to design. Application of materials according to these principles is stressed. Ferrous, nonferrous, and nonmetallic materials are considered. (1028 701 or equivalent) **Class 4, Credit 4**

1028-714 **Glass Science**
Topics include the structure and properties of glass, applied areas such as glass melting and processing, and various technological applications of glass. (1028-701 or equivalent; 1028-704) **Class 4, Credit 4**

1028-717 **Material Degradation: Corrosion**
This course introduces the basic electrochemical nature of corrosion and considers the various factors that influence the rate of corrosion in a variety of environments. Various means of controlling corrosion are considered. (1028-701 or equivalent) **Class 4, Credit 4**

1028-720 **Organic Polymers**
Meets the needs of students in the area of organic chemistry related to synthesis, polymerization mechanism, structures, stereochemistry of reactions of organic polymers and their industrial usage. (1028-702 or equivalent) **Class 4, Credit 4**

1028-721 **Physical Chemistry of Polymers**
A study of the theoretical and experimental methods available for designing plastics products and selecting appropriate materials, with special emphasis on the interrelationships between materials, product design, tooling construction, and manufacturing producibility. (1028-702 or equivalent) **Class 4, Credit 4**

1028-722 **Polymer Processing**
A study of the basic principles and methods involved in the technology of processing polymeric materials, including treatments of heat transfer, mass transfer, and mixing and shaping or molding of these materials. (1028-702 or equivalent) **Class 4, Credit 4**

1028-730 **Optical Properties of Materials**
Fundamentals of geometrical and physical optics, interaction of radiation with matter, dielectrics and thin films, introduction to electro-optic and acousto-optic effects. (1028-704 or equivalent) **Class 4, Credit 4**

1028-733 **Magnetic Properties of Materials**
Magnetostatics, creation and measurement of magnetic fields, galvanomagnetic and magneto-optic effects, magnetic materials, applications. (1028-701 and 704 or equivalent) **Class 4, Credit 4**

1028-734 **Advanced Optics**
Lasers: theory, types and construction; optics of metals; multilayer dielectrics; electro- and acousto-optic modulators and deflectors; optical detectors. (1028-730 or equivalent) **Class 4, Credit 4**

1028-736 **Amorphous and Semicrystalline Materials**
Electrical, thermal, and optical properties of amorphous materials; model of conduction. (1028-701, 703,704 or equivalents) **Class 4, Credit 4**

1028-740 **Nuclear Science and Engineering**
Systemics of the atomic nuclei, radioactivity, nuclear reactions, fission, nuclear reactor principles, designs, materials, and safety. (1028-701 and 704 or permission of instructor) **Class 4, Credit 4**

1028-760 **Plasma Science**
An introduction to plasma science; a study of the basic phenomena and application of plasma to etching, deposition, polymerization, plasma production of materials, analytical emission spectroscopy, and atmospheric science. (1028-701 or equivalent) **Class 4, Credit 4**

1028-770 **Physics and Chemistry of IC Processes**
Study of the various processing steps used in integrated circuit fabrication technology with special emphasis on diffusion, thermal oxidation, ion implantation and plasma-assisted deposition, and etching processes. Process modeling using SUPREM. (1028-703 or permission of instructor) **Class 4, Credit 4**

1028-780 **Theory of Microsensors**
This course gives a broad background to the theory and development of sensors at the molecular and ionic levels. The mechanistic details of operation of the sensors and actuators limited to selected examples will be considered. Fundamental aspects related to chemical, bio chemical, piezo resistive, magnetic, thermal and luminescent sensors will be discussed with an orientation towards development of innovative products. Control systems based on ion selectivity for biomedical applications will be dealt with rigorously. Special topics to be covered will be neuro transmitters, neural network and directional selectivity using conducting polymers. (Permission of instructor) **Class 4, Credit 4 (F,** W)

1028-800 **Special Topics**
In addition to in-depth study of any of the courses listed under Elective Courses, special topics may be selected from such areas as elastomers, organometallics, radiation damage, processing of materials, superconductivity, sensors, and actuators, etc. (Permission of instructor) **Class variable, Credit 4**

1028-877 **External Research**
Research using equipment and facilities at a site other than RIT. Prior to enrollment in the course, a proposal from the student that includes a letter of support from the host facility is evaluated for determination of credit to be awarded upon successful completion of the project. A total of 8 quarter credit hours, with a maximum of 4 quarter credit hours per quarter, can be applied toward the MS degree. For matriculated MSE students employed full time by local companies. (Permission of program director) **Credit variable**

1028-879 **Research and Thesis Guidance**
A project involving research on a topic in materials science and engineering. An oral examination and written thesis are required. **Credit variable**

1028-890 **Seminar**
Required for completion of the program and involves a one-hour presentation on some topic in materials science in engineering. **Class variable, Credit 1 (F, S)**

1028-899 **Independent Study**
This course number should be used by students wishing to study a topic on an independent study basis. (Permission of instructor) **Credit variable**

1028-999 **Materials Science Graduate Co-op**

Color Science

1050-701 **Vision and Psychophysics**
This course provides an overview of the human visual system and psychophysical techniques used to investigate it with an emphasis on applications to imaging. The first half of the course covers topics including threshold techniques, one- and multi-dimensional scaling techniques, and psychometric functions. The second half of the course includes discussions of the anatomy and physiology of the visual system and aspects of functional vision ranging from form and color perception to motion and depth perception. (Graduate status in Color Science or permission of instructor) **Class 4, Credit 4 (F)**

1050-702 **Applied Colorimetry**
This course covers the principies of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, the Munsell color order system, metamerism, color inconstancy, history and theory of color tolerance equations and spaces, and an overview of color management. (Graduate status in Color Science or permission of instructor) **Class 4, Credit 4 (VU)**

1050-703 **Color Appearance**
This course is for students who have an understanding of the applications of colorimetry. It presents the transition from the measurement of color patches and differences to the description and measurement of color appearance. This seminar course is based mainly on review and discussion of primary references. Topics include appearance terminology, appearance phenomena, viewing conditions, chromatic adaptation and color appearance modeling. (1050-701,702) **Class 3, Credit 3 (S)**

1050-721 **Color Measurement Laboratory I**
This course is the first part of a two-course sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing, and basic programming. Topics include the instrumentation and standardization required for high quality optical radiation measurements, analysis techniques for determining the accuracy and precision of those measurements, the optical properties of objects and radiation, optical and electronic design of spectroradiometric and spectrophotometric instrumentation, the use of standard reference materials for calibration, and evaluation of instrumentation and psychophysical experimentation. (Graduate status in Color Science or permission of instructor) **Class 1, Lab 3, Credit 3 (F)**

1050-722 **Color Measurement Laboratory II**
This course is the second part of a two-quarter sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing, and basic programming. Topics include the precision and accuracy analysis of color measuring instrumentation, color tolerance psychophysics, and building an imaging colorimeter. (1050-721, Corequisite 1050-701) **Class 1, Lab 3, Credit 3 (W)**

1050-751 **Special Topics**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of color science. Specific topics announced in advance. (Not offered every quarter. Consult the color science graduate program coordinator.) **Credit variable**

1050-752 **Special Topics**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of color science. Specific topics announced in advance. (Not offered every quarter. Consult the color science graduate program coordinator.) **Credit variable**

1050-753 **Special Topics**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of color science. Specific topics announced in advance. (Not offered every quarter. Consult the color science graduate program coordinator.) **Credit variable**

1050-799 **Independent Study**
An independent project in an area of color science not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. **Credit variable**

1050-801 **Color Science Seminar**
A seminar course in which students will study the literature in particular areas of color science and present that material to the class. Topics will be based on student interest and current issues in the field. Available to color science MS students or by permission of the instructor. May be taken more than once for credit with permission of coordinator (Graduate status in Color Science or permission of instructor). **Class 1, Credit 1 (F, W, S)**

1050-813 **Color Modeling**
This course explores mathematical techniques for predicting the spectral and colorimetric properties of colored materials and images from user-controlled drive signals. Color systems that are modeled include paint, computer-controlled LCD and projector, continuous and halftone printing, and spectral cameras. Accompanying laboratory stresses the use of multivariate statistics, nonlinear optimization, and technical writing. Final laboratory consists of spectral-based color reproduction system including input, display, and printed output. (1050-702, 721, 722) **Class 4, Credit 4 (S)**

1050-840 **Color Science MS Project**
An independent project in an area of color science that serves as the major culminating experience for students in the Graduate Project Option of the color science MS program. This project can be an experiment, critical literature review, demonstration or other appropriate work. This course requires a formal proposal and faculty sponsor; a written technical report and oral presentation of the results. **Credit 4**

1050-890 **Research and Thesis**
Thesis based on experimental evidence obtained by the candidate in an appropriate topic as arranged between the candidate and the coordinator of the program. **Credit variable (minimum of 9 credits for MS)**

1050-999 **Color Science Co-op**
Cooperative work experience for graduate color science students. **Credit 0**

Imaging Science

1051-706 **Introduction to Imaging Science Research**
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). The students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (F)**

1051-707 **Introduction to Imaging Science Research**
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. This course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course will also address issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (W)**

1051-708 **Introduction to Imaging Science Research**
This course is focused on familiarizing students with research activities in the Carlson Center, research practices in the university, research environment and policies and procedures impacting graduate students. The course is coupled with the research seminar sponsored by the Center for Imaging Science (usually weekly presentations). Students are expected to attend and participate in the seminar as part of the course. The course also addresses issues and practices associated with technical presentation and technical writing. Credits earned in this course apply to research requirements. **Class 1, Credit 1 (S)**

1051-713 **Noise and Random Processes**
The purpose of this course is to develop an understanding and ability in modeling noise and random processes within the context of imaging systems. The focus will be on stationary random processes in both one dimension (time) and two dimensions (spatial). Power spectrum estimation will be developed and applied to signal characterization in the frequency domain. The effect of linear filtering will be modeled and applied to signal detection and maximization of SNR. The matched filter and the Wiener filter will be developed. Signal detection and amplification will be modeled, using noise figure and SNR as measures of system quality. At completion of the course, the student should have the ability to model signals and noise within imaging systems. Also offered online. (1051-716, 718, 719 or permission of instructor) **Class 4, Credit 4 (S)**

1051-714 **Information Theory for Imaging Systems**
This course develops a basic understanding of the efficient representation of information for storage and transmission. Classical concepts of information theory are developed and applied to image compression, storage and transmission. The intent is to develop a foundation for the efficient handling of image-based information in imaging systems. Also offered online. (1051-713 or consent of instructor) (offered alternate years) **Class 4, Credit 4 (F)**

1051-716 **Fourier Methods for Imaging**
This course develops the mathematical methods required to describe continuous linear systems, with special emphasis on tasks required in the analysis or synthesis of imaging systems. The classification of systems as linear/nonlinear and shift variant/ invariant is discussed first, followed by development and use of the convolution integral, and by a discussion of Fourier methods as applied to the analysis of linear systems, including the Fourier series and Fourier transform. Emphasis is placed on the physical meaning and interpretation of these transform methods. Within the context of image analysis, imaging systems as a linear filter, image enhancement and information extraction and several basic image processing techniques are also introduced. Also offered online. (Graduate standing in a science or engineering program or permission of instructor) **Class 4, Credit 4 (F)**

1051-718 **Digital Imaging Mathematics**
This course provides a basic understanding of imaging systems, image transformations and associated mathematics and computational processes needed for upper-level classes in the imaging science graduate program. Topics covered include: camera models; image projections and rectification; image statistics and point processing; linear and nonlinear image filters; image transforms; image mathematics; and computer algorithms. Some laboratory experiments are included. Also offered online. (1051-716) **Class 4, Credit 4 (W)**

1051-719 **Radiometry**
This course is focused on the fundamentals of radiation propagation as it relates to making quantitative measurements with imaging systems. It includes an introduction to common radiometric terms and derivation of governing equations with an emphasis on radiation propagation in both non-intervening and turbid media; and an introduction to detector figures of merit and noise concepts. Includes some laboratory experiments. Also offered online. (Graduate standing in a science or engineering program, or permission of instructor) **Class 4, Credit 4 (F)**

1051-720 **Vision and Visual Displays**
This course describes the underlying structure of the human visual system and the design of visual displays. The optical and neural systems responsible for collecting and detecting spatial, temporal, and spectral signals from the environment are described and discussed in terms of the "enabling limitations" of the human visual system that allow practical visual displays. Softcopy and hardcopy display systems are described in terms of their spatial, spectral, and temporal characteristics. Some laboratory experiments are included. Also offered online. (Graduate standing in a science or engineering program, or permission of instructor). **Class 4, Credit 4 (F)**

1051-726 **Computing for Imaging Science**
A course to prepare graduate students in science and engineering to use computers as required by their disciplines. Covers: the organization and programming of computers at various levels of abstraction (e.g. assembly, macros, high-level languages, libraries), advanced programming techniques, the design, implementation, and validation of large computer programs, modern programming practices, introduction to a programming environment and to a variety of programming languages. Programming projects will be required. Also offered online. **Class 4, Credit 4 (W)**

1051-728 **Design and Fabrication of a 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. **Class 1.5, Lab 7.5, credit 4 (W)**

1051-733 **optics**
This course will provide the requisite introductory knowledge in optics needed by a student in the graduate program in imaging science. The course will cover geometrical optics, wave nature of light, the Fresnel equations, interference and diffraction, and resolution of imaging systems. Some laboratory experiments are included. Also offered online. (1051-716, 719) **Class 4, Credit 4 (W)**

105 1-736 **Geometrical Optics**
This course leads to a thorough understanding of the geometrical properties of optical imaging systems. A method is developed of performing a first-order design of an optical system, applicable to uniform and Gaussian beams. The following topics are included: paraxial optics of axisymmetric systems, Gaussian optics (cardinal points, pupils and stops, optical invariant), propagation of energy through lens systems, basic optical instruments and components, gradient index optics, finite raytracing, introduction to aberrations. Class 3, **Lab 3, Credit 4 (F in class, S online)**

1051-737 **Physical Optics**
The wave properties of light and their application to imaging systems and metrology. Polarization, birefringence, interference and interferometers, spatial and temporal coherence, scalar diffraction theory are covered. (1051-717) **Class 4, Credit 4 (W)**

1051-738 **Optical Image Formation**
This course presents a unified view of the formation of images and image quality of an optical system from an applications viewpoint, but with a strict mathematical development. Topics covered are: geometrical and diffraction theory of aberrations, image quality criteria and MTF, MTF tolerance theory, image formation with coherent light. Throughout the course, the problem of image formation is treated also in its inverse form of designing an optical imaging system that satisfies a given set of specifications. (1051-737) **Class 3, Lab 3, Credit 4 (offered alternate years, offered 2006-07) (S)**

1051-739 **Principles of Solid State Imaging**
This course covers the basics of solid state physics, electrical engineering, linear systems and imaging needed to understand modern focal plane array design and use. The course emphasizes knowledge of the working of infrared arrays. (Optics, Linear Systems) **Class 4, Credit 4 (F)**

1051-742 **Testing of Focal Plane Arrays**
An introduction to the techniques used for the testing of solid state imaging detectors such as CCDs, CMOS and Infrared Arrays is provided. Focal plane array users in industry, government and university need to ensure that key operating parameters for such devices either fall within an operating range or that the limitation to the performance is understood. This is a hands-on course where the students will measure the performance parameters of a particular camera in detail. While this course can be taken individually, students will obtain maximum educational value by taking it as the third part of a sequence of imaging science courses preceded by 1051-739 Principles of Solid State Imaging Arrays and then 1051-728 Design and Fabrication of a Solid State Camera. (Graduate status in imaging science or permission of instructor) **Class 2, Lab 6, Credit 4 (S)**

1051-749 **Color Reproduction**
This course presents the concepts required for an understanding of the relationships between mean-level input and output in various color imaging systems. Analog, digital, and hybrid color imaging systems will be covered. Special emphasis will be given to mean-level reproduction in photography, printing, and television. Offered online. (W)

1051-751 **Special Topics: Imaging Science**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of imaging science. Specific topics announced in advance. (Not offered every quarter. Consult the imaging science graduate program coordinator.) **Credit variable**

1051-752 **Special Topics: Imaging Science**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of imaging science. Specific topics announced in advanced. (Not offered every quarter. Consult the imaging science graduate program coordinator.) **Credit variable**

1051-753 **Special Topics: Imaging Science**
Advanced topics of current interest, varying from quarter to quarter, selected from the field of imaging science. Specific topics announced in advanced. (Not offered every quarter. Consult the imaging science graduate program coordinator.) **Credit variable**

1051-762 **Remote Sensing and Image Analysis**
The problem of inverting recorded image data to surface reflectance on temperature values is treated using a variety of techniques, including the use of ground truth, "in scene" methods, and radiation propagation models. Multispectral digital image processing methods are introduced and their utility in various remote sensing applications considered. The potential for including multiple sources of data in image analysis is treated through consideration of multispectral image data fusion and the use of geographic information systems. (1051-719) Also offered online. **Class 4, Credit 4 (W)**

1051-763 **Remote Sensing and Image Analysis III**
Analysis of digital remotely sensed images is treated with emphasis on multispectral analysis techniques. This includes consideration of multivariate discriminate analysis and principal components for material identification and analysis. Special topics such as radar, Fraunhofer line discriminator, hierarchical classifiers will also be treated. (1051-762) Also offered online. **Class 4, Credit 4 (S)**

1051-765 **Remote Sensing Systems**
This course is designed to draw on the student's knowledge of linear system theory, digital image processing, and noise concepts and apply it to an end-to-end system in an area associated with remote sensing. Generalized concepts from these fields will be focused to show how they can be applied to solve remote sensing image analysis and systems design and evaluation problems. An overriding objective is on the application of theory to practice. (Permission of instructor) **Credit 4**

1051-774 **Vision and Psychophysics**
This course provides an overview of the human visual system and psychophysical techniques used to investigate it. The optical, sensory, and neural aspects of vision and image quality are treated. Topics include color vision, adaptation, senspr response functions, neural networks, and an introduction to electro-optical and computational analogs. Also offered online. **Class 4, Credit 4**

1051-775 **Applied Colorimetry**
This course covers the principles of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, the Munseil color order system, metamerism, color inconstancy, history and theory of color tolerance equations and spaces, and an overview of color management. Also offered online. **Class 4, Credit 4 (W)**

1051-776 **Color Modeling**
This course explores mathematical techniques for predicting the spectral and colorimetric properties of colored materials and images from user-controlled drive signals. Color systems that are modeled include paint, computer-controlled LCD, continuous and halftone printing, and spectral cameras. Accompanying laboratory stresses the use of multivariate statistics, nonlinear optimization, and technical writing. Final laboratory consists of a spectral-based color reproduction system including input, display, and printed output. (1051-775) **Class 4, Credit 4 (S)**

1051-779 **Astronomical Instrumentation and Techniques**
This course provides an in-depth look at various pieces of instrumentation used in many low light imaging applications with emphasis on astronomical requirements. Aspects of hardware, systems analysis, and performance calculation will be covered. **Class 4, Credit 4 (offered occasionally) (S)**

1051-782 **Digital Image Processing**
This course follows up on concepts introduced in 1051-718 Digital Imaging Mathematics. Topics covered include linear vector spaces, image mathematics, image statistics and point processing, linear and nonlinear image filters, image transforms and computer algorithms. Computational methods and techniques for essential processes for imaging systems are used as the course framework. Also offered online. (1051-718 or permission of instructor) **Class 4, Credit 4 (S)**

1051-784 **DIP: Spatial Pattern Recognition**
This course develops a fundamental understanding of adaptive pattern recognition and a basic working knowledge of techniques for use in a broad range of applications. Inherent in adaptive pattern recognition is the ability of the system to learn by supervised or unsupervised training, or by competition within a changing environment. The effectiveness of the system depends upon it structure, adaptive properties and specifics of the application. Particular structures developed and analyzed include statistical PR, clustering systems, fuzzy clustering systems, multi- layered perceptrons (with a variety of weight training algorithms), and associative memory systems. The goal is to gain both a fundamental and working knowledge of each kind of system and the ability to make a good system selection when faced with a real application design. Also offered online. (1051-716, 718, 726, and 0307-834 or equivalent) **Class 4, Credit 4 (W)**

1051-786 **Advanced Digital Image Processing**
This course investigates algorithms and techniques for a variety of imaging applications. The techniques build on the background that is established in the course 1051-782 Introduction to Digital Image Processing, which focuses on basic image processing methods. The course is taught using a lecture and group project format, in which the lectures focus on advanced techniques and provide applications of their use in selected applications. The group projects enable students to work on substantial designs that require the understanding of the task domain, exploration of solution methods by analysis and proto-typing, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration. (1051-726, 1051-782 or permission of instructor) **Class 4, Credit 4 (offered alternate years, offered 2005–06)*(S)***

1051-790 **Image Rendering**
This course covers the fundamental principles of computer image synthesis with a focus on rendering techniques. Topics include geometric scene specification, shading (e.g., flat, Gouraud, Phong), and global illumination rendering (e.g., ray tracing, radiosity). Commercial software such as OpenGL and Radiance will be briefly described. Lastly, the design, advantages and limitations of modern computer graphics hardware are discussed. Students implement fundamental computer graphics techniques and produce images using IDL (or similar) environment. (Graduate status CIS or permission of instructor, 1051-726 or equivalent, Matrix Algebra) **Class 4, Credit 4 (offered alternate years, offered 2005-06) (W)**

1051-797 **Principles of Computed Tomographic Imaging**
Image reconstruction from projections is introduced as a mathematical problem. Technique for reconstruction via Fourier domain is explained using Fourier slice theorem. Simple and Filtered Backprojection and iterative methods are analyzed. Algorithms for various techniques are developed and artifacts and noise in discrete case are considered. Applications to several medical imaging modalities are outlined, with brief consideration of the physics of imaging involved in each case. **Class 4, Credit 4 (S)**

1051-799 **Independent Study**
An independent project in an area of imaging science not covered in the available courses. This project can be experimental research, literature review, or other appropriate work. This course requires a formal proposal and a faculty sponsor. **Credit variable**

1051-807 **Hard Copy Systems**
The focus is on concepts of “Imaging Systems” and system’s Image Quality (IQ metrics of concern in systems which are not discussed elsewhere in the curriculum. These will include concepts such as costs, reliability, and permanence. Two particular types of imaging systems will be covered in detail. The first, designated the “Internal Imaging System”, focuses on strategies for the design and quality optimization of components internal to individual technologies. The second type of imaging system, designated the “External Imaging System”, focuses on strategies for the design and quality optimization of components of an imaging chain. **Class 4, Credit 4 (S)**

1051-812 **Medical Imaging Systems**
This is an advanced graduate level course that describes existing medical imaging systems in terms familiar to imaging scientists and electrical engineers. These include impulse response, the transfer functions, and the signal to noise ratio. The course considers in detail, four different imaging modalities: conventional projection X-ray, CT, ultrasonic imaging, and magnetic resonance imaging. A complete system is examined piece by piece in terms of subsystems. **Class 4, Credit 4 (S)**

1051-816 **Color Systems**
This course builds on the theory and concepts presented in the Color Reproduction and Color Modeling courses to cover the key techniques utilized in device-independent color imaging systems. Topics covered include: device calibration and characterization (input, output, display), device profiles, multidimensional look-up table construction, inversion, and interpolation, gamut mapping, appearance matching, and color-management systems. Also offered online. (1051-775, 726 or permission of instructor) **Class 4, Credit 4**

1051-840 **MS Project Paper**
The analysis and solution of Imaging Science Systems problems for students enrolled in Systems Capstone option. **Credit 1**

1051-890 **Research and Thesis**
Thesis (MS) or dissertation (Ph.D.) based on experimental data obtained by the candidate for an appropriate topic as arranged between the candidate and the research adviser. **Credit variable**

1051-999 **Imaging Science Graduate Co-op**
Cooperative work experience for graduate imaging science students. **Credit 0**

National Technical Institute for the Deaf

www.ntid.rit.edu

T. Alan Hurwitz, Vice President and Dean

The National Technical Institute for the Deaf is the world's largest technological college for deaf students. Among RIT's more than 15,000 full- and part-time students are more than 1,100 deaf students from the United States and other countries. NTID offers a master of science degree in secondary education of students who are Deaf or hard of hearing, as well as a fellowship program. Students also pursue master's degrees through RIT's other seven colleges.

Programs

Master of Science degree in:

Master of Science in Secondary Education of Students Who Are Deaf or Hard of Hearing

Geruld C. Butemun, Director
(585) 475-6480 (voice/TTY), gcbnmp@rit.edu

The National Technical Institute for the Deaf offers a graduate program leading to the master of science degree in secondary education of students who are deaf or hard of hearing. The unique program prepares professionals to meet the national need for excellent teachers of secondary students who are deaf or hard of hearing. The program's purpose includes the preparation of teachers not only as effective practitioners but also as leaders in the profession.

NTID is a logical home for this innovative program. Faculty members are international leaders in research and the art of teaching in the education of deaf people. A carefully designed system of faculty advisement is a prominent feature of this program. On-campus facilities, state-of-the-art technology, and a well-established system of educational access services combine to make this a vital program for both deaf and hearing students who desire careers as professional educators of deaf students. Graduates of teacher education programs at RIT have a 96-percent pass rate on the New York State Teacher Certification Examination.

Admission guidelines

Admission to the program is based on the following criteria:

- Successful completion of the baccalaureate degree at an accredited college or university
- Cumulative grade point average of 3.0 or above
- International students are required to obtain a minimum score of 550 (paper-based) or 213 (computer-based) on the Test of English as a Foreign Language (TOEFL)
- 30 semester credit hours in a content area are required by the New York State Department of Education for initial certification to teach a secondary (grades 7–12) content area. Students who do not have the required number of

hours must complete the additional credits before applying for New York State certification. Secondary academic subjects include American Sign Language, English, mathematics, social studies, or science. **Note:** A major in social studies includes economics and government, and at least 21 semester hours in the history and geography of the United States and the world.

- Applicants must demonstrate a basic knowledge of sign language as measured by a departmental skilll assessment, or be willing to take American Sign Language I, or its equivalent, at NTID or another college prior to beginning the program.
- Evidence of professional commitment and potential for success in the program: letters of reference and an expository essay
- An individual interview

Costs

On the date of publication, the 2006–2007 tuition for students pursuing a master of science degree in secondary education of students who are deaf or hard of hearing is as follows:

Domestic

- Full time (12–18 credit hours) — $3,141 per quarter
- Part time (11 credit hours or less) — $349 per credit hour

International

- Full time (12–18 credit hours) — $6,282 per quarter
- Part time (11 credit hours or less) — $698 per credit hour

		Qtr. Cr. Hrs.
0835-701	Psychology and Sociology of Adolescence	4
0835-702	Deaf Students: Educational and Cultural Diversity	4
0835-703	Special Education in the Social Context	4
0835-704	Teaching Deaf Learners with Secondary Disabilities	4
0835-705	Political/legal Environment	4
0835-706	Educational Technology and Teaching	2
0835-712	Curriculum Content and Methods of Instruction	4
0835-713	Assessment	4
0835-721	Structure of American Sign Language	4
0835-722	Audition and Spoken Language: Application in Education	4
0835-723	Language Acquisition and Variation	4
0835-724	English Language Development	4
0835-790	Foundations of Educational Research	4
0835-820	Perspectives in Teaching Deaf and Hard-of-Hearing Students	2
0835-860	Student Teaching I	10
0835-861	Student Teaching II	10
0835-880	Master's Project Seminar	2
0835-890	Master's Project	8
0835-898	Special Topics	variable
	Professional Development Seminars	0
0886-xxx	American Sign Language *	8
0507-701	History of American Educational Thoughts and Practice	4
	Total Credits	**94**

** ASL course placements and credit by exam for ASL courses are determined by the Department of American Sign Language and Interpreting Education.*

Note: At graduation, students are expected to have at least intermediate-level signing skills as determined by the Sign Communication Proficiency Interview (SCPI) .

Proposed plan of study

First Year	Fall Quarter	0835-703	Special Education in the Social Context
		0835-701	Psychology and Sociology of Adolescence
		0835-706	Educational Technology and Teaching
		0835-721	Structure of American Sign Language
		0886-xxx	ASL course
	Winter Quarter	0835-722	Audition and Spoken Language: Application in Education
		0835-712	Curriculum Content and Methods of Instruction
		0835-723	Language Acquisition and Variation
		0507-701	History of American Educational Thoughts and Practice
		0886-xxx	ASL course
	Spring Quarter	0835-860	Student Teaching I*
		0835-820	Perspectives in Teaching Deaf and Hard-of-Hearing Students
Second Year	Fall Quarter	0835-713	Assessment
		0835-790	Foundations of Educational Research
		0835-724	English Language Development
		0835-702	Deaf Students: Educational and Cultural Diversity
	Winter Quarter	0835-880	Master's Project Seminar
		0835-861	Student Teaching II*
	Spring Quarter	0835-890	Master's Project
		0835-704	Teaching Deaf Learners with Secondary Disabilities
		0835-705	Political/Legal Environment

** Students are required to complete a minimum of 250 hours of supervised student teaching, working with deaf and hard-of-hearing students at the 7–12 grade level. In addition to the above requirement, 100 hours of field experience is required before the first student teaching placement.*

Degree requirements

Course work will require a minimum of six quarters. A cumulative GPA of at least 3.0 must be maintained. Before graduation, students are expected to have at least intermediate-level signing skills as determined by the Sign Communication Proficiency Interview (SCPI).

Professional Fellowship Program

Dianne Brooks, Associate Dean
585-475-6433 (voice/TTY), dkbnca@rit.edu

The professional fellowship program at NTID is a full-tuition fellowship for deaf or hard-of-hearing students who choose to pursue selected technical programs of study. The purpose of this fellowship is to expand options for deaf and hard-of-hearing persons in the areas of professional and technical employment by providing the opportunity to earn a master's degree.

Two fellowship appointments are made each year to qualified deaf and hard-of-hearing graduate students who are pursuing a two- or three-year master's degree program at RIT.* To qualify for the fellowship, students must first apply for graduate study in one the following program areas:

- Photography/fine arts/graphic arts/communication
- Business/management
- Engineering and related programs
- Science, mathematics, and imaging science
- Computer science and information technology

Students who are accepted into one of these programs and chosen for the fellowship will receive:

- Full tuition waiver for the master's degree
- A guaranteed part-time, career-related, paid internship at NTID for which the recipient will receive a $15,000 annual stipend
- Free housing on campus in a single room in a residence hallt

The only educational expenses remaining for the recipient are health insurance, books, and supplies.

Depending on the student's program of study, the recipient must complete course work within two or three years, maintain a 3.0 GPA, and meet the same university requirements as other matriculated graduate students.

Fellowship selection guidelines

The NTID Selection Committee evaluates applicants on academic achievement, clarity of career goals, prior work experience, community involvement, and leadership ability or potential. The fellowship recipient must first apply and be accepted to a two- to three-year master's degree program and therefore must meet the requirements of the individual program to which he or she applies. In addition, fellowship selection is based on the following criteria:

- Successful completion of the baccalaureate degree from an accredited college or university
- United States citizenship
- A 70-decibel or greater hearing loss in the better ear, unaided
- A minimum GPA of 3.0
- Acceptance into a program of graduate study at RIT

Application materials should be submitted by February 15 for admission the following fall. Applicants will be notified after May 1. For application materials and more information, contact:

Rochester Institute of Technology
National Technical Institute for the Deaf
Outreach and Technical Assistance
One Lomb Memorial Drive
Rochester, NY 14623-9650
585-475-6433 (voice/TTY)
dkbnca@rit.edu

** Students pursuing a master's certificate program do not qualify for this fellowship.*

† Fellows are required to live in an on-campus residence hall.

Graduate Faculty

Tohn A. Albertini,,BA. Drew University; MS, Ph.D., Georgetown University-Professor, Linguistics

Gerald C. Bateman, BS, MS, State University of New York at Geneseo; Ed.D., University of Rochester—Professor; Director, MSSE, Curriculum and Education

Gerald P. Berent, BA, University of Virginia; Ph.D., University of North Carolina at Chapel Hill—Professor, Linguistics

Joseph Bochner, BA, City University of New York, Queens College; MA, Ph.D., University of Wisconsin—Professor, Language and Audition

Cynthia Campbell, BS, MA, Syracuse University; DA, State University of New York at Albany—Assistant Professor, Communication

Karen Christie, BS, M.Ed., Lewis and Clark College; Ph.D., University of Pittsburgh—Associate Professor, Education

Carol Lee De Filippo, BA, Newark State College; MS, Purdue University; MS, Ph.D., Washington University—Associate Professor, Communication Sciences: Audiology

Susan Foster, BA, Northwestern University; BS, University of Maine; M.Ed., Bridgewater State College; Ph.D., Syracuse University—Professor, Special Education and Rehabilitation

Ronald Kelly, BS, M.Ed., Ph.D., University of Nebraska at Lincoln—Professor, Educational Psychology and Measurements

Baldev Kaur Khalsa, BA, M.Ed., Western Maryland College—Assistant Professor, Deaf Education

Christopher Kurz, BA, Rochester Institute of Technology; MS, University of Kansas—Assistant Professor, MSSE, Special Education: Education of Deaf Students

Harry G. Lang, BS, Bethany College; MS, Rochester Institute of Technology; Ed.D., University of Rochester—Professor, Science Curriculum and Teaching

Gary Long, BA, University of Akron; MA, Ph.D., Texas Christian University—Associate Professor, Cognitive Psychology/Mathematical Psychology

Ila Parasnis, BA, MS, Nagpur University; MA, Ph.D., University of Rochester-Professor, Psychology

Jeffrey E. Porter, B.Ed., MaEd., University of Virginia; Ph.D., Washington University-Associate Professor, Educational Psychology

Vincent Sanar, BA, MA, Ph.D., University of Rochester—Associate Professor, Psychology/Cognitive Neuroscience

Sara Schley, BA, Reed College; MA, Northeastern University; Ed.D., Harvard University—Associate Professor, Human Development

J. Matt Searls, BA, MA, Gallaudet University; Ph.D., American University—Associate Professor, Counseling and Development

Nora Shannon, BS, Nazareth College of Rochester; MS, Canisius College—Associate Professor; Coordinator of Student Teaching, MSSE, Education of the Deaf

Donald G. Sims, BA, University of Colorado; MS, Ph.D., University of Pittsburgh—Associate Professor, Audiology

Michael S. Stinson, BA, University of California at Berkeley; MA, Ph.D., University of Michigan—Professor, Educational Psychology

M. Josara Wallber, BS, Colorado State University; MS, Idaho State University; AuD, Pennsylvania College of Optometry—Associate Professor, Audiology

Secondary Education of Students Who Are Deaf or Hard of Hearing

0835-701 **Psychology and Sociology of Deaf Students**
The purpose of this course is to examine the psychological and social development of deaf and hard-of-hearing students. The ways that family, school and community affect the student's development, including effects on cognitive processes, identity formation and peer relationships, are considered. Psychological and sociological perspectives on the students' experience in general are used to provide a framework for understanding the development of deaf and hard-of-hearing students. Educational implications of the theories and research presented are discussed. **Class 4, Credit 4 (F)**

0835-702 **Deaf Students: Educational and Cultural Diversity**
This course introduces the concepts underlying cultural anthropology and uses a cross-cultural approach to examine issues that include transmission and preservation of culture, cultural change and transformation, concepts of marginality, and majority and minority cultures. Deaf culture is examined and compared with other cultures, using comparative studies and cultural constructs such as norms, values and beliefs. The relationship between education and culture is discussed, and the nature of this relationship with respect to Deaf culture is studied. **Class 4, Credit 4 (F, S)**

0835-703 **Special Education in the Social Context**
This course takes a sociological approach to disability and special education. Three models of disability are introduced: clinical, social interactionist, and political. The models provide a foundation for the course and guide study of three major aspects of disability and special education. First, students explore how each of the models has guided and continues to guide service and social institutions for persons with disabilities including educational and rehabilitation services. Second, students examine the process through which people with disabilities are *so* labeled and the interaction between these individuals and others (family, school, community). Third, students analyze the role of the human service professional (including teachers) and the ways in which training programs reflect the various models of disability. The course draws heavily on a variety of philosophical, theoretical, conceptual and methodological perspectives, including phenomenology, symbolic interactions, and human ecology. **Class 4, Credit 4 (F)**

0835-704 **Teaching Deaf Learners with Secondary Disabilities**
This course focuses on providing students with basic information regarding the needs of deaf learners with disabilities, including (1) developmental disability, (2) emotional or behavioral disorder, (3) learning disability, attention deficit disorder or attentional deficit hyperactivity disorder, or (4) visual impairment. Topics include incidence, identification, assessment, and teaching strategies. The goal is to enable students to see students in a holistic fashion, and incorporates the perspectives of parents, teachers and students themselves through site visits, interviews and panel discussion. The course regularly incorporates guest lecturers who have specialized expertise in teaching or research in one or more topic areas. (0835-703) **Class 4, Credit 4 (S)**

0835-705 **Political/Legal Environment**
The relationship of the goals and processes of deaf education to those of special education and education in general is explored. The course provides a detailed examination of historical and current demographic, economic, political, legal and social trends that affect the education of deaf and hard-of-hearing students. Current federal and state legislation affecting students with disabilities is analyzed and critiqued. **Class 4, Credit 4 (S)**

0835-706 **Educational Technology & Teaching**
This introductory course provides an overview of the use of educational technologies to enhance the learning experiences of deaf students. The use of productivity software and educational software including Web-based instruction and resources are explored. The selection, development, implementation, and evaluation of technology-based solutions are addressed. Instructional materials are created following a simplified model of instructional development. **Class 2, Credit 2 (F)**

0835-712 **Curriculum Content and Methods of Instruction**
Note: There are five discipline-specific courses here, designated by section: O1 (English), 02 (Mathematics), 03 (Science), 04 (Social Studies) and 05 (American Sign Language). Students will take only the section focusing on the content area in which they will be certified.

0835-712 **Section 01 English**
This course examines issues and methods related to teaching English in the secondary level to students who are deaf or hard-of-hearing. Students investigate and analyze current approaches to curriculum, instruction and materials in the area of English instruction through readings, observations, and seminars. Students design content area projects to demonstrate a variety of methodological philosophies. **Class 4, Credit 4 (W)**

0835-712 **Section 02 Mathematics**
This course examines issues and methods related to teaching Mathematics at the secondary level to students who are deaf or hard-of-hearing. Current instructional methods, curriculum and professional resources in mathematics are studied through seminars, readings, special projects, observations and work with content-area specialists and teachers in secondary-level mathematics courses. **Class 4, Credit 4 (W)**

0835-712 **Section 03 Science**
This course examines issues and methods in teaching secondary-level Science to deaf or hard-of-hearing students, including the selection, modifications, and use of curriculum materials in science. Discussions will be concerned with instructional strategies, classroom managements, cognitive development, testing and evaluation, lab report writing and theories of science teaching. Students will be required to observe teachers in secondary level science courses. **Class 4, Credit 4 (W)**

0835-712 **Section 04 Social Studies**
This course examines issues and methods related to teaching social studies at the secondary level to students who are deaf or hard-of-hearing. Through seminars, readings, special projects, and work with content area specialists/teachers, current instructional methods, curriculum and professional resources in social studies are examined. Students will be required to observe teachers of secondary level social studies courses at public schools, residential schools for deaf students or in mainstream programs. **Class 4, Credit 4 (W)**

0835-712 **Section 05 American Sign Language**
This course examines issues and methods related to teaching American Sign Language at the secondary level. Students investigate and analyze current approaches to ASL curriculum, instruction, and materials through readings, observations, and seminars. Students design content area projects to demonstrate their understanding of teaching theories and methods, curriculum design and evaluation techniques. **Class 4, Credit 4 (W)**

0835-713 **Assessment**
This course addresses assessment as a process involving the choice and interpretation of assessment measures to diagnose the need for and aid in planning for services, referrals and placement of secondary students who are deaf and hard of hearing, including students with other secondary disabilities. The respective roles of the classroom teacher, school psychologist, parents and support service providers are addressed. Assessment and educational planning for a student are viewed from an ecological perspective, including the family, the school, the community, the support services and the legal systems. This course also addresses the development and interpretation of assessment measures of learning through teacher-made, criterion-referenced, curriculum-based and norm-referenced methods. (0835-802, 0835-860) **Class 4, Credit 4 (F)**

0835-721 **Structure of American Sign Language**
This course concentrates on the linguistic structures of American Sign Language (ASL). Students examine all levels of structure from phonology (sublexical) through morphology and syntax to semantics and discourse. ASL structures will be elucidated through comparison and contrast with English and other spoken languages or dialects, as well as with other sign languages. ASL literacy, language variation and code switching in the deaf population are also examined. **Class 4, Credit 4 (F)**

0835-722 **Audition and Spoken Language: Applications in Education**
This course focuses on the ways individuals comprehend and produce spoken English. It provides a functional understanding of auditory physiology, speech perception and deafness, hearing aids and other assistive listening devices. Procedures for audiological and speech/language assessment are examined with their implications for auditory training, speechreading and speech/language instruction. Models of collaboration among teachers, speech/language pathologists and audiologists to enhance students' communication using spoken English are discussed and observed. **Class 4, Credit 4 (W)**

0835-723 **Language Acquisition and Variation**
This course is designed to familiarize students with the processes involved in learning English with a focus on reading and writing. The course concentrates on those aspects of English language development that pertain to teaching deaf and hard-of-hearing students in grades 7 to 12. Students investigate deaf learners' attainments in reading and writing, patterns of English language performance observed in deaf learners, relationships between spoken and written English performance, bilingual/bicultural issues related to English learning and use, second language teaching strategies, and reading and literacy questions. (0835-721 or permission of instructor) **Class 4, Credit 4 (W)**

0835-724 **English Language Development**
This course is designed to familiarize students with the processes involved in learning English with a focus on reading and writing. The course concentrates on those aspects of English language development that pertain to teaching deaf and hard-of-hearing students in grades 7 to 12. Students investigate deaf learners' attainments in reading and writing, patterns of English language performance observed in deaf learners, relationships between spoken and written English performance, bilingual/bicultural issues related to English learning and use, second language teaching strategies, and reading and literacy questions. **Class 4, Credit 4 (F)**

0835-790 **Foundations of Educational Research**
This course is an introduction to research and inquiry in education. Perspectives on and issues related to research in the education of people who are deaf and hard of hearing are examined. Students are introduced to the research process, including design, theoretical perspectives, methods of data collection, validity/reliability, data analysis and interpretation. Students leave this course with a preliminary proposal for the master's thesis or project. **Class 4, Credit 4 (F)**

0835-820 **Perspectives on Teaching Deaf and Hard-of-Hearing Students**
This course reviews fundamental principles of teaching and learning in light of the recently completed student teaching assignment. Students analyze examples of theoretical applications in teaching this class and from viewing videotapes of their actual lessons used during the student teaching experience. Students propose a plan for change and skill development. (Student Teaching I, 0835-860) **Class 2, Credit 2 (S)**

0835-860 **Student Teaching I**
This first practicum consists of 10 weeks (250 hours) of teaching and observation. Student teachers are placed with cooperating teachers in residential schools for the deaf. Students develop lesson and unit plans and teach in the content area in which they plan to receive New York State certification. (Curriculum Content and Methods of Instruction, 0835-712) **credit 10 (S)**

0835-861 **Student Teaching II**
This is an eight-week practicum done in conjunction with an itinerant or resource room cooperating teacher at the middle or secondary level in a mainstream setting with students who are deaf or hard of hearing. Students develop and deliver support for instruction, participate in student assessment, and, where appropriate, prepare lesson plans and teach to specific IEP objectives. (Student Teaching I, 0835-860; Perspectives on Teaching Deaf and Hard-of-Hearing Students, 0835-820) **Credit 10 (W)**

0835-880 **Master's Project Seminar**
Students finalize their thesis/project proposal and begin research and development. Students also finalize the selection of their thesis/project adviser. Format for the seminar is full group meetings in the early part of December followed by individual or small group consultation with thesis/project advisers. (Foundations of Educational Research, 0835-790) **Class *2,* Credit 2 (W)**

0835-890 **Master's Project**
This is the capstone experience of the master's degree program. Students must have already submitted an acceptable proposal in order to enroll. Project development, presentation, and/or reporting or research and the preparation of the written thesis are completed in this course. The coursework and project must be completed within a seven-year period; register for one credit of continuation of master's project each school term (except summer quarter) after all required coursework/student teaching assignments have been met and until the final project is completed. **Credit variable 0 to 8**

0835-898 **Special Topics**
Special topics courses will be developed based on student interest and demand as well as faculty interest and availability. They may include electives in speech, audiology and comparative linguistics, among others. **Credit variable**

0886-199 **American Sign Language I**
Designed for students who have no previous knowledge of American Sign Language. ASL I includes the linguistic features, cultural protocols and core vocabulary for students to function in basic ASL conversations that include ASL grammar for asking and answering questions while introducing oneself; exchanging personal information; talking about family, friends and surroundings; and discussing activities. Classroom and lab activities include practicing conversations and videotaping. **Class 4, Credit 4 (F, W)**

0886-200 **American Sign Language II**
Expands the basic principles presented in ASL I. The course teaches students to use linguistic features, cultural protocols, and core vocabulary to function in additional basic ASL conversations including ASL grammar for giving directions; describing others; making requests; talking about family, occupations and routines; and attributing qualities to others. Classroom and lab activities include practicing conversations and videotaping. (0886-199) **Class 4, Credit 4 (F, W, S)**

0886-201 **American Sign Language III**
This course is a continuation of ASL II expanding the emphasis on ASL grammar, syntax, spatial referencing and vocabulary development. ASL III teaches further communicative competencies in ASL conversations beyond the basic level that include telling life events, describing events in time, asking for clarification, correcting, conforming, elaborating on information, agreeing and disagreeing, resolving conflicts, and giving directions. Classroom and lab activities include practicing dialogues, short stories, narratives and short conversations. (0886-200) **Class 4, Credit 4 (F, W, S)**

0507-701 **History of American Educational Thought and Practice**
A historical analysis of change and continuity in American educational history from colonial through contemporary America. Special emphasis on the leading historiographical aspects of American educational history and on enabling the student to acquire mastery of the relevant bibliography. Lectures, seminars and readings offer comprehensive coverage of the salient intellectual themes and a chronological structure to mark the significant educational developments in particular periods-e.g., the Progressive Era, the 1920's and '30's and post-World War II changes. Course structure: lectures, seminars, readings from multiple paperbacks and class handouts, essay exams and critique. **Class 4, Credit 4 (W)**

Professional Development Seminars
Variety of topics: second-year students present research topics and ideas to all program faculty and students; child abuse and substance abuse; the code of ethics for interpreters; using educational support personnel effectively; identifying and using community resources. **Credit 0**

Online Learning and Executive Education

Rochester Institute of Technology is a recognized leader in the delivery of online asynchronous education. Since the late 1980s, RIT has been experimenting with distance learning through the use of online education delivery, and in 1991, RIT began offering full degrees through distance delivery.

Online Learning is responsible for supporting distance learning, the RIT online course management software (myCourses), training for faculty, and assisting the ITS Help Desk with student questions about my courses. Online Learning also reviews emerging technologies that support the critical mission of constantly improving teaching and learning.

RIT offers 42 degree and certificate programs in an online format; 11 masters degrees, five undergraduate degrees, nine graduate certificates, and 17 undergraduate certificates - all of which can be earned without ever coming to campus. Including graduate and undergraduate courses, RIT offers more than 400 courses online annually. Students are encouraged to select and apply to their chosen academic program, but may enroll in courses prior to matriculation into a program.

All online courses are taught using Internet and Web-based technologies. Students must have full Internet access, a computer, VCR and monitor, and a telephone to participate in courses. Not all courses use the same technologies. Some take advantage of toll-free phone 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-based tools for the fundamental class structure.

Online students have full access to customer and technical support through a toll-free phone number and e-mail. Online learners also have full access to the library and library services. Other online services include registration, orientation, access to student records and course material ordering. Registration can also be accomplished through touchtone phone and fax. Annual offerings can be found at http://online.rit.edu. Officially registered students receive orientation information about three weeks before the quarter begins. This information directs them to the Registered Students website at http://online.rit.edu/students to follow the process to prepare for their upcoming courses. Online learning offers students the flexibility to learn on their own time, when and where it best meets their needs.

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 will be present in the online classroom. Most classes establish either a weekly schedule for learning activities or a project-based learning approach where deliverables are due after certain learning outcomes are accomplished. These may include team-based projects, required asynchronous discussion, or computer programs. 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 more than 40 different countries. Those living near Rochester can choose to take both online and traditional courses as a way of increasing flexibility and remaining on target to complete a degree. For more information on Online Learning at RIT **go to http:/online.rit.edu or call us at 1-800-CALLRIT (V/TTY) or (585) *475-5089/5896* (V/TTY).**

Online Graduate Programs:

Master's Degrees

- Applied Statistics
- Cross-Disciplinary Professional Studies
- Environmental, Health and Safety Management
- Health Systems Administration
- Imaging Science
- Information Technology
- Learning and Knowledge Management Systems
- Microelectronics Manufacturing Engineering
- Print Media
- Software Development and Management
- Telecommunications Engineering Technology

Advanced Certificates

- Health Information Administration
  (Elements of Healthcare Leadership, Health Information Resources, Health Systems Finance, Senior Living)
- Human Resource Development
- Statistical Methods for Product and Process Improvement
- Statistical Quality
- Technical Information Design
- Materials Science Engineering

Admission

Decisions on graduate selection are made by the college offering the program. Correspondence between the student and the Institute will be conducted through the Office of Graduate Enrollment Services, according to the following policies and procedures:

1. Inquiries about, and applications for, graduate study are directed to the Office of Graduate Enrollment Services, Rochester Institute of Technology, Bausch & Lomb Center, Building 77 Room 1241, 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 made formal application, the Office of Graduate Enrollment Services will prepare an applicant file for him or her. All correspondence and admission data will be 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, 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 will be sent to the appropriate school or department for action.
5. When the school or department has made a decision on the application, this decision and the applicant's file will be returned to the Office of Graduate Enrollment Services.
6. The Office of Graduate Enrollment Services will notify the student of the admission decision.
7. Academic departments may informally advise nonmatriculated students, but no formal program of study can be approved prior to matriculation.
8. The formal program of study will be approved by the dean's designee (department head, coordinator, program director, etc.). This program must be followed by all students applying for admission or readmission.
9. The basic entry requirements for master's degree candidates include the completion of a baccalaureate degree and whatever other evidence of the applicant's potential to successfully complete graduate studies may be required by the particular college. 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.

International applicants must demonstrate English language proficiency as part of the admission process. This is normally accomplished through submission of test scores from the Test of English as a Foreign Language (TOEFL). Minimum TOEFL scores vary by program. Most programs require a TOEFL score of 213 (550 paper-based, or 79-80 internet based) or higher. Upon arrival at RIT, students with English as a second language may be required to take a battery of English language exams. Depending on the results, a student may have to enroll in English instruction, which will result in additional study time and tuition cost.

In certain cases graduate students may be admitted prior to, but conditional upon, completion of the baccalaureate degree. Applicants will not be considered for admission prior to the start of the final year of undergraduate study. The student must present a final transcript covering all undergraduate study within one quarter after first registering for a graduate program.

Graduate applicants who do not fully satisfy all admission criteria as to grades, test scores, or their credentials but show sufficient promise to qualify for a trial period of graduate study may be admitted on probation to the Institute. Such students must achieve a 3.0 ("B") program cumulative grade point average by the end of their first 12 quarter credit hours of graduate study. Those students who do not meet this criterion will be suspended. Responsibility for specific requirements and maintenance of the student's appropriate status rests with the student's academic department in consultation with the Office of Graduate Enrollment Services and the Registrar. Evaluation of transfer credit (see p. 176) is made by the academic school or department in question. RIT will admit and hire men and women, veterans, persons with disabilities, and individuals of any race, creed, religion, color, national or ethnic origin, sexual orientation, age, or marital status in compliance with all appropriate legislation.

New York State immunization requirement

New York State Public Law 2165 requires that all matriculated students enrolled for six or more quarter credit hours in a term and born after January 1, 1957, must provide the RIT Student Health Center with proof that they have received the appropriate immunizations against measles, rubella, and mumps. Immunization requirements include: two measles vaccinations at least one month apart, with a live virus after January 1, 1968, and after the first birthday; and one vaccination each against mumps and rubella after January 1, 1969, and after the first birthday. Additional information concerning the necessary documentation and where it must be sent is included with the student's acceptance packet or available from the Student Health Center.

Readmission

If a student has become inactive (has not completed a course in four quarters) or has withdrawn from RIT, Institute policy requires that the student reapply for admission as follows:

1. Students who left a graduate program with a GPA of 3.0 or better (in good standing) and will return to the program within two years of the time their last course was completed will be readmitted to the program upon reapplication.
2. Students who left the program with a GPA of 3.0 or better and return to the program more than two years after the last course was completed must meet current admission standards upon reapplication. The program of study shall be subject to review and will be rewritten. Previous waiver and/or transfer credit may be lost and the student may need to make up program deficiencies.
3. Students who leave a program with a GPA below 3.0 must meet current admission standards upon reapplication. Readmission will be based on all information, including previous graduate level work. Program requirements in effect at the time of reapplication will apply. Previous waiver a nd/or transfer credit may be lost and the student may need to make up program deficiencies.

Expenses and Financial Aid

Electronic Billing

The university has an electronic billing (E-Bill) program for students. E. Each quarter, all RIT 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 selecting three additional e-mail addresses to allow for a parent, guardian, sponsor, or other authorized user to receive E-Bill notifications.

Costs and Payment Procedures

The Institute reserves the right to change its tuition and fees without prior notice. Non-matriculated 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 $755/credit hour for each hour of study exceeding 18.

Room and board for full-time students for 2006–07 will be $1,238 per quarter for a standard meal plan and $1,678 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 will vary depending on the area of study and the number of courses taken by a student. The estimated costs for books and supplies ranges from $500 to $2,500 a year for full-time students and $300 to $700 a year for part-time students.

Charges for tuition, fees, and room and board are computed on a quarterly basis. University billing statements may be paid by cash, check, or electronic check (e-check). The university does not accept credit card payments for tuition, fees, and room and board that appear on the student billing statement. However, we have an arrangement for a third-party vendor to accept Mastercard and Discover Card when payment is made online. The vendor does charge a percent 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 may also be made in person at the Office of Student Financial Services on the first floor *of* the George Eastman Building. Credit card and e-check payments can be made at http://ipay.rit.edu.

Due dates are clearly designated on the billing statement and our website. Failure to pay the amount due (or to arrange an optional payment by the due date) will result in a late payment fee for students without a valid deferral. Due dates for the 2005–06 school year are as follows:

Fall Quarter—August 16, 2006
Winter Quarter—November 21, 2006
Spring Quarter—March 7, 2007
Summer Quarter—May 23, 2007

Students who have not participated in the early registration process for the quarter will be expected to pay the quarterly charges (tuition, fees, room and board) at the time of registration. They may pay these charges in a single payment or by the partial payment plan. Partial payments are due twice a quarter: 50 percent (plus a $25 partial payment processing fee) at the time of registration and the remaining 50 percent by the mid-quarter bill due date. A late payment fee will be assessed if the balance is not paid by the due date.

Graduate Costs

Tuition	Per Quarter	3 Quarters
Full-time (12-18 credit hours)	$8,967	$26,901
Part-time (11 credit hours or less)	$755/credit hour	$755/credit hour
Student activities fee	$65	$195

If you have questions concerning payment options, please contact the RIT Student Financial Services Office, (585) 475-6186.

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 semi-annual basis.

There is no need to waive coverage if it is not desired. Students who want to enroll in this plan may enroll online or by mail. An open enrollment period is available at the beginning of each academic quarter. Payment can be made by check, money order, or credit card, or the premium can be added to the student's account.

The open enrollment period ends 30 days after the start of the academic quarter the student first registers at RIT.
For plan and enrollment information visit the Web at www.universityhealthplans.com or call 800-437-6448. Students are not required to obtain the RIT student accident and sickness insurance plan to receive services at the RIT Student Health Center.

Financial Aid

Rochester Institute of Technology is interested in seeing that all students qualified for graduate study at RIT find the financial resources needed to assist with their educational expenses. The information provided in this section is an overview of the sources of assistance available. Please contact the offices listed for additional information.

Scholarships and assistantships are available in most graduate departments. In addition, some departments offer externally funded stipends from corporate or governmental sources. Please contact the appropriate department chairperson or the Office of Graduate Enrollment Services at 585-475-2229 for additional information.

While students may apply before matriculation, these awards are awarded only to matriculated students. Awards are generally given to full-time students, but exceptions are made for qualified part-time students.

Standard of Satisfactory Progress for the Purpose of Determining Eligibility for State Student Aid
Graduate Degree—QuarterSystem

Before being certified for this payment	1st	2nd	3rd	4th	5th	6th
A student must have accrued at least this many credits	0	12	24	36	48	60
With at least this cumulative grade point average	0	2.00	2.50	2.70	2.80	2.90

Additional sources of financial assistance include the New York State Tuition Assistance Program, work-study, and various student loan programs. Please refer to the Graduate Financial Aid Programs for details.

It should be noted that international students (F-1 or J-1 visa holders) may generally work on campus up to 20 hours a week. Special authorization from International Student Services and/or the INS is needed for all other employment, including co-op, internships, etc. Please consult International Student Services at (585) 475-6943 or www.rit.edu/internationalservices for employment or visa questions.

All federal assistance programs require submission of the Free Application for Federal Student Aid (FAFSA). The FAFSA is available from the Office of Financial Aid and Scholarships, (585) 475-2186. You can also complete the FAFSA online at www.fafsa.ed.gov. Satisfactory academic progress for federal aid recipients is evaluated at the end of spring quarter each year. Students must maintain a 2.0 grade point average and complete two-thirds of credit hours attempted each year. Federal aid eligibility is exhausted after attempting 150 percent of the number of credit hours required for the degree or certificate. In addition, loan eligibility for students with full-time-equivalent status is limited to a maximum of four quarters.

Students receiving New York Tuition Assistance Program benefits must meet credit hour and grade point average requirements based on the number of TAP payments received at the graduate level at RIT. Course completion is defined as meeting course requirements and receiving a letter grade of A, B, C, D, or F. Complete state student aid academic requirements are listed on the following page.

Refund Policies

Advance deposits are nonrefundable. The acceptable reasons for a withdrawal with refund during the quarter are:

For a full refund

1 Active military service: A student called to active military service during the first eight weeks of the term may receive a full tuition refund. If called after the eighth week, he or she may elect to complete the course by making special arrangements with both the instructor and department, or to withdraw and receive a full tuition refund. If the student withdraws, he or she will have to repeat the course at a later date.

2. Academic reasons: Students sometimes register before grades for the previous quarter are available. If such a student later finds that he or she is subject to academic suspension or has failed prerequisites, the student will be given a full refund upon withdrawal. It remains the student's responsibility to contact his or her department to assure that the withdrawal form and refund are properly processed.

3. If students drop a course(s) during the Official Drop Period (first six days of classes during that specific quarter), they may contact the Office of Student Financial Services for a full refund for the courses dropped. Courses dropped after the Official Drop Period will not result in any tuition refund.

For a partial tuition refund

A student must officially withdraw from all courses or take a leave of absence from the Institute in order to be eligible for a partial tuition refund. Students must complete a leave of absence or withdrawal form, which can be initiated with their academic department.

A partial refund will be made during a quarter if withdrawal/leave of absence is necessitated for one of the following reasons:

1. Illness, certified by the attending physician, causing excessive absence from classes
2. Withdrawal for academic or disciplinary reasons at the request of the Institute during a quarter
3. Transfer by employer, making class attendance impossible
4. Withdrawal for academic or personal reasons at the request of the student, approved by the student's adviser or department representative, the Institute Coordinator for Academic Advising, and the Director of Student Financial Services

Students withdrawing from the Institute must complete a withdrawal form to initiate the refund process. Refunds will be made according to the following schedule.

During the first week of classes — 100% tuition reduction
During the second week of classes — 70% tuition reduction
During the third week of classes — 60% tuition reduction
During the fourth week of classes — 50% tuition reduction
During the fifth week of classes — 25% tuition reduction
Sixth and subsequent weeks — No tuition reduction
Note: Nonattendance does not constitute an official withdrawal.

A student is not "officially withdrawn" until he or she receives the student's copy of the withdrawal form. The date on which a withdrawal form is properly completed shall be the date of "official withdrawal" used to determine the refundable amount. If a student drops his or her course load from full-time (12 or more credits) to part-time (less than 12 credits) status during the Official Drop Period, he or she may contact the Office of Student Financial Services for a refund based on the difference between the full-time tuition payments and the total per-credit charge for the part-time load.

No refund will be made for classes dropped after the Official Drop Period unless the student is officially withdrawing from the Institute.

Room and meal/debit plan

To complete a withdrawal from RIT, a resident student or a nonresident student on a meal plan must check out with Housing Operations, located in Grace Watson Hall, and/or the Food Service Administrative Office, A520 Union. When released from the residence halls, students may receive a partial refund on their meal/debit plan in accordance with the following schedule. Sales tax of 8.25 percent will be assessed to the used portion of the quarterly plan charge and will be deducted from the refund. Refunds, when granted, are from the date of official check out.

1. RIT Housing

During the first week of classes — 90% of unused room charge
During the second week of classes — 75% of unused room charge
During the third week of classes — 60% of unused room charge
During the fourth week of classes — 50% of unused room charge
During the Fifth and all subsequent weeks — no refund

2. Meal/debit plan

During the first four weeks — 75% of unused meal/debit charges
After the first four weeks — 50% of unused meal/debit charges
During the last two weeks of classes — no refund

Any student who intentionally defrauds or attempts to defraud the Institute of tuition, fees, or other charges or gives false information in order to obtain financial aid is subject to legal liability, prosecution, and Institute disciplinary action.

Appeals process

An official appeals process exists for those who feel that individual circumstances warrant exceptions from published policy. The initial inquiry in this process should be made to the Director of Student Financial Services.

Financial Aid Refund Policy

Return of federal funds

In accordance with federal regulations, the Office of Financial Aid and Scholarships recalculates quarterly federal aid eligibility for students who withdraw, drop out, are suspended, or take a leave of absence prior to completing 60 percent of a quarter. "Withdrawal date" is defined as the actual date the student initiated the withdrawal process, or the student's last date of recorded attendance, or the midpoint of the quarter for a student who leaves without notifying the university. Recalculation is based on the percent of earned aid using the following formula: number of days completed up to the withdrawal date/total days in the quarter. Aid returned to federal programs is then equal to 100 percent minus the percentage earned multiplied by the amount of federal aid disbursed.

Funds are returned to the federal government in the following sequence: Federal Direct Unsubsidized Loans, Federal Direct Subsidized Loans, Federal Parent Loans, Federal Perkins Loans, Federal Pell Grants, Federal SEOG, other federal aid.

Late disbursement

If the student is otherwise eligible, the first disbursement of Federal Direct Subsidized Loan or Federal Direct Unsubsidized Loan proceeds is allowed up to 120 days after the student has ceased to be enrolled. Subsequent disbursements are not allowed.

State scholarships

Regulations vary. Any adjustments are done in accordance with the specific requirements of the sponsoring state.

Privately funded grants and scholarships

In the absence of specific instructions from the sponsor, 100 percent of the quarterly award will be credited to the student's account.

RIT grants and scholarships

If a credit balance remains after all federal, state, and private adjustments, a percentage of the remaining credit balance is returned to the RIT scholarship account according to the following formula, where A = scholarship amount; B = scholarship plus student payments; C = percent returned to scholarship program, and D = remaining credit balance.

$$A = \frac{C \times D}{B}$$

Financial Aid Programs

Grants/Scholarships	Eligibility	Amount	Where to Apply
Graduate Assistantships	Graduate student matriculated into an RIT graduate degree program.	Amounts vary.	Contact academic department
Institute Graduate 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.
AALANA Graduate Scholarship	Awarded to a full-time, matriculated African-American, Latino American, or Native American who demonstrates financial need and academic achievement.	Awarded to a full-time, matriculated African-American, Latino American, or Native American who demonstrates financial need and academic achievement.	File the Free Application for Federal Student Aid (FAFSA).
Tuition Assistance Program (TAP)	New York state resident matriculated and enrolled full-time (minimum of 12 credit hours per quarter).	Amounts vary.	File the Free Application for Federal Student Aid (FAFSA) and Express TAP Application (ETA) if sent after filing FAFSA.
Vietnam Veterans Tuition Award Program/Persian Gulf Veterans Tuition Award Program	Recipients must meet NYS residency requirements and have served in the armed forces in Indochina or the Persian Gulf during specified periods of hostility.	Awards are $1,000 per year for full-time study, $500 per year for part-time study.	Same as TAP. In addition, file the appropriate award supplement to establish eligibility. Contact NYSHESC at 1-888-697-4372 for more information.
Regents Professional Opportunity Scholarship	U.S. citizen and permanent NYS resident as defined by legislation. For certain approved professional programs (e.g. accounting, engineering, physician's assistant), recipient must agree to practice for 12 months in chosen profession in NYS for each annual payment received.	Awards are $1,000 to $5,000 per year. TAP and certain other benefits may supplement this award.	Contact: HEOPNATEA Scholarships. NYS Education Dept., Education Bldg Annex, Rm. 1071, Albany, NY 12234, (518) 486-1319.
Veterans Benefits	Eligible veterans and children of deceased veterans, or service-connected disabled veterans.	Amounts vary.	Contact: Office of Veterans Affairs at 1-888-442-4551, 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 (505) 881-4584, or on the Web at www.aigc.com.
NTID Professional Fellowship Program	Matriculated students in selected programs of study.	Full tuition and stipend.	Contact NTID Office of Outreach and Transition Services.

Loans	Eligibility	Amount	Where to Apply
Federal Direct Loans	All students enrolled at least half-time in a degree program.	Maximum amount: $18,500 ($8,500 of which may be subsidized, depending on financial need). The maximum amount cannot exceed the cost of education less other financial aid.	File the Free Application for Federal Student Aid (FAFSA).
Federal Perkins Loan	Students who meet requirements established by the federal government.	Up to $6,000 per year ($40,000 limit for undergraduate and graduate study).	File the Free Application for Federal Student Aid (FAFSA).
Private Alternative Loans	Enrolled student who is credit-approved by lender.	Up to the cost of education less other financial aid.	Contact the Office of Financial Aid and Scholarships at 585-475-2186, or at www.rit.edu/financial aid.

Employment	Eligibility	Amount	Where to Apply
Federal Work Study Program	Students with financial need. Most jobs provided on campus. Some community service positions are available.	Varied, depending on hours and wage rate. RIT wage rates start at $6.00 per hour.	File the Free Application for Federal Student Aid (FAFSA).
RIT Employment Program	No financial need requirement. May be on campus or off.	Varied, depending on hours and wage rate. RIT wage rates start at $6.00 per hour.	Contact the RIT Student Employment Office at 585-475-2631, or www.rit.edu/seojobs.

This chart covers the most commonly awarded financial aid programs available to full-time graduate students at RIT. Information is correct as of March 2005. 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.

RIT Payment Options

Quarterly Payment Option	Who is Eligible	Terms
Quarterly payment	All students	Payment in full by billing due date. Payments received after each billing due date are subject to a late payment fee.
Deferred payment plan	All students	$25 participation fee. Bill must be paid in full from prior quarter. 50% of net "out of pocket" quarterly balance due with registration. A deferred payment agreement form must be completed and submitted to the Office of Student Financial Services on or before the start of classes. Remaining 50% due by mid-quarter bill due date. Payments received after billing due date will be assessed a late payment fee.
Company deferred payment plan	All students who have official verification of employer's tuition reimbursement practice	Account must be paid in full from prior quarter. Official verification form must be submitted quarterly in lieu of payment. Full payment for the quarter is due by mid-quarter bill due date (regardless of whether the employer has reimbursed the student). Payment received after the billing due date will be assessed a late payment fee.
Veteran payment option	All veterans who are certified for VA educational benefits by the RIT Veteran Enrollment Services Office	Account must be paid in full from prior quarter. An authorized veteran deferment form must be submitted in lieu of payment. The student pays monthly in accordance with his or her scheduled VA benefit checks.

Annual Payment Option	Who is Eligible	Terms
Monthly Payment Plan	Matriculated day undergraduate and graduate students (full- and part-time)	The plan, which offers flexibility in both timing and method of payment, carries no interest or finance charge, but does require a $50 administration fee. Account must be paid in full from prior school year. Student must submit enrollment and housing plans for upcoming academic year by July 15. Projected net annual amount due is divided into 10 monthly installments. First monthly payment due August 1 prior to school year. The minimum annual amount must be $1,000 ($100 per month). Students must be registered for a minimum of two quarters during the academic year. Applications cannot be accepted after the first day of fall quarter classes.

Payment Procedures

Past Due Amount	Late Payment Fee
$100 through $500	$25
$500.01 through $1,000	$50
Over $1,000	$75

Payment made by check should be payable to Rochester Institute of Technology. Late payment fees will be assessed as follows on accounts that are past due as of each billing due date. Since there are two billings per quarter, there is a potential that two late fees (total maximum of $150) may be assessed as well.

Registration and Degree Requirements

A graduate degree at RIT may be obtained in more than 60 programs ranging from business administration to imaging science. (Please refer to page 4 for a complete listing of graduate programs of study.)

Upon completion of the stipulated requirements, students are certified by their academic departments for their degree. After commencement, a statement verifying that a degree has been awarded will be posted to the transcript. Diplomas for fall graduates are mailed in winter quarter; for winter graduates, in spring; for spring graduates, in the summer; and for summer graduates, in the fall.

Registration

1. Student should complete the registration and payment process in accordance with Institute registration/billing procedures, as indicated in the quarterly schedule of courses.
2. It is the responsibility of the student to update his or her address on-line through the Student Information System (SIS) or to advise the Registrar of any change of address.
3. University ID cards are required for students to use many campus facilities and services (e.g., the library, Student Life Center, meal plans, check cashing). Identification cards are available at the Registrar's Office.
4. Students are expected to pursue their degree without a substantial break. Failure to enroll (register) for four successive academic terms can result in the loss of matriculated status.
5. RIT considers graduate-level students to be "full time" in every academic quarter in which they are enrolled for at least 12 credit hours. With approval of the department chair and associate provost for academic programs, additional "equivalent" credit can be granted for such activities as thesis work, teaching assistantships, and internships.

Matriculation

Matriculated graduate students are those who have applied to and been formally accepted into a graduate program through the Office of Graduate Enrollment Services. Such students may register for graduate-level courses (700 and above) that fit their home department-approved programs. When registering for graduate courses outside the home department, students may need to secure the approval of the department offering the course.

Nonmatriculated students will be allowed to take graduate courses on a space-available basis with the department's approval, and with the knowledge that course work completed while a nonmatriculated student will not necessarily apply to any given academic program.

Matriculated and nonmatriculated graduate students may register for undergraduate-level courses with the understanding that these courses may not apply to any RIT graduate program. In certain cases, where educationally sound programs will result, appropriate undergraduate courses, as approved by the faculty adviser and the department, may be included in a master's program. However, not more than nine undergraduate quarter credit hours (600-level or below) may be applied toward the 45-quarter-credit minimum (12 undergraduate hours for those programs requiring 48 or more quarter credit hours). Where undergraduate work is allowed, it must be well-planned and closely controlled. In the vast majority of cases, most, if not all, course work will be at the graduate level.

Degree Requirements

Credit requirements

The minimum credit requirement for a master's degree is 45 quarter credit hours. At least 36 of these quarter credit hours must be earned at the graduate level and in residence at the Institute.

Transfer credit

A maximum of nine quarter credit hours in a 45-credit-hour program or 12 quarter credit hours in a 48 or more credit-hour program may be awarded as transfer credit from other institutions. A request for transfer credit must be made at the time of application for graduate student status. Only a course with a grade of B (3.0) or better may be transferred.

Transfer credits are not calculated in the student's grade point average but will count toward overall credit requirements for the degree. Transfer credits do not count toward the satisfaction of residency requirements.

A graduate student who wishes to take courses at another institution and transfer them to his or her degree work at the Institute must obtain prior permission from the appropriate departmental officer or dean.

Candidacy for an advanced degree

A graduate student must be a candidate for an advanced degree for at least one quarter prior to receipt of the degree. The position of the Graduate Council is that a student is a candidate for the master's degree when he or she has been formally admitted to the Institute as a graduate student.

Thesis requirements

Included as part of the total credit-hour requirement may be a research, dissertation, thesis, or project requirement as specified by each department. The amount of credit the student is to receive must be determined by the time of registration for that quarter.

For the purpose of verifying credit, an end-of-quarter grade of R should be submitted for each registration of research and thesis/dissertation guidance by the student's faculty adviser. Before the degree can be awarded, the acceptance of the thesis/dissertation must be recorded on the student's permanent record. Students should also note the following continuation of thesis/dissertation policy.

Continuation of thesis/project/dissertation*

Once work has begun on a thesis, project, or dissertation, it is seen as a continuous process until all requirements are completed. If a thesis, project, or dissertation is required, or such an option

is elected, and if the student has completed all other requirements for the degree, the student must register for the Continuation of Thesis/Project/Dissertation course each quarter (including summer quarter). This course costs the equivalent of one-quarter credit hour, although it earns no credit.

1. Registration for the Continuation of Thesis/Project/Dissertation course preserves student access to RIT services; e.g., Wallace Library, academic computing, and faculty and administrative support. With payment of appropriate user fees, access to the Student Life Center and Student Health Center is also 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 and/or department head. The dean's signature of approval is required on the Leave of Absence or Institute Withdrawal form, a copy of which also must be sent to the associate provost for academic programs. If students do not register for the Continuation of Thesis/Project/Dissertation course or take an approved leave of absence, their departments may elect to remove them from the program.
3. The length of time to complete a thesis/project/dissertation is at the discretion of the department. Be sure to read, however, point 1 under "Summary of requirements for master's degree" on this page. * *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 his or her total educational experience. The nature of the experience will be determined by the individual college or department.

Overlapping credit for second degree

At the discretion of the Graduate Committee in the specific degree area, nine to 12 previous master's quarter credit hours 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 36 quarter credit hours of residency be accepted for the second degree. If duplication of courses causes a student to go below the 36-hour limit in the second degree program, he or she would be exempted from these courses but required to replace the credit hours with departmentally approved courses. An RIT student will not be admitted through the Graduate Enrollment Services Office to the second degree program until the first program has been completed.

Financial standing

Tuition and fees paid to the Institute cover approximately 60 to 70 percent of the actual expense of a student's education. The rest of the cost is borne by the Institute through income on its endowment, gifts from alumni and friends, and grants from business and industry. Students, former students, and graduates are in good financial standing when their account is paid in full in the Student Financial Services Office. Any student whose account is not paid in full will not receive transcripts, degrees, or recommendations from the Institute.

The Institute 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 Institute and the college. These requirements should be met within seven years of the date of the oldest course counted toward the student's program. Extension of this rule may be granted through petition to the Graduate Council.
2. Complete a minimum of 45 quarter credit hours for the master's degree. At least 36 quarter credit hours of graduate-level course work and research (courses numbered 700 and above) must be earned in residence at the Institute.
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 Institute.

Note: The dean and departmental faculty can be petitioned, in extraordinary circumstances, to review and judge the cases of individual students who believe the spirit of the above requirements have been met yet fall short of the particular requirement. If the petition is accepted and approved by the faculty, dean, and provost and vice president for academic affairs, a signed copy will be sent to the registrar for inclusion in the student's permanent record.

Definition of grades

Grades representing the students' progress in each of the courses for which they are registered are given on a grade report form at the end of each quarter of attendance. The letter grades are as follows:

- A Excellent
- B Good
- C Satisfactory
- D and F grades do not count toward the fulfillment of program requirements for a master's degree.

The grades of all courses attempted by graduate students will **count in the calculation of the cumulative grade point average.** This program cumulative grade point average shall average 3.0 (B) as a graduation requirement. The dean of the college or his/her designee must approve all applications for graduate courses a student wishes to repeat.

Quality points

Each course has a credit-hour value based on the number of hours per week in class, laboratory, or studio and the amount of outside work expected of each student. Each letter grade yields quality points per credit hour as follows:

- A Four quality points
- B Three quality points
- C Two quality points
- D One quality point
- F does not count in computing the grade point average (GPA).

The GPA is computed by the following formula:

GPA = total quality points earned total quality hours

There are other evaluations of course work that do not affect GPA calculations. Only I and R (as described below) can be assigned by individual faculty members at the end of a quarter.

Registered (R) - a permanent grade indicating that a student has registered for a given course but has yet to meet the total requirements of the course or has continuing requirements to be met. The grade is given in graduate thesis/dissertation work. Completion of this work will be noted by having the approved/ accepted thesis/dissertation title, as received by the registrar from the department, posted to the student's academic record. Full tuition is charged for these courses. "R" graded courses are allowed in the calculation of the residency requirement for graduate programs.

Incomplete (1) - this notation is given when the professor observes conditions beyond the control of the student such that the student is not able to complete course requirements in the given quarter. This is a temporary grade that reverts to an F if the registrar has not received a change of grade directive from the professor by the end of the second succeeding quarter (including summer terms). Full tuition is charged.

Withdrawn (W) - will be assigned in courses from which a student withdraws through the end of the sixth week of classes, or if a student withdraws from all courses in a given quarter.

Audit (Z) - indicates a student has audited the course. An audit request form must be completed and approved by the department offering the course. The student need not take exams, and half tuition will be charged. A student can change from credit to audit or from audit to credit status for a course only during the first six days of classes. Audited courses do not count toward the residency requirement, do not get included in GPA calculations, and do not count toward degree requirements.

Credit by examination (X) - assigned for the successful completion of various external or Institute examinations, provided such examinations cover or parallel the objectives and content of the indicated course. Credit must be assigned in advance for any credit received through registration for the indicated courses. "X"-graded courses do not count toward the residency requirement. A maximum of 12 quarter credit hours is allowed for graduate courses. Exceptions to the maximum transfer credit or credit-by-exam for graduate programs can be granted by the associate provost for academic programs in unusual circumstances upon appeal from the dean of the college involved.

Waived - Waived courses are those courses eliminated from the list of requirements that a student must take to graduate. For graduate students, required courses may be waived because of previously completed academic work, but in no case shall the resulting graduate program requirements be reduced below 45 quarter credit hours.

In addition, waiver credit for graduate courses can be applied only toward required, not elective, courses. The process of waiving courses and thereby reducing graduate program requirements is not to be confused with the process of exempting certain requirements that are then replaced by an equal number of credit hours in the specified program.

Changing grades

Once a grade has been reported by a faculty member, it is not within the right of any person to change this unless an actual error has been made in computing or recording it. If an error has been made, the faculty member must complete the appropriate form. The completed form must be approved by the head of the department in which the faculty member teaches. When approved, the form is then sent to the registrar. There is, however, an appeal- procedure for disputed grades through the Academic Conduct Committee of the college in which the course is offered. A final appeal can be sent to the Institute Hearing and Appeals Board.

Academic probation and suspension

Any matriculated graduate student whose program cumulative GPA falls below a 3.0 after 12 quarter credit hours will be placed on probation and counseled by the departmental adviser concerning continuation in the graduate program.

Those students placed on probation must raise their program cumulative GPA to the 3.0 level within 12 quarter credit hours or be suspended from the graduate program.

Should it be necessary to suspend a graduate student for academic reasons, the student may apply for readmission to the dean of the college or his designee upon demonstration of adequate reason for readmission.

Standards for student conduct

The RIT community intends that campus life will provide opportunities for students to exercise individual responsibility

and places high priority on self-regulation by its members. All members of the community are responsible for encouraging positive behavior by others, as well as preventing or correcting conduct by others that is detrimental to RIT's educational mission and values.

As an educational community, RIT strives for a campus environment that is free from coercive or exploitative behavior by its members. Moreover, it sets high standards that challenge students to develop values that enhance their lives professionally and that 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 Institute 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

RIT libraries

RIT Libraries are comprised of three separate entities. In addition to Wallace Library, the Cary Collection and the RIT Archives are all housed within Building 5 on the RIT campus. Recently added resources include the Publishing & Scholarship Support Center (PSSC) and the Business and Entrepreneurship Resources Area.

Wallace Library is a high-technology multimedia resource center, which serves as the main library on campus. Its vast information resources are conveniently available via the Internet, and are a particular boon to busy graduate students. The library's online menu provides access to a wide selection of current electronic resources in web-based and text formats. Users can easily access the library's online catalog, search electronic databases, and surf the Internet. The staff offers hands-on instructional sessions for using various electronic and Internet resources. Specialized class instruction can be scheduled upon request. Reference librarians are available during the week and on weekends to provide individual assistance at the RE:SEARCH ZONE on the library's first floor. In-depth assistance is also available by appointment. The Publishing & Scholarship Support Center provides a one-stop service for advice and assistance in preparing research, articles, books and other documents for publication.

Videotapes (VHS) and DVDs can be checked out at the Circulation Desk. Audio Books and wireless laptop computers are also available. The IDS (Information Delivery Services) Department manages interlibrary loans, and patrons can request materials online through IDS Express. ConnectNY is a service that makes available the combined resources of (currently) seven academic libraries in New York State. Requests submitted online are usually fulfilled within 48 hours. The combined collection of the ConnectNY member institutions currently exceeds three million items. The Rochester Regional Library Council's Access program allows graduate students to obtain a library card that offers access to other area libraries, including those of the University of Rochester and the State University of New York colleges in Geneseo and Brockport.

The Idea Factory is a multipurpose room on the first floor, featuring The Soap Box (for both impromptu and scheduled use), a living coral reef aquarium, an art gallery, numerous modular study tables, and a conference area. Special library events are frequently held here, offering educational and recreational programs throughout the academic year. The Idea Factory is adjacent to the very popular Java Wally's café, a favorite spot for anyone interested in relaxing, studying, or meeting in an informal setting. Also on the first floor is Wally's Book Nook, which features a constantly changing array of available books on various topics of interest. Other recreational reading material is available in the 14-Day Collection.

The second-floor computer lab provides access to numerous state-of-the-art workstations, image scanning, and color copying. Also located on the second floor, The Cary Library is a unique collection of more than 14,000 volumes of rare books illustrating fine printing and other materials detailing the history of printing, book design and illustration, papermaking, and other aspects of the graphic arts. The RIT Archives collects, organizes, preserves, and displays materials from the Institute's past. Located on the third floor of the Library, it is housed in an environment that is temperature-and humidity-controlled for the preservation of paper and photographs. It is the primary source for studying the history of the Institute.

The Library is open more than 100 hours per week, with extended hours before and during finals. For library hours, call (585) 475-2046 (voice); for the RE:SEARCH ZONE, call (585) 475-2563 (voice/TTY) or (585) 475-2564 (voice). You can e-mail the Library at 610wmlref@rit.edu. The Circulation Desk can be reached at (585) 475-2562 (voice) and (585) 475-2962 (TTY).

Information and Technology Services

Computing and network services at RIT are provided by Information and Technology Services (ITS).

Wireless, portal, and more

The campus-wide network includes wireless capabilities in open public areas such as the Student Union, Crossroads Café, Wallace Library, and in every college. Popular features are e-mail and access to the Internet, including Internet 2, a second-generation Internet technology with increased broad-band capabilities for better access to digital libraries, scientific instruments, and other research applications. Many ,faculty members have incorporated these features into their curricula.

ITS partnered with several on-campus departments such as Student Affairs and Student Government to launch myRIT, the Institute's internal Web portal found at: http://my.rit.edu.

Users can customize their own site on the portal with personal Web links, in addition to enjoying such 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 manages numerous computer labs and "smart" classrooms (in cooperation with the Educational Technology Center) 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.

Computer security and safeguards

Computing system use is guided by the RIT Code of Conduct for Computer and Network Use. This document, located at www.rit.edu/computerconduct, reflects current issues related to ethical use of computing and network resources. ITS has put into place multiple safeguards to protect the Institute network environment and the integrity of individual user accounts.

Computer accounts are issued to students, faculty, and staff

so that they can perform activities supporting educational goals and internal RIT functions. Students can obtain an account at the ITS HelpDesk or at the reference desk at Wallace Library by showing their RIT ID card. Forms for faculty and staff accounts are available by contacting the HelpDesk: www.rit.edu/its/help/forms.

Computer training and consulting services
ITS also provides consulting services, seminars, and computer training courses. Mobile learning assistants help faculty, staff, and students with specific computer tasks. ITS also offers computer-based training modules covering 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 or to log onto the system, go to www.rit.edu/cbt.

Student employment information and Resnet services
ITS employs more than 250 students and is one of the largest student employers at RIT. Contact Student Employment at www.rit.edu/~967www for more information about ITS job opportunities, or go to Desktop Support Services (ITS) to learn about job information in on-campus labs: www.rit.edu/its/services/computer_labs.

The Resnet Office, an area within ITS, provides computer support to students living in residential housing at RIT. The Resnet team can assist students with getting their computers connected to the RIT network, accessing campus computing resources, and troubleshooting computer software and hardware. Call Resnet at (585) 475-2600 (voice), (585) 475-4927 (TTY); email resnet@rit.edu, or visit http://resnet.rit.edu.

Modem access to the campus computer network
Both asynchronous and DidP remote Internet connection service (14.4 to 56 Kbps): (585) 427-2000. Also available is Virtual Private Network (VPN) for users on Roadrunner or DSL.

Contacting the Help Desk
The ITS HelpDesk is located in room 1113 of the Gannett Building (7B). Contact HelpDesk staff via telephone or TTY

(585) 475-HELP (4357) voice callers
(585) 475-2810 TTY callers
helpdesk@rit.edu

Service hours
Fall, winter, and spring quarter hours

Monday through Thursday: 7:30 a.m. to 8 p.m.
Friday: 7:30 a.m. to 5 p.m.
Saturdays: Closed
Sundays: Noon to 6 p.m.

Summer quarter, holidays, and quarter breaks

Monday through Friday: 7:30 a.m. to 5 p.m.
Weekends: Closed

Cooperative Education and Career Services

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 office website at www.rit.edu/co-op/careers, or by visiting the office on the first floor of the Bausch and Lomb Building. Individual appointments can be made by calling (585) 475-2301.

Educational Technology Center

The Educational Technology Center (ETC) provides services that enhance and support the educational environment.

ETC's Media Production Services produces educational and informational media for faculty and staff. These include video, multimedia/lweb, graphics, and photography/digital imaging production. Media Production Services also captions video and other digital media.

The Classroom Learning Technologies department deals with many aspects of classroom technology. Support covers the delivery and setup of projectors (slide, overhead, and video/data) as well as TV/VCR/DVD carts; access to and training on installed classroom equipment; and the operation of equipment in the academic auditoriums. ETC also supports the installation and maintenance of computer and video projection equipment and podiums in classrooms and lecture halls. Instructional Services also provides equipment and technical support to RIT student clubs and organizations.

The Media Resource Center (MRC) provides media support to faculty, staff, and students. The MRC staff works with faculty to identify media within the collection and locate new media to support their curriculum needs. The MRC collection consists of a variety of media formats, including videotape, DVD, audiotape, and an art history slide collection. The various media formats are available for use in the classroom or the MRC viewing area. Requests for captioning RIT-owned media (ETC or department collections) are coordinated by the MRC staff.

ETC arranges an array of communication feeds including, webcasts, satellite feeds, and teleconferences.

ETC is located on the lower level of Wallace Library. More than 70 students assist with production, classroom technology support, and office duties. Individuals are invited to drop in and explore these resources. For further information, call (585) 475-2551 or visit www.rit.edu/~613www/etc.

Counseling Center

The RIT Counseling Center is located on the second floor of the August Center. The center offers a variety of services to hearing, deaf, and hard-of-hearing RIT graduate students. These include:

- Personal/Psychological Counseling
- Crisis Intervention
- Career Counseling
- Career Resource Center
- Discover (Computer- Assisted Career Guidance)
- Testing
- Consultation
- Referral Services

Counseling Center hours are 8:30 a.m. to 7 p.m., Monday through Thursday, and 8:30 a.m. to 4:30 p.m. on Friday, except during finals weeks, break weeks, and summer quarter. During these periods, the hours are 8:30 a.m. to 4:30 p.m., Monday through Friday. For more information about counseling services, call (585) 475-2261 (voice/TTY), (585) 475-6897 (TTY), or check out our website at www.rit.edu/counseling.

Center for Religious Life

RIT has long recognized the importance of spiritual growth in the development of the whole person. The Center for Religious Life was founded to nurture this aspect of life on campus. Members of various faith traditions work together to serve the spiritual, ethical, and personal needs of our students, faculty, and staff. A variety of services-including Christian, Muslim, Buddhist, Jewish, and Hindu — are offered. Services are also provided for deaf and hard-of-hearing individuals. The Kilian J. and Caroline F. Schmitt Interfaith Center is located on the east side of the Student Alumni Union. It houses the ministers' offices, chapels, and meeting rooms. Visit the webpage at www.rit.edu/~320www/, or call (585) 475-2135 for more information.

Academic Support Center

The Academic Support Center provides instruction in reading, study skills, mathematics, and writing. These services are available at no additional charge during regular ASC scheduled hours to all graduate students at the Institute and may be scheduled at the center, located on the second floor, north end, of the administration building. For more information about Academic Support Center services, call (585) 475-6682.

Student Health Center

The Student Health Center provides primary medical care on an outpatient basis. The staff includes physicians, nurse practitioners, registered nurses, health educators, an alcohol/drug counselor, and an interpreter for the deaf. Services are available by appointment. Health education programs are provided also.

The Student Health Center is located on the walkway linking the academic and residence hall areas of the campus. Students are seen Monday through Thursday, 8:30 a.m. to 7 p.m., and Friday, 8:30 a.m. to 4:30 p.m, by appointment. Emergencies are seen as need requires. Hours are subject to change and are posted.

The university requires students to maintain health insurance coverage-which they may purchase either on their own or through RIT — as long as they are enrolled at RIT.

The quarterly student health fee is mandatory for all full-time undergraduate students. Graduate and part-time students may pay either the quarterly fee or a fee for service. Some laboratory work ordered through the Student Health Center is not covered by this fee; there is a charge for this service. Prescription medicines may be purchased from local pharmacies or, for some specific prescriptions, from the Student Health Center. The health fee does not include prescription medications.

Questions about the Student Health Center or health insurance should be directed to the office at (585) 475-2255 (voice) or (585) 475-5515 (TTY).

RIT Ambulance

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. Twenty-four-hour ambulance service is available seven days a week. If, for some reason, the RIT ambulance is not available, there may be a charge for services provided by another corps.

For emergency assistance and/or transport, the RIT ambulance can be dispatched through Campus Safety at (585) 475-3333 (voice) or (585) 475-6654 (TTY).

Health records

Medical records are confidential. Information will not be released without the student's written consent. Exceptions to this rule are made only when required by the public health laws of New York State.

New York State and RIT immunization requirements

New York State Public Law 2165 requires that all matriculated students enrolled for more than six quarter credit hours in a term and born after January 1, 1957, must provide RIT's Student Health Center with proof that they have received the appropriate immunizations against measles, rubella, and mumps. Immunization requirements include two measles vaccinations, at least one month apart, with a live virus, after January 1, 1968, and after the first birthday; and one vaccination each against mumps and rubella, after January 1, 1969, and after the first birthday. RIT requires all students under 26 years of age, who live in campus housing, and are enrolled for at least four credit hours to be immunized against meningitis (meningococcal disease). Other immunizations required by RIT include Hepatitis B, DPT, polio, Td booster, and PPD (for students from high risk areas). Additional information concerning these requirements, the necessary documentation, and where it must be sent is included with the Admissions Office acceptance packet and also is available from the Student Health Center office.

Emergencies, Escort Service

In case of emergency, call the Institute's 24-hour emergency number, (585) 475-3333 (V/TTY). For routine security services, call (585) 475-2853 (V/TTY), which is staffed 24 hours a day.

Campus Safety strongly encourages students to use the escort service, available seven days a week. The Mobile Escort Service is available seven days a week, 11:30 p.m. to 3 a.m., on a timed basis. Call (585) 475-2853 (V/TTY), or use the blue-light courtesy call boxes located throughout the campus.

Information about Campus Safety services, security procedures, and crime statistics can be found in the Campus Safety report, which can be obtained by calling (585) 475-6963. Our services are also explained on our website: http://finweb.rit.edu/campussafety.

The Advisory Committee on Campus Safety will provide, upon request. all campus crime statistics as reported to the United States Department of Education. The designated RIT contact person can be reached at (585) 475-6620. Campus crime statistics can also be found at http://ope.ed.gov/security/search.asp.

Identification Cards, Vehicle Registration

You will need an RIT identification card to use any campus facility. You should obtain your identification card at the time of your first registration. For further information, call the ID office, (585) 475-2821 (voice/TTY).

All vehicles operated on campus must be registered with Campus Safety, and stickers must be properly displayed on the inside glass on the driver's side of the vehicle as far to the rear as possible. Institute fines are imposed for operators violating parking and traffic regulations. Fines are payable at the Bursar's Office in the George Eastman Building.

Campus Stores

RIT operates two campus stores. The main store, Campus Connections, is located on the west side of the Student Alumni Union. It consists of two selling floors and is divided into 10 departments, selling everything from clothing to textbooks to computers. Store hours are Monday through Thursday, 8:30 a.m. to 8 p.m.; Friday, 8:30 a.m. to 4:30 p.m.; and on Saturday, 11 a.m. to 4 p.m. Store hours may change on holidays, during quarter breaks, and during summer quarter. You can also visit the Campus Connections website at http://bookstore.rit.edu.

Campus Connections accepts cash, checks, Mastercard, VISA, and RIT flexible debit cards (Tiger Bucks) for payment. Certain students may have arrangements with a government agency to pay for some of their books and supplies; this is handled at our service counter on the first floor.

The Candy Counter in the Student Alumni Union sells candy, tobacco products, health and beauty aids, film, daily newspapers, snack items, ice cream, and drinks. Ben & Jerry's offers Vermont's famous ice cream (including sugar free), frozen yogurt, sorbet, shakes, fruit smoothies, Cappuchillo Coolers, ice cream cakes, and more. The Candy Counter accepts cash, checks, Mastercard, VISA, RIT flexible debit (Tiger Bucks), and food debit cards.

Housing Operations

Serving nearly 7,000 students, RIT's 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, a smoke-free facility, offers students fully furnished double rooms with private baths. Included in each room is a TV with standard cable service, phone with free local service, high-speed Ethernet, and air conditioning. Students have access to a heated indoor/outdoor pool, sauna, whirlpool, fitness center, and laundry room. Full shuttle service to campus is also available to students. Students with cars receive a reserved parking pass to the lot of their choice. RIT Inn housing is available to graduate students on a space-available basis.

Apartment Housing

RIT has five apartment complexes with nearly 1,000 apartment and townhouse units. The five complexes — Colony Manor, Perkins Green, Racquet Club, Riverknoll, and University Commons — differ in layout and design. Apartments range in size from one-, two- and four-bedroom units; townhouses have two or three bedrooms.

Although the majority of apartment residents are undergraduates, some graduates can be found in each apartment complex. Apartment contracts run from September through May. Security deposits are not required. **A** modified meal plan is also available to apartment residents through RIT's Food Service Department. University apartment housing is available to graduate students on a space-available basis. For further information on RIT housing, contact Housing housing@rit.edu,http://housing.rit.edu, or call (585) 475-2572 (voice) or (585) 475-2113 (TTY).

The Housing Connection

A service of Housing Operations, Housing Connection is designed to meet the general housing needs of the RIT community. Housing Connection offers the only on-campus clearinghouse for apartment residents in need of additional roommates, providing a continually updated listing of available roommates and their specific interests.

Located in Housing Operations in Grace Watson Hall, Housing Connection provides free maps, information pamphlets, and telephones for users of the service. A trained staff member will assist you in your search for housing or roommates. For more information, go online at www.rit.edu/~hcwww, stop in, or call (585) 475-2575.

International Student Services

With several programs receiving worldwide recognition, RIT enrolls more than 1,300 full-time international students from approximately 100 countries. International Student Services serves as a resource for all deaf and hearing international students, as well as for members of the campus community seeking cross-cultural help. The staff advises students on immigration issues, helps them adjust to academic and cultural expectations in the United States, and provides cross-cultural programs. The office also coordinates off-campus programs through the Rochester International Council.

International student clubs offer social activities throughout the year. Campus housing options include International House, a special-interest residence hall floor offering a community experience for both international and U.S. students.

International Student Services offers orientation each quarter. In the fall, the Peer Adviser Leader program matches up returning students with new students to help with their adjustment to RIT and the United States. The office is located in the Student Alumni Union. For more information, call (585) 475-6943 (voice/TTY), or visit our website at www.rit.edu/international services.

The English Language Center

Students whose native language is not English can find assistance at the English Language Center. Courses in writing, grammar, vocabulary, conversation, reading, presentation skills, writing a research paper, pronunciation, business communication, and TOEFL preparation, among others. Students may enroll in a full-time intensive English to Speakers of Other Languages (ESOL) program, and may receive individualized instruction tailored to meet their needs. Tuition is charged for the services of the English Language Center.

International students may find employment at the ELC, where they can teach their native language and culture, or do translations. The office is located on the first floor of the George Eastman Building, room 1301. For more information, call (585) 475-6684, visit the website at www.rit.edu/~370www, or email jbcelc@rit.edu.

English Language Testing

The minimum TOEFL requirement for most graduate programs at RIT is 213/550. Upon arrival, students with English as a second language may be required to take a battery of English tests, including a writing test, a speaking test, and the Michigan Test of English Language Proficiency. Students who do not demonstrate proficiency in writing, listening, speaking, or other language skills may be advised to enroll in English instruction at an additional cost.

The tests are given at the ELC before registration each quarter, or by appointment. Students who have paid enrollment deposits will receive information on testing dates from the Center for Student Transition and Support. There is no cost for the test to RIT students who have already been accepted. Others pay a fee. For more information, call (585) 475-6684.

Margaret's House—Child Care Programs

Margaret's House is a New York State-licensed and nationally accredited child care center offering full-day quality care and education for children eight weeks to eight years of age. It includes a district-approved full-day kindergarten as well as after-school, vacation, and summer programs. The center is open to children of RIT students, faculty, and staff, as well as 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: eight weeks to 36 months
- Preschool programs: 3 and 4 year olds
- Full-day kindergarten/after-school programs: 6 to 8 year-olds
- "Lil" Kids on Campus: for children entering grades 1 through 4 (Full-day program offered July through August) Contact Roberta DiNoto at (585) 475-5176 (voice/TTY) or rxdhcc@rit.edu.

Kids on Campus Programs

Kids on Campus provides a variety of academic and sports activities.

- Kids on Campus: for students entering grades 5 through 10
- Full-day program offered during July

Programs are offered to all Rochester-area students, Call Susan Kurtz at (585) 475-5987 or sfkldc@rit.edu for details.

Veterans Services

Courses and programs at the university are approved for the education of veterans under the Veterans Readjustment Benefits Act, the Rehabilitation Acts and the War Orphans Act.

To receive benefits, an eligible veteran or dependent must submit an application for the VA "Certificate of Eligibility.'' This application must be sent to the VA Regional Office in Buffalo, N.Y., well in advance of the beginning of the starting quarter. These applications are available at local VA offices, or on campus from the Office of Part-time Enrollment Services. For benefits assistance or information, call (585) 475-6641.

Commission for Promoting Pluralism

The Commission for Promoting Pluralism was established to formulate a plan of action that would address seriously and deliberately the subject of pluralism and community building in every part of the university. Its evolution is the result of an identified need for RIT constituents to deepen their respect and appreciation for all people in the RIT community and beyond. This institutional focus attempts to:

- proactively identify and eliminate barriers that restrict equality throughout the RIT community;
- develop and implement programs that promote commitment to equality and justice in campus-wide activities; and
- develop and nurture a support system that increases participation by all members of the RIT community.

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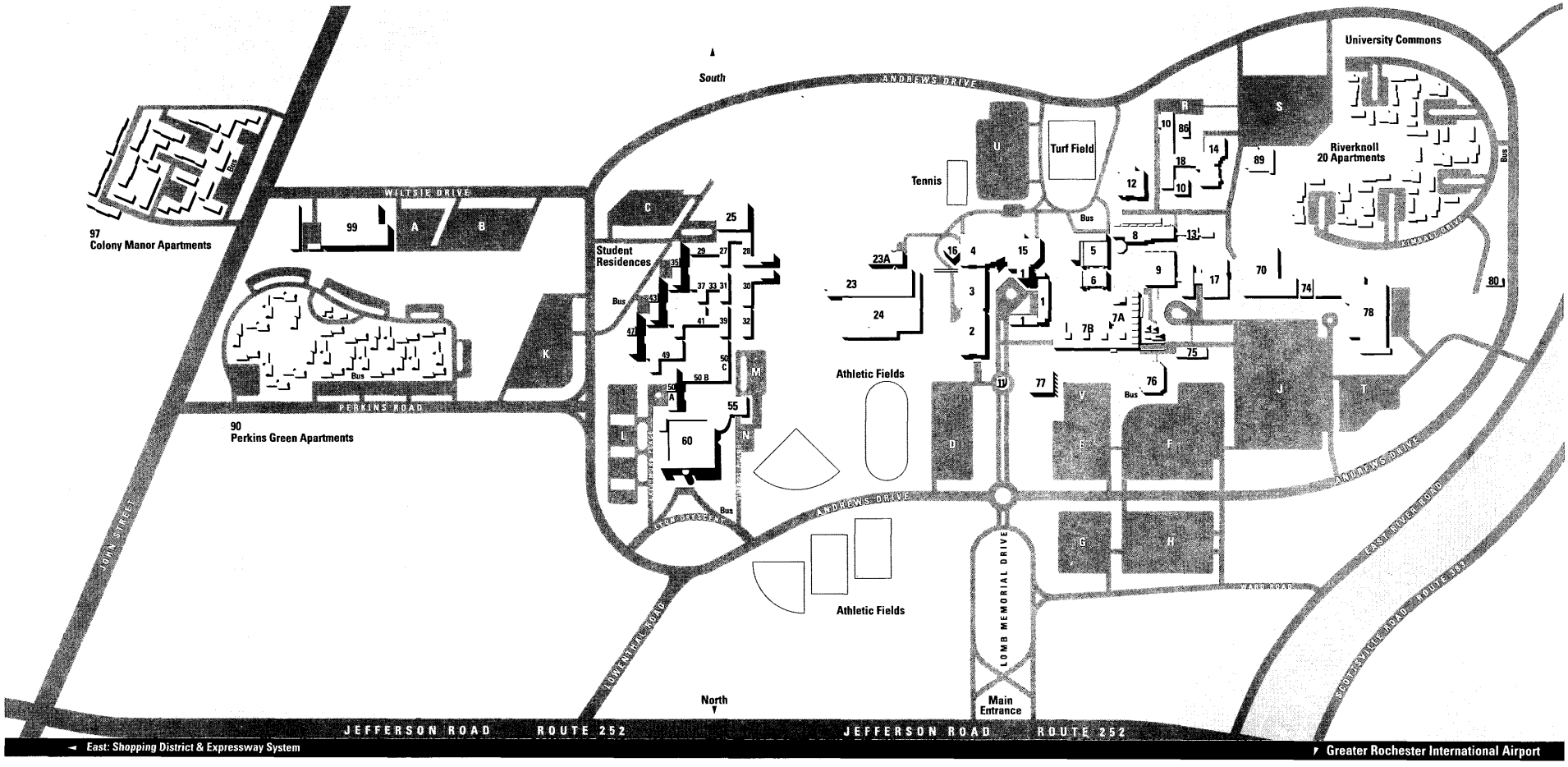

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