Graduate Education at RIT

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

APPLIED SCIENCE AND TECHNOLOGY

BUSINESS

B. THOMAS GOLISANO COLLEGE OF COMPUTING AND INFORMATION SCIENCES

KATE GLEASON COLLEGE OF ENGINEERING

IMAGING ARTS AND SCIENCES

LIBERAL ARTS

SCIENCE

NATIONAL TECHNICAL INSTITUTE FOR THE DEAF

For additional information, write, phone or e-mail:
Rochester Institute of Technology
Office of Graduate Enrollment Services
58 Lomb Memorial Drive
Rochester, NY 14623-5604
585-475-2229
gradinfo@rit.edu
www.rit.edu/grad

Katherine Mayberry,
Associate Provost for Academic Programs

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 have 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 at 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.

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.

Graduate Education at RIT

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 Company, Konica, Agfa Gevaert, Xerox, and Fuji—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 its most recent ranking of national photography programs, *U.S. News & World Report* named RIT's School of Photographic Arts and Sciences in the top five. This publication has also consistently ranked RIT in the top 20 in its master of fine arts category.

Convenient and flexible programs

RIT's diversity also extends to the manner in which courses and programs are scheduled. Many of our graduate programs are available on a part-time, online, or evening basis and are designed for working professionals. Examples of programs offered through online learning include 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 four-week 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 Institute'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 Institute 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 work place and an international community.

The Institute'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 Institute.

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 (NSF), the National Institutes of Health (NIH), the Department of Education (USDE), the Department of Defense (DoD), the National Aeronautics and Science Administration (NASA), and New York State. The office of Sponsored Research Services (SRS) projects more than $35 million in awarded projects for the 2004–05 fiscal year. Contact SRS at 585-475-7985 or research@rit.edu, or visit the Web site at www.research.rit.edu.

Accreditation

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, NY 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 Associate Provost for Academic Programs.

RIT Research Centers & Organizations

- Center for Biotechnology Education & Training
- Center for Electronics Manufacturing & Assembly (CEMA)
- Center for Excellence in Lean Enterprise
- Center for Imaging Science
- Center for Integrated Manufacturing Studies
- Center for International Business & Economic Growth
- Center for Materials Science & Engineering
- Center for Quality & Applied Statistics
- Center for Remanufacturing & 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

	College	Degree and HEGIS Code							Page
		Advanced Certificate	Ph.D.	MBA	ME	MFA	MS	MST	
Business and Management									
Accounting	Business						0502		33
Business Administration	Business			0506†					31
Finance	Business						0504		39
Health Information Resources	Applied Science & Technology	1202*							18
Health Systems Administration	Applied Science & Technology						1202*		16
Health Systems Finance	Applied Science & Technology	1202*							17
Hospitality-Tourism Management	Applied Science & Technology						0510.1†		11
Human Resource Development	Applied Science & Technology	0515					0515.00†		14
Integrated Health Systems	Applied Science & Technology	1202*							18
International Business	Business						0513		39
Manufacturing Leadership	Engineering						0599		79
Senior Living Management	Applied Science & Technology	0599							18
Service Leadership & Innovation	Applied Science & Technology	0510							14
Service Management	Applied Science & Technology						0599†		12
Training and Instructional Design	Applied Science & Technology						0699†		15
Computer and Information Sciences									
Computer Engineering	Engineering						0999		65
Computer Science	Computing & Information Sciences						0701		47
Information Technology	Computing & Information Sciences						0699*		51
Interactive Multimedia Development	Computing & Information Sciences	0699							54
Software Development and Management	Computing & Information Sciences						0799*		50
Technical Information Design	Applied Science & Technology	0605*							19
Cross-Disciplinary Studies (Individualized Program)									
Cross-Disciplinary Professional Studies	Applied Science & Technology						4999*		18
Education and Liberal Arts									
Art Education	Imaging Arts & Sciences							0831	102
Communication and Media Technologies	Liberal Arts						0605.00		123
Human Resource Development	Applied Science & Technology	*					0515†		14
Public Policy	Liberal Arts						2102.00		124
School Psychology	Liberal Arts	0826.02					0826.02		125
School Psychology and Deafness	Liberal Arts	0826.02#							129
Secondary Education of Students Who Are Deaf or Hard of Hearing	NTID						0803		159
Training and Instructional Design	Applied Science & Technology						0699†		15

Graduate Programs of Study

	College	Degree and HEGIS Code							Page
		Advanced Certificate	Ph.D.	MBA	ME	MFA	MS	MST	
Engineering and Technology									
Applied Statistics	Engineering						1702*		76
Computer Engineering	Engineering						0999		65
Computer Integrated Manufacturing	Applied Science & Technology						0913		8
Electrical Engineering	Engineering						0909		65
Engineering Management	Engineering				0913				68
Environmental, Health and Safety Management	Applied Science & Technology						0420*		7
Industrial Engineering	Engineering				0913				67
Industrial and Manufacturing Engineering	Engineering						0913		69
Manufacturing Engineering	Engineering				0913				71
Manufacturing Leadership	Engineering						0599		79
Materials Science and Engineering	Engineering/Science						0915		136
Mechanical Engineering	Engineering				0910		0910		69, 71
Microelectronic Engineering	Engineering						0999*		73
Microelectronics Manufacturing Engineering	Engineering				0999*				72
Microsystems	Engineering		0999						80
Packaging Science	Applied Science & Technology						4999		9
Product Development	Engineering						0599		77
Statistical Quality	Engineering	1702*							76
Systems Engineering	Engineering				0913				68
Telecommunications Engineering Technology	Applied Science & Technology						0925*		10
Vibrations	Engineering	0910							
Photography, Fine Art, and Graphic Communication									
Art Education	Imaging Arts & Sciences							0831	102
Ceramics	Imaging Arts & Sciences					1009			104
Computer Graphics Design	Imaging Arts & Sciences					1009			102
Fine Arts Studio	Imaging Arts & Sciences					1002			101
Glass	Imaging Arts & Sciences					1009			104
Graphic Design	Imaging Arts & Sciences					1009			103
Imaging Arts/Computer Animation	Imaging Arts & Sciences					1011			107
Imaging Arts/Film	Imaging Arts & Sciences					1011			106
Imaging Arts/Photography	Imaging Arts & Sciences					1011			108
Industrial and Design	Imaging Arts & Sciences					1009			103
Medical Illustration	Imaging Arts & Sciences					1299			101
Metals	Imaging Arts & Sciences					1009			104
Non-toxic Intaglio Printmaking	Imaging Arts & Sciences	1009							102
Print Media	Imaging Arts & Sciences						0699*		105
Wood	Imaging Arts & Sciences					1009			104
Science, Mathematics, and Imaging Science									
Applied Statistics	Engineering						1702*		76
Bioinformatics	Science						0499		133
Chemistry	Science						1905		136
Clinical Chemistry	Science						1223		137
Color Science	Science						1099		140
Environmental Science	Science						0420		134
Imaging Science	Science		1999.20				1999.20*		142
Industrial and Applied Mathematics	Science						1799		138
Materials Science and Engineering	Engineering/Science						0915		139
Statistical Quality	Engineering	1702*							76
Statistical Methods for Product and Process Improvement	Engineering	1702*							76

* *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 2004-2005.*

College of Applied Science and Technology

Programs

Master of Science Degrees in:

Advanced Certificates in:

Executive Leader:

A nontraditional 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*

Wiley R. McKinzie,
Dean

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.

Faculty

All faculty are experienced at preparing individuals for current career opportunities. They are accessible to students for 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 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, telecommunications, a circuits "studio," 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 that we have technology that is considered the industry standard.

Most important, all the programs are recognized as being academic leaders in the state, national, and international education communities. 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, with 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
Joseph Rosenbeck, Graduate Program Coordinator

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 program 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. The program is designed for early- to mid-career professionals and other professionals planning a career move into this field.

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.
- 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: 1) general chemistry or organic chemistry; 2) biology, microbiology, ecology or biochemistry; and 3) physics, geology, hydrology or geochemistry
- At least one college-level course in statistics
- At least one college-level course or equivalent experience in computer science

Graduate Record Examination (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.

International students are required to have achieved a score of 570 on the pen-and-paper-based version or 230 on the computer-based version of 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
- 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 graduate co-op quarters during their program of study.

Potential applicants are strongly encouraged to contact the graduate program coordinator (585-475-6469) for informal advising and additional information about the program. The program Web site address is www.rit.edu/ ~704www.

Transfer credit

Up to 12 quarter credits of graduate course work may be accepted into the program if appropriate and approved by the student's major professor or the admissions committee. The maximum number of transfer credits may be reduced in order to ensure that transfer credits and foundation course work do not exceed 20 quarter credits.

The curriculum

The master of science degree 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. Some courses are taught only in 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 gaps in academic preparation and/or 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 15 credits of foundation course work may be counted toward the degree as elective course work.

Core courses include:

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

A 6-credit graduate thesis or graduate project is required for graduation. Thesis and project topics should complement the student's interests and program of study. A thesis will be most appropriate for students with interests in conducting original research or in topics requiring substantial theoretical analysis. A graduate project will be most appropriate for students interested in applied problem solving.

Department of Manufacturing & Mechanical Engineering Technology/Packaging Science

Master of Science in Computer Integrated Manufacturing

S. Manian Ramkumar, Program Adviser

The master of science in computer integrated manufacturing (CIM) 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. The 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 design, manufacturing, software, 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 on a 4.0 scale. 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 and transcripts from previous college attendance, along with the graduate application form.

A minimum TOEFL score of 550 (for paper-based exam) or 213 (computer-based) and the GRE is 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 tests program, along with a reduced MS-CIM program course load.

Curriculum

The graduate program of study consists of 52 credits composed of the core, concentration, elective, and a capstone project course 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 chair. 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 & Assembly Systems
0617-730 Data Management & Communication
0304-618 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 & Critical Path Management
0610-830 Inst. & Computer Aided Data Acquisition
0610-870 Robust Design

Automated Manufacturing

0617-833 Robotics in CIM
0617-870 Manufacturing Automation Controls
0610-830 Inst. & Computer Aided Data Acquisition
0303-710 Systems Simulation
0303-729 Computer Integrated Manufacturing

Management of CIM

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

Software Development

0610-830 Inst. & 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 Exp. for Engineers & 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 as follows:

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

The master of science degree program in packaging science is designed to accommodate a wide range of needs of people in differing circumstances. It is flexible enough 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 receiving the 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 Principles, Materials I, Materials II, Rigid Containers, Flexible Containers, Production Systems, Packaging for Distribution, Packaging for Marketing, and/or Shock and Vibration. 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 having completed the equivalent of 0307-711 and having completed 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 B (3.0) average grade in their final two years of undergraduate degree work, submit transcripts of undergraduate work to the RIT Office of Graduate Enrollment Services and submit two letters of recommendation to the department of packaging science. Normally, completion of the last two years of the undergraduate degree program with a B average will serve to satisfy entrance requirements. In those cases where there may be some question of the capability of the applicant to complete this program of graduate study, 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 degree 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 0607-701, Research Methods, and any four of the following:

0607-72I Packaging Administration
0607-731 Advanced Packaging 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 packaging core (20 credits, including Research Methods) and thesis (12 credits), each student will complete a minimum of 16 elective credits selected in consultation with the adviser to complete the degree requirement.

In general, graduate-level course work will be selected to meet degree requirements, but, in limited circumstances, where individual need indicates that 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' work experience beyond the baccalaureate degree. Admission to the executive leader MS program also requires endorsements from 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 integrated task of making and selling the company's product. Candidates are encouraged to align research project goals with current job responsibilities.

More information on courses and the thesis project can be found in the executive leader brochure for packaging science.

Electrical, Computer and Telecommunications Engineering Technology Department

Master of Science in Telecommunications Engineering Technology

Carol Richardson, Department Chair
Warren Koontz, MSTET Program Chair

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 is offering a unique program that is focused on telecommunications and on developing the advanced level of skill and knowledge for future leaders of the industry.

The master of science degree in telecommunications engineering technology is offered by the Department of Electrical, Computer, and Telecommunications Engineering Technology. The new program accommodates individuals with both technical and non-technical baccalaureate degrees who are seeking graduate education to help them 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 or 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. The professional recommendations for applicants without engineering technology or engineering degrees should 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 complete an additional technical elective or management course. The management courses are currently being offered by the College of Business.

Core courses

0614-720 Telecommunications Concepts
0614-722 Principles of Telecommunications Networks
0614-724 Telecommunications Network Protocols
0614-650 Telecommunications Policy and Regulation
0614-726 Telecommunications Project Management
0614-728 Operating Systems for Telecommunications

Technical electives

Network Design
0614-640 Telecommunications Network Engineering
0614-642 WAN/LAN Planning and Design

Fiber Optic Telecommunications
0614-630 Fiber Optic Telecommunications Technology
0614-832 Fiber Optic Telecommunications Systems

Wireless Telecommunications
0614-660 Telecommunications Systems
0614-662 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 out of a selection of COB graduate courses. Students who choose the graduate project instead of the graduate thesis may take an additional COB graduate course.

Master's project/thesis

Each student is required to take the thesis/project planning seminar and 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.

Additional information

Additional information may be found at http://www.rit.edu/~706www/new/mstet.php3.

Hospitality and Service Management Department

Master of Science in Hospitality-Tourism Management

Francis M. Domoy, Chair
James Jacobs, Program Chair

The MS in hospitality-tourism management graduates professionals who can step into numerous mid-level service management and training director positions. The program is focused on service-quality training and supervision functions within the corporate setting and at postsecondary academic institutions.

The hospitality-tourism management major may be taken as a full- or part-time master's degree program. 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 master of science 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 master of science degree program, applicants must illustrate to the chairman 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:

- graduate application
- earned baccalaureate degree
- official undergraduate transcript(s)
- two professional recommendations
- an on-campus interview (when possible)
- 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)
- Test of English as a Foreign Language (TOEFL) of 550 paper-based or 213 computer-based (international students) All international students will take English language exams upon arrival.

Students who already are qualified for one or more required courses may substitute other course work with the permission of the chair of the program. Students whose prior undergraduate work was in areas other than hospitality-tourism may be required to complete additional courses, after a review of their work by the chair of the program. 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-quality 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 are generally scheduled on evenings or weekends and are also offered during the summer and online to facilitate part-time students.

Program requirements

The MS in hospitality-tourism management program 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 to 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* (building customer loyalty, customer complaints and recovery, managing for productivity gains, managing variable supply and demand), *customer-focused research* (determining customer requirements, developing reliable customer satisfaction instruments) and *human resource issues* (selection, training, recognition and rewards, teamwork and assessing corporate culture).

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 by which to examine service organizations and to explore such issues as empowerment, teamwork, horizontal management and corporate cultures.

0625-750 Elements of Service Management: A Systems Approach
0624-770 Service Leadership: Examining & Implementing Change
0625-791 Foundations of Applied Social & Managerial Research
0624-825 Strategic Process of Service Firms
0626-780 Human Resource Management I

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 8 professional "cluster" courses focuses on specific industry issues and applications:

0624-823 Strategic Environment of the Hospitality-Tourism Industry
0624-826 Tourism Policy Analysis
0624-827 Technology Transfer in the the Hospitality-Tourism Industry
0624-828 Meeting Planning Management
0624-835 Planning & Marketing of Health Care Related Services
0625-844 Breakthrough Thinking
0624-846 Travel Marketing Systems
0624-867 Tourism Planning & Development
0624-868 Legal Issues and Evaluation of Events
0625-842 Customer Relationship Management
0625-846 Service Leadership Futures
0625-849 Service Performance Metrics
0626-780 Human Resource Management I

Elective courses provide students with an opportunity to individualize their graduate programs in line with their career and professional interests. Students are allowed a selection of courses from hospitality and service management; the College of Business; human resource development; instructional technology; the College of Engineering; Health Systems Administration, and the College of Computing and Information Sciences. However, students are cautioned to observe course prerequisites in their selections.

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

- all courses must be graduate level
- a maximum of 12 graduate quarter hours may be transferred from another university
- a maximum of eight 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 research 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 forecasting 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

This program fills an emerging need in the many service businesses and industries that focus on customer satisfaction. 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. Problems in such areas as measuring customer satisfaction, empowering front-line employees, developing a teamwork environment, benchmarking, etc., require the employee to be skilled in different analytical techniques. 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 (computer science-information technology, quality and applied statistics, business and others) responds 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 (four two-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, or 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 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 master of science degree program, applicants must illustrate to the program chairperson that their previous training, ability, practical experience and education indicate a reasonable chance of success. The complete list of admission requirements includes:

- graduate application
- baccalaureate degree or equivalent from an accredited institution
- official undergraduate transcript(s)
- two professional recommendations
- an on-campus interview (when possible)
- 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 or 213 computer-based for international students. All international students will take the Michigan Test at entry unless approved otherwise.

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 was not in the service industries field may be required to complete additional courses and/or a cooperative educational experience. This will be determined after a review of their work by the program chair. A thesis or final project is also required for all students.

The student may choose elective courses with the approval of the program chair. Electives may be selected from within hospitality and service management, from RIT's College of Business, the department of instructional technology, human resource development, and information technology. Of the possible six 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
- 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 hospitality/tourism management and service management programs as a concentration within their degree program.

Required core courses (20 credits)

		Credits
0625-750	Elements of Service Management: A Systems Approach	4
0624-770	Service Leadership: Examining & Implementing Change	4
0624-825	Strategic Process of Service Firms	4
0625-791	Foundations of Applied Social & Managerial Research	4
0626-780	Human Resource Management I	4

Professional concentration (16-18 credits)

Hospitality and Service Management

		Credits
0625-841	Benchmarking & 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	Reengineering Service Environments	4
0625-849	Service Performance Metrics	4

Instructional Technology

		Credits
0627-735	Theories of Adult Learning	4
0627-755	Criterion Reference Instruction I	4
0627-756	Criterion Reference Instruction II	4

Human Resource Management

		Credits
0626-710	Theories of Organizational Development	4
0626-720	Theories of Career Development	4
0626-730	Theories of Human Resource Development	4

Information Technology

		Credits
0602-718	Current Themes in Information Technology	4
0602-733	Fundamentals of Telecommunications	4
0602-741	Fundamentals of Web-Based Multimedia	4
0602-745	Theories of Interactive Computing	4

College of Business

		Credits
0102-763	Behavioral Skills in Total Quality	4
0106-745	Quality Control & 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

		Credits
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

- Computers: dedicated access to 17 advanced American Airlines SABRE reservation terminals; 20 dedicated Dell computers tied to both LAN and RIT's VAX system.
- Applied software packages: business application software such as MS Office, WordPerfect; database programs such as MSAccess and FoxPro, spreadsheet programs such as Lotus 1-2-3 and Excel; graphics programs, including Harvard Graphics, FreeLance, WordPerfect Presentation, and PowerPoint; as well as service research application packages such as SurveyPro, Survey Tracker (including the Customer Service, Strategic Planning, Market Strength, Malcolm Baldrige, Food Services, and Lodging Resort modules); and AllClear and ABC Flow-Chart programs. RIT also maintains X-SPSS, Minitab and SAS on its VAX cluster.

Executive Leader MS program

This is an intensive program consisting of four two-week summer sessions conducted over the span of two summers and an independent research project conducted over the span of two summers. It emphasizes the strategic dimensions of service quality, policy analysis and executive performance within the context of the service economy. It is designed to enhance the continued lifelong learning and career development of executives and mid-level hospitality professionals without disruption of employment. Graduate credit is granted for life and management experiences.

The executive leader MS program is offered to service management practitioners who have a minimum of five years' experience beyond the baccalaureate. 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.

ADVANCED CERTIFICATE IN SENIOR LIVING MANAGEMENT

RIT now offers an advanced certificate in senior living management to help address the significant shortage of trained managers of senior living facilities. The four-course graduate certificate allows those with diverse backgrounds in health care, hospitality, or other related or often unrelated areas to gain necessary skills to excel as managers in this new industry which is experiencing exponential growth. Few U.S. universities offer a separate curriculum or even courses related to senior living management.

Admission requirements

The certificate is open to students qualified for and meeting the requirements for graduate study. Certificate courses are introductory graduate courses in each area and thus require no prerequisite coursework. The certificate may be completed as a stand-alone credential. It may also serve as an entry point for the MS programs housed in HSA including service management, health systems administration, human resources development, and instructional technology or 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 within other RIT graduate programs with the appropriate approvals.

Curriculum

The courses in this four-course certificate are drawn from three disciplines housed in HSA: service management, health systems administration, and human resources development.

0625-810 Senior Living Management
0625-750 Elements of Service Management
0626-891 Human Resource Planning
0625-842 Customer Relationship Management

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. In sum, the certificate will heighten these individuals' 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
- Constructing innovative approaches to service and managing those changes

Program Content (20 credits)		**Credits**
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 students qualified and meeting 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, may serve as an entry point for the MS program, or may 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

Dianne Mau, Program Chair

The mission of this program is to provide education, training, research, and consultation for human resource development.

Primary activities center on the MS-HRD program, which is characterized by a philosophy of pragmatism, theoretical foundations in the social sciences and mastery of relevant technologies and human productivity methodologies.

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 human resource development 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 master of science 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†
- TOEFL 570 (paper); 230 (computer)
- an interview with 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, or call 585-475-5062 for further information.

Curriculum

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

Elements of Service Management
Applied Data Analysis in HRD
Foundations of Applied Social and Managerial Research
Human Resource Management I
Internship

Choose three of four:
Theories of Organizational Development
Theories of Career Development
Theories of Human Resource Development
Human Resource Management II

Elective/technique courses

Planning & Evaluation in Organizational Dev.
Practice of Consultation in Organizational Dev.
Career Counseling Techniques
Group Leadership Skills
Design & Delivery of Training
Needs Assessment & Proposal Dev.
Assessment & Measurements
Human Resource Planning
Global Aspects Human Resources
Human Resource Information Systems

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 (NEW OFFERING 2004)

If you currently hold a bachelor's or master's degree, in another discipline than human resource development, you may want to enhance your 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 you decide to continue your education. A total of 16 quarter credits is required for certification. The courses are:

0626-710	**Theories of Organizational Development**	**4**
0626-720	**Theories of Career Development**	**4**
0626-780	**Human Resource Management I**	**4**
xxxx-xxx	**Elective (choose one):**	**4**
0626-891	**Global Aspects of HR**	
0626-733	**Needs Assessment & Proposal Development**	
	Course approved by advisor	
Total		**16**

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

Master of Science in Training and Instructional Design (formerly Instructional Technology)

C. J. Wallington, Program Chair

The RIT training and instructional design program focuses on creating courses that other people teach or that need no teacher. For three decades graduates have found employment in the design, development, and evaluation of training and instruction. The majority of graduates hold jobs in medium or large organizations, usually in business and industry. There they work in teams on ways to develop training and to improve employee performance. Some examples of the linkage between the instructional technology program and business and industry are:

- ongoing feedback from training and performance technology professionals
- Mager Associates' courses in Criterion Referenced Instruction, Instructional Module Development, Training the Training Manager, Instructor-Led Training, and Building Better Job Aids
- continuing communication with program graduates to keep abreast of best practices in training and performance technology

Instructional design supports training and performance improvement through highly structured, carefully designed and tested materials, and performance support tools. Instructional design differs from information technology and computer tools by *focusing on individual and group performance rather than on computers.*

The training and instructional design program *does* offer courses in computer-assisted instruction, but the emphasis is on the learner rather than on media—an approach that contributes to our graduates' employability. To broaden their experience with delivery systems, instructional technology students experience a range of courses from completely modular and self paced to working in interactive groups.

In short, the program prepares its graduates to develop ways for working adults to improve job performance—especially through training in technical, professional and managerial fields.

Admission requirements

Admission decisions for the human performance development and training program are based on:

- a review of the baccalaureate degree and any other degrees or course work
- letters of reference from academic advisers or major professors and from supervisors or managers
- a description of previous work experience (usually a résumé)
- a personal statement of work or career goals and how the degree can contribute to those goals.

For advising purposes, a writing sample and the Miller Analogies Test are also required.

Nonmatriculated students who have a baccalaureate degree may, with prior permission, take two courses from a selected list. Successful completion of any course work does not change the requirements for admission nor are those courses necessarily counted toward the degree.

If a prospective student has questions about the program, job prospects or relation of the degree to any personal goals, he or she should contact the program chair for additional information and possibly an interview—either in person or by telephone (585-475-2893). Graduate application forms are available from the Office of Graduate Enrollment Services or Hospitality and Service Management, College of Applied Science and Technology.

Prerequisites

Two sets of skills are required of every graduate—basic computer skills and basic statistical skills. Basic computer skills include using basic software tools (word processors, spreadsheets, databases). Students may show proof of these skills through previous courses or through work experience.

Skill requirements in basic (descriptive) statistics can be met through previous courses or through experience. RIT offers several graduate courses that will meet the requirement and can be counted toward the degree.

Degree requirements

The degree requires a minimum of 48 quarter credit hours at the graduate level. Twenty-six of the 48 hours are seven core courses required for *all* students. In addition, every student must complete an instructional development project that can serve as part of a portfolio for prospective employers. The degree can be completed in three or four consecutive quarters *if* the student starts in the fall quarter. The majority of students attend part time and take from two to four years to complete the degree work. The degree must be completed within seven years of the first course counted toward the degree. All courses are offered in the evening—and occasionally on Saturdays—so that students may work in the daytime as they take courses.

Of the 26 elective hours, students are relatively free to choose those they feel best meet their needs. Restrictions are:

- all courses must be graduate level
- a maximum of nine quarter credit hours (not counted toward another degree) may be transferred from another college or university
- a maximum of 16 hours may be taken outside the instructional technology program
- a maximum of 12 hours may be taken in special projects, independent study or internship courses

Each student has an adviser with whom a course plan should be developed to best suit the student's career and graduation requirements.

While the student has some liberty to choose course sequence, careful attention should be given to course prerequisites. A good rule-of-thumb is to take 0627-735, 755, and 756 within the first 20 hours of course work in order to prepare for 0627-771, 772, and 773 (the instructional development sequence). For answers to specific questions, the student should contact his or her adviser.

Required core courses (26 credits)		**Credits**
0627-721	Evaluation of Training	4
0627-735	Theories of Adult Learning	4
0627-755	Criterion-Referenced Instruction 1	3
0627-756	Criterion-Referenced Instruction 2	3
0627-771	Instructional Development 1	4
0627-772	Instructional Development 2	4
0627-773	Instructional Development 3	4

Master of Science in Health Systems Administration (HSA)

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, where and who is providing health care. Concurrently, customers of health care have high expectations for quality and responsiveness to their needs delivered in a cost effective manner. To provide these strategic skills to health care management, the 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 which meets the individual challenges of the participating students. To find out more about these options, please refer to the program Web site www.rit.edu/healthsytems.

One of the advantages of this program is its online/distance format—students can pursue their degree while maintaining full-time employment in locations around the country and world. Another distinct advantage of the program is the diversity of our student population; it allows for creative discussion and comprehension of global health care issues and how these relate to the standards and practice of the American health care system. The ability to share information and ideas and 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 the registration and use of distance learning tools. In addition, for select subject areas, the HSA program plans and invites students to attend sessions that blend presentation styles. This format provides a combination of both distance learning and seminar attendance, and allows students to interact with presenters who provide state of the art experiences. For those learners who cannot physically attend these sessions, technology provides a summary in video format which is sent to the students immediately following the presentations.

Admission requirements

Admission requirements for the master of science degree include:

- Completion of a baccalaureate degree in a regionally accredited college or university.
- A cumulative grade point average of 3.0 or above on a 4.0 scale 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.
- Three or more years of experience in a health care or health related organization as either a practitioner or manager. For those applicants who do not meet this requirement they 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.
- Participation in a telephone interview with the health systems administration program chair.

International candidates

- Test of English as a Foreign Language (TOEFL) minimum score of 600 (paper), 250 (computer).

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 master of science degree in health systems administration currently requires 57 quarter credit hours at the graduate level. The program can be completed in approximately two years by taking two courses per quarter or 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 at RIT. Toward the end of their program of study, students must complete a research paper which applies the comprehensive academic information acquired during the program to a topic of professional interest to them and approved by their advisor.

Upon matriculation, each student works with the program chair for advice and direction to develop their plan of study. For specific questions about this, contact Linda Underhill at 585-475-7329 or at lmuism@rit.edu.

Curriculum

Required courses

Foundations of Research
Integrated Health Care Systems
Preventive Epidemiology
Information Systems for Health Administrators
Quality Management for Health Systems
Health Systems Policy & Law
Finance for Health Systems Operations
Health Systems Economics & Finance
Health Systems Planning
Health Systems Administration
Health Systems Issues
Human Resource Management I

Electives

Health Information Resources
Comparative Health

Additional elective credit can be obtained from courses offered in the School of Hospitality and Service Management department with permission of advisor and other program chairs.

Executive Leader MS Program

The health systems administration program provides an executive leader program which utilizes a format of intensive sessions conducted over a limited time span in locations throughout the country. For more information on this highly focused strategic program visit the program Web site at www.rit.edu/healthsystems.

ADVANCED CERTIFICATES IN HEALTH ADMINISTRATION

The health systems administration program offers several advanced certificates for students looking for focused study in a particular area of health care, or for practitioners seeking continuing education credit for their professional development. The certificate programs are open to students qualified for and meeting requirements of graduate study. However, prerequisite health care experience is not required. The certificates can be completed as a stand-alone credential and/or the courses within the certificate can be applied toward the MS degree at a later date. Qualified students may use individual courses, or the certificate, within other RIT graduate programs with the appropriate approvals. The certificate courses are provided in an online/distance format, and consist of four courses for a total of 16 credits each. The certificates are as follows:

Advanced Certificate in Health Systems Finance

	Credits
Health System Policy and Law	4
Health Systems Economics and Finance	4
Health Insurance and Reimbursement	4
Finance for Operations	4
Advanced Certificate Total	**16**

Advanced Certificate in Health Information Resources

	Credits
Information for Health Administrators	4
Clinical Information Resources	4
E Health	4
Health Administration Application	4
Advanced Certificate Total	**16**

Advanced Certificate in Senior Living Management

	Credits
Senior Living Management	4
Elements of Service	4
Human Resource Planning	4
Customer Relationship Management	4
Advanced Certificate Total	**16**

Advanced Certificate in Integrated Health Systems

	Credits
Integrated Health Systems Planning	4
Health Systems Administration	4
Information Systems for Health Administrators	4
Elective	4
Advanced Certificate Total	**16**

Center for Multidisciplinary Studies Department

Master of Science in Cross-Disciplinary Professional Studies

James Myers, Ph.D., Director
Richard Morales, Ph.D., Program Chair

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—for example, interactive media design, human resource development, graphic design, information technology and health systems administration—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 can also be pursued through distance learning.

The master of science in cross-disciplinary professional studies requires 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 three to four courses drawn from an existing RIT graduate program.) Graduate credits earned in other programs can be used in completing a concentration. Certain concentrations can be completed with distance delivered courses, including:

- Applied Statistics
- Organizational Development
- Environmental Management
- Health Systems Administration
- Information Technology
- Product and Production Systems Design
- Technical Information Design
- Other distance-delivered concentrations as they become available.

Besides course work in two or three concentrations, there are two required courses. Credit hours not required in a student's concentrations can be used for electives. All elective course, like all transferred courses, need to be integrated into the proposed plan of study. For further information or advising, call Dr. Richard Morales 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
- an undergraduate cumulative grade point average of 3.0 or better on a 4.0 scale or superior endorsements and 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
- a proposed plan of study to be developed with the program chair.

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.

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 conclude with oral and written presentations.

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

Examples of Study Plans in the Cross-Disciplinary Professional Studies Format

1. Cross-Disciplinary Professional Studies with Two Professional Concentrations

		Credits
0699	Context & Trends	4
Concentration A: Marketing		
0105-761	Marketing Concepts	4
0105-762	Advanced Marketing Management	4
0105-772	Marketing on the Internet	4
0105-xxx	Marketing Elective	4
Concentration B: Communication and media		
0535-705	Electronic Communication	4
0535-710	Visual Communication	4
0535-704	Communication Law & 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-Disciplinary Professional Studies with Three Professional Concentrations

		Credits
0699	Context & Trends	4
Concentration A: Instructional technology		
0627-706	Fundamentals of Interactive Multimedia Development	4
0627-735	Interactive Multimedia Development	4
0627-755	Programming for Interactive Multimedia	4
0627-756	Interactive Multimedia Project	4
Concentration B: Manufacturing and mechanical engineering technology		
0304-618	Computer Aided Engineering	4
0304-801	Design for Manufacture	4
0304-964	Production Tool Design	4
0610-710	Product Development & Integration	4
Concentration C: General management		
0102-740	Organizational Behavior & Leadership	4
0102-741	Managing Organizational Change	4
0102-763	Behavioral Skills for Managers	4
0699	Capstone Project	4
Total		**52**

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 to 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 non-matriculated basis and be admitted after successful completion of two or more courses and permission of the program chairperson. 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 program in English along 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 design.

The curriculum

Required courses		**Credits**
4004-741	Fundamentals of Web-Based Multimedia	4
0688-711	Technical Information Design	4
0688-731	Technical Procedures	4
0688-741	Usability Design & Testing	4

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

Elective courses		
4004-730	Interactive Media Implementation	4
4004-745	Theories in Interactive Computing	4
0688-721	Creating Technical Proposals	4
0688-732	Managing Technical & Scientific Communication	4
2081-723	Contemporary Publishing	4
2081-742	Document Processing Languages	4
2081-743	Markets for Electronic Publishing	4
2081-744	Introduction to Multimedia Publishing	4

Many of these electives are available through distance education. Other electives in instructional technology, human-computer interface, and other relevant fields may be used with an adviser's approval.

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 Financial Aid Office (585-475-2186).

Limited scholarships and graduate assistantships are available in the departments. Contact your department or program chair for information.

College of Applied Science and Technology

GRADUATE FACULTY

College of Applied Science and Technology

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

Linda A. Tolan, BS, State University of New York College 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—Associate Professor

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

Robert H. Easton, BS, U.S. Military Academy; MSCE, Iowa State University; PE—Professor

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—Associate 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; MCE, Virginia Polytechnic Institute; PE—Chair, Civil Engineering Technology, Environmental Management and Safety; Associate Professor

Scott B. Wolcott, AAS, State University of New York, 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

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

Louis B. Gennaro, BS, U.S. Military Academy; MS, Northeastern University—Professor

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

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

Deanna M. Jacobs, BS, State University of New York College at Plattsburgh; MA, State University of New York College at Geneseo; MS, Rochester Institute of Technology—Associate Professor

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

Guy Johnson, BS, Pennsylvania State; MS, Syracuse University—Professor

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

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

Elizabeth A. Scholle, BSE, University of Pittsburgh; MS, Ph.D., University of Illinois; EIT Professional Certification—Assistant Professor

James F. Scudder, BME, Cornell University; PE—Assistant Professor

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

George Sutherland, BSME, McMaster University; Ph.D., Stanford University—Department Chair, Professor

Fritz J. Yambrach, BS, Michigan State University; BS, MBA, Utah State University—Associate Professor

ADJUNCT FACULTY

Packaging Science

Edward A. Colombo, BS, St. Peters College; Ph.D., Brooklyn Polytechnic Institute

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

Carl F. M. deWinter, BS, MS, Katholicke Universiteit Lennen

Robert Ferraro, BS, US Naval Academy; MS, George Washington University; MBA, Rochester Institute of Technology

James W. Jacobs Jr., MS, Troy State University; Ph.D., University of Buffalo

Stephen R. Pierce, BS, MS, Michigan State University

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

FACULTY

Electrical Computer and Telecommunications Engineering Technology

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

Chance M. Glenn, BS, University of Maryland at College Park; MSEE, Ph.D., EE, 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 College 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 Horne, 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 College 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

Edward B. Stockham, AB, Ph.D., University of Pennsylvania—Associate Professor

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

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

ADJUNCT FACULTY

Hospitality and Service Management Department

Anita Beck, BA, State University of New York College at Geneseo; MA, Nazareth College

Vincent Iglesias-Cardinale, BA, MA, Humbolt State University; MFA, Vermont College

Richard Cowen, MBA—Health Care Management Consultant, Rochester

Christopher Davis, M.D.—Physician, Rochester

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

James Fatula, Ph.D.—Consultant, Health Care Management, Rochester, New York

Rebecca Ferraro, BS, State University of New York College at Brockport; 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

Patricia Houghton, RN, MHA, CPHQ

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

Ed Keyes, BS, University of Massachusetts; MS, Rochester Institute of Technology

Joseph M. LaLopa, MS, Rochester Institute of Technology; Ph.D., Michigan State University

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

Todd Mittler, BA, Canisius College

Richard Morano, BS, Rochester Institute of Technology; MS, University of Rochester; Ed.D., University of Rochester;

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

Michael O'Connor, MS—Executive Director, Rochester Community Individual Practice Association

A. Holly Olsen, BS, University of Montana; MS, Rochester Institute of Technology

Denise Pieratti, 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

Annette Rummel, BBA, Northwood University; MS, Rochester Institute of Technology

Patricia Seischab, MS, Rochester Institute of Technology

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

Dan L. Sirmans, BBA, Georgia State University; MS, Rochester Institute of Technology

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

Michael Tarcinale, Ph.D., RN—Vice President, Randamax, Inc., Rochester, New York

Arthur G. Tweet, Ph.D.—Consultant, CQI Associates, Rochester, New York

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

Albro C. Wilson, MS, Rochester Institute of Technology

Carl Winkelbauer, Ed.D., University of Rochester

FACULTY

Center for Multidisciplinary Studies Department

Janet Graham, BS, MS, Rochester Institute of Technology—Assistant Professor

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 College at Brockport; MSW, Ph.D., Syracuse University—Associate Professor

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

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

Henry Cooke, BEE, MS, Ohio State University—Professor Emeritus

Mary Boyd, BA, Earlham College; MS, Computer Science, University of Iowa

College of Applied Science and Technology

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. **Class 3, Lab 2, Credit 4**

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

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

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

0607-770 Advanced Computer Applications
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. **Class 3, Lab 2, Credit 4**

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 5 years of experience in the packaging industry after completion of the appropriate baccalaureate degree. The content for the portfolio and the number of credits sought are determined in conjunction with the graduate coordinator. Final review and award of credit are then completed through the graduate coordinator and the Program Chair. **Credit 1–10**

Manufacturing & Mechanical Engineering Technology

0610-630 Tolerance Design
This is a comprehensive course on the topics of analytical and experimental development of design and production tolerances. The course covers worst case and statistical tolerance analysis, 6 Sigma methods for tolerancing, Monte Carlo Simulation Sensitivity Analysis of systems, and Taguchi's approach to tolerance design. Special emphasis will be given to developing tolerances for complex aggregations of technologies. System tolerance and cost balancing is covered in detail. The use of tolerance design in critical parameter management will be covered. Students will conduct a project in computer-aided tolerance analysis. **Credit 4**

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 & 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 and 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
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 & Production 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

0614-630 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 course including basic optics and electromagnetic waves, calculus and differential equations) **Lecture 4, Credit 4**

0614-640 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. (0614-720, 0614-722, 0614-724) **Lecture 4, Credit 4**

0614-642 WAN/LAN Planning & Design
This course provides participants with an introduction to the art and science of wide area network design. Various design approaches are introduced and several heuristic design algorithms are utilized. Blocking networks (telephone voice circuit networks) & delay networks (packet) are studied; greater emphasis is placed on delay networks. The course instills in participants the concept that most networks are holistic entities and therefore, piecemeal approaches to their design yield limited results. A PC design tool is utilized in the course. The course is taught in a collaborative participatory manner with considerable student interaction and project work. While the more complicated WAN is stressed, LAN planning & design is also addressed. Whenever possible, real-world examples are utilized to illustrate topics.(0614-720, 0614-722) **Lecture 4, Credit 4**

0614-650 Telecommunication 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. (Course work and or experience in telecommunications or policy) Note: This course is not appropriate if the student has completed the 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. **Lecture 4, Credit 4**

0614-660 Telecommunication Systems
The fundamental principles that govern the communication 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(1016-232 or equivalent) and an undergraduate electronic communications systems course that teaches the concepts of modulation and demodulation and the electronic components in transmitters and receivers 0609-363 or equivalent). **Lecture 4, Credit 4**

0614-662 Telecommunications Transmission 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(1016-232 or equivalent), differential equations (1016-304) or equivalent), and an undergraduate course in advanced circuit theory and analysis techniques (0609-333 or equivalent)). **Lecture 4, Credit 4**

0614-708 Cisco CCNA 1 Instructor
This course provides coverage of layered network models, industry standards, network topologies, IP addressing, networking components, structured cabling, cable testing, and basic network design. This course is the first of four instructor courses in CCNA curriculum series. (1016-204 or equivalent and eligibility to become a Cisco Networking Academy instructor or permission of instructor) **Credit 2**

0614-709 Cisco CCNA 2 Instructor
This course provides coverage of beginning router configuration for and troubleshooting of WANs and LANs using concepts in the layered network models. This course is part 2 of the CCNA curriculum. (0614-708 or equivalent and eligibility to become a Cisco Networking Academy instructor or permission of instructor) **Credit 2**

0614-710 Cisco CCNA 3 Instructor
CISCO Certified Network Academy course CCNA 3 provides coverage of switching configuration, network segmentation, and network management issues. This course is part 3 of the CCNA curriculum. (0614-709 or equivalent and eligibility to become a Cisco Networking Academy instructor or permission of instructor) **Credit 2**

0614-711 Cisco CCNA 4 Instructor
This course provides advanced coverage of switching configuration, network segmentation, and network management issues. This course is part 4 of the CCNA curriculum. (0614-710 and eligibility to become a Cisco Networking Academy instructor or permission of instructor) **Credit 2**

0614-712 Cisco Case Study Project
This course provides opportunity to design and document a network infrastructure that includes all the major technology studied in the previous CCNA curriculum course work. (0614-711 and eligibility to become a Cisco Networking Academy instructor or permission of instructor) **Credit 4**

0614-720 Telecommunications 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 Telecommunications Network
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 software 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 software 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. (B.S. in engineering technology, engineering, or a closely related degree.) **Lecture 4, Credit 4**

0614-832 Fiber Optic Telecommunications Network
This course is focused on the operation of the elements of fiber optic telecommunications networks and the structure and operation of optical telecommunications networks. Students will be able to design optical networks to meet specified capacity, flexibility, and reliability requirements at the end of the course. (0614-630) **Lecture 4, Credit 4**

0614-864 Wireless RF Telecommunications Systems
The fundamental principles that govern the application of wireless mobile and fixed radio frequency communication systems are studied in this course. At the end of this course students will understand the radio frequency mobile wireless environment, the common wireless systems, and the zoning/public policy aspects related to deployment of the wireless infrastructure. (Telecommunication Systems (0614-660) and Calculus and Differential Equations) **Lecture 4, Credit 4**

0614-890 **Grad Thesis/Project Planning Seminar**
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, software or other assets that benefit the field of telecommunications. A formal written thesis and an oral defense are required. (0614-890, Thesis/ Project Planning Seminar) **Credit 6**

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

Computer Integrated Manufacturing

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**

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

0617-842 **Data Management in CIM**
Introduction to data management for manufacturing applications. Topics include conceptual, implementation and physical design of data bases as well as data representation used in manufacturing processes. Geometric modeling of 3D objects for analysis and display is included. Laboratory work required. (0602-710, 730) **Class 4 Credit 4**

0617-845 **Distributed Systems**
This is a course in writing distributed applications, as distinguished from distributed operating systems. As such, it focuses on two principal issues: types of implementation platforms and interprocess communication mechanisms. The first issue involves a discussion of different types of environments in which the programmer may find himself or herself, including traditional timesharing systems, event-driven systems and uniprogramming systems. The pros and cons of each are discussed as a basis for implementing distributed systems. The second issue is concerned with how processes, or tasks, communicate with one another, whether this is different when the processes are on a single processor or different processors and how they can synchronize their accesses to shared resources. (0602-710, 730) **Credit 4**

0617-850 **Flexible Manufacturing & 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, equipment, 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**

0617-896 **Project Management in CIM**
Interdisciplinary course covering project management in CIM. Students will study real-world problems that are related to manufacturing hardware or manufacturing processes and propose solutions to problems requiring an integrated approach. Topics include the identification and definition of the goal; strategy development; project planning; required resource estimation; project organization; proposal development; project approval; project staffing; team building; implementation of the project managing scope, performance, schedule and resources; and project termination. (Completion of required courses in CIM curriculum) **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 **Graduate Independent Study**
Faculty directed study of appropriate topics on a tutorial basis. This course is generally used to allow an individual to pursue topics in depth under faculty sponsorship. **Credit 1–4**

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

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**

0624-823 **Strategic Environments of Food System**
The strategic environments of the hospitality-tourism system are examined as a whole and from the perspectives of major segments: consumers, producers, regulatory agencies, distributors and retailers, including food service operators. Specific issues examined include the use distribution systems, international government policies, consumer expectations and the impact of these on the producer and end user. **Credit 4**

0624-825 Strategic Processes 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, and 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**

0624-880 Seminar: Current Issues
A small-group examination of contemporary issues and topics chosen by the students and faculty member. Research, oral presentations and Class discussions of all issues selected. **Credit 4**

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

0624-896 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 2–9**

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 of Service Management: A Systems Approach
A general systems framework is used to explore the major components of service management using a variety of service sectors - health care, banking, insurance, real estate and hospitality-tourism. The course examines the interactions, interdependencies, and interactivity of service systems—to learn about the synergistic effects of the current changeable markets. In addition to this organizational focus above, the course begins the process of examining the learning organization form 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 & 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**

0625-810 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**

0625-841 Benchmarking & 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, transformations, and assumptions needed to decentralize the service firm and implement self-directed, empowered teams. Among the issues examined are accepting more responsibility for the service performance, assuming accountability for customer satisfaction, and planning with the "customer-in" decision-making framework. **Credit 4**

0625-844 Breakthrough Thinking, Creativity & 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 1–3**

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

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

Human Resource Development

0626-707 **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 **Theories of Organizational 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 in Organizational 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 in Organizational 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 analyze non-clinical techniques used in career counseling. (0626-720) **Credit 4**

0626-722 **Career Counsel Techniques II**
Focuses on the application of counseling theories and techniques to non-clinical group counseling situations. (0626-721) **Credit 3**

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 & 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**

0626-740 **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**

0626-850 **Special Projects**
Provides for designing and carrying out a project for academic credit. Proposals approved by a supervising faculty member and the department director 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 variable 1–3**

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**

Training and Instructional Design

0627-706 Instructor Led Training
An overview of the process of designing and giving training presentations. Included are principles of presentation design, selection and production of presentation media. Required for graduation. **Credit 4**

0627-709 Training the Training Manager
A service course explaining the management of the training process, instructional design and development, and performance technology. Includes principles of needs assessment and evaluating the worth of training as well as trends in instructional design and training delivery systems. Not for Training and Instructional Design majors. Credit 3

0627-710 CRI Management
A special version of Training the Training Manager (0627-709) only for those who have either the criterion-referenced instruction (Mager) certificate or have completed 0627-755, 756 (Criterion Referenced Instruction 1, 2)and have student developed course materials from one of these courses. (0627-755, 756, or CRI materials; permission of the department) **Credit 2**

0627-712 Computer Assisted Instruction I (CAT I)
Students learn the use of the computer for instruction (computer-assisted instruction) and then produce their own computer-assisted instruction programs. Students review and research various hardware and software configurations, programming languages and sources of previously developed computer-assisted courses. Covers some methods of course and lessons development. Project required. (0627-755 or permission of department) **Credit 4**

0627-713 Computer Assisted Instruction 2 (CAT 2)
The student develops more complex and sophisticated instructional sequences that incorporate advanced CAI programming techniques; enters the sequence on the computer, tests and debugs the sequences; and using the computer, gathers the student response information necessary to validate the sequences. The student also explains and demonstrates CAI and writes proposals for CAI courses and lessons. Two projects required. (0627-712) **Credit 4**

0627-721 Evaluation of Training and Instruction
A course to train students in the development and application of testing methods and used to measure performance, principally cognitive and psychomotor skills, as well as methods to determine overall course effectiveness. Covers methods for both formative and summarative evaluation and the means of validating instructional materials and instructional systems. (Basic descriptive statistics) **Credit 4**

0627-735 Theories of Learning
Relates various theories of learning to actual teaching and training. Students review learning principles and apply them to practical instructional situations. Emphasis is on both behavioral and cognitive approaches to designing instruction and training. Required for graduation. **Credit 4**

0627-755 CRI & Tech Training I (CRI 1)
A two course sequence (0627-755 and 756) that applies the principles of instructional development specifically to those areas of training in which performance criteria can be precisely stated and accurately measured. Such training usually tends to be in technical skill areas where procedures or product are predetermined or can be clearly specified. **Credit 3**

0627-756 CRI & Tech Training II (CRI 2)
A two course sequence (0627-755 and 756) that applies the principles of instructional development specifically to those areas of training in which performance criteria can be precisely stated and accurately measured. Such training usually tends to be in technical skill areas where procedures or product are determined or can be clearly specified. (0627-755) **Credit 3**

0627-757 Techniques of Work Analysis
Students learn a variety of job analysis and task analysis techniques based on functional job analysis. Data gathered from analyses is cast into various formats for job restructuring, writing job descriptions, establishing task and job hierarchies, and developing training programs. **Credit 3**

0627-759 Technical Writing in Instructional Design
This course introduces instructional developers to the process of writing technical manuals and reports. Indicates an overview of the production process, content and audience analysis, information layout. Two major writing projects and other exercises required. (Writing skills and experience, 0627-755, 756, 758) **Credit 3**

0627-762 Instructional Module Development I (IMD1)
This course is designed to follow 0627-755 and 756 to give the student practice in the development, evaluation and revision of self-instructional materials. The course, largely self-instructional and project oriented, emphasizes structuring the module, actual module writing, and tryout and revisions procedures. Students must have already selected a content area and developed objectives, a course plan, and criterion tests. (0627-755, 756) **Credit 3**

0627-763 Instructional Module Development (IMD2)
In this extension of Developing Instructional Modules I (0627-762), the student completes an additional course module and develops course control documents for both the course manager and the student. (0627- 755, 756, 762) **Credit 3**

0627-765 Individual Learning Styles
The course examines the ways different individuals learn. It relates instructional strategies to learning styles. Covers cognitive style mapping and various test and measures as each relates to individual learning style. (0627-735) **Credit 4**

0627-771 Instructional Development I
First of a required three-course sequence (0627-771, 772, 773). Covers the concepts and principles underlying the developing of instructional programs and materials. Instructional development is the systematic solution of instruction and learning problems involving needs assessment, task analysis, specification of objectives, analysis and synthesis of instructional strategies and methods of evaluation. An instructional development project is part of the sequence. Required for graduation and must be taken before 24 hours of program are completed. (0627-735, 755, 756) **Credit 4**

0627-772 Instructional Development 2
Second of a required three-course sequence (0627-771, 772, 773). The instructional development principles are applied in an actual project selected by the student. Includes more sophisticated means of development as well as module and test development. Required for graduation. (0627-735, 755, 756, 771) **Credit 4**

0627-773 Instructional Development 3
Last in a required three-course sequence (0627-771, 772, 773). Covers the differences in human resource development, instructional program development, and performance technology as well as the instructional developer's role in these processes. Covers development of evaluation plans and the development and revision of course modules. Also covers trends in selected areas of instructional design and development. Required for graduation. (0627-735, 755, 756, 771, 772) **Credit 4**

0627-777 Internship
Special opportunities may occur for students to obtain work experience in a job or environment similar or coincident with their career objectives. A proposal (guidelines available from the department) must be approved by the department prior to registering for this course. (0627-755, 756, 771 plus 20 hours of course work) **Credit variable 1–3**

0627-797 Finding & Maintaining: Voice of the Customer
This course shows students how business and industry use the Quality Function Deployment (QFD) process to identify the voice of the customer, to identify customer requirements, and to follow those requirements through houses of quality. Includes customer interviewing, Kano analysis, competitive assessment, affinity diagramming, preplanning matrix, substitute quality characteristics, houses of quality. Emphasizes QFD in the service sector. Project required. Some statistics required. **Credit 4**

0627-890 Independent Study
An opportunity for a student to explore, with a faculty advisor, an area of interest to the student. A proposal (guidelines available from the department) must be approved by the department prior to registering for this course. (0627-755, 756, 771 plus 20 hours of course work) **Credit variable 1–3**

Environmental Health & Safety

0630-610 Survey of Occupational Health
An intensive foundation course for students who have completed the appropriate science and mathematics prerequisites, but lack academic preparation or practical experience in environmental/industrial health. Provides students with an overview of the fundamentals of Industrial Hygiene. Emphasis will be placed on the toxicological effects of various industrial substances on the body; monitoring and personal sampling for these substances and personal protection against such substances. (Graduate students only or permission of department) **Credit 3**

College of Applied Science and Technology

0630-611 Survey of Occupational Safety
An intensive foundation course for students who have completed the appropriate science and mathematics prerequisites, but lack academic preparation or practical experience in safety management and engineering. Topics examined include recordability and safety indices; incident investigation; guarding, electrical, and material handling; welding, fire prevention, excavation; medical surveillance and workers compensation; inspection techniques and auditing; committees, incentives, and voluntary programs. (Graduate students or permission of department) **Credit 3**

0630-620 Survey of Solid & Hazard Waste Management
An intensive foundation course for students who have completed the appropriate science and mathematics prerequisites, but 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. **Credit 3**

0630-621 Survey of Industrial Wastewater Management
An intensive foundation course for students who have completed the appropriate science and mathematics prerequisites, but 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. **Credit 3**

0630-622 Survey of Air Emission Management
An intensive foundation course for students who have completed the appropriate science and mathematics prerequisites, but lack academic preparation or practical experience in air emissions management. Identifies and categorizes industrial air pollutants and their sources. Addresses applicable state and federal laws and regulations, reduction strategies. Control technologies, testing, monitoring and reporting requirements. **Credit 3**

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**

0630-720 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. **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. **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. **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) **Credit 4**

0630-750 EHS 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. **Credit 4**

0630-760 Integrating Environmental Health & 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) **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. **Credit 4**

0630-770 Risk Assessment Management & Communications
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) **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) **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) **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**

0630-888 **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**

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 proposal 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 an environmental, health and safety project and/or management decision. A formal written paper and oral defense are required. (0630-890) **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**

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) **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—the content of which is expected to change accordingly. (0630-450 or 0630-610) **Credit 4**

0633-730 **Mechanical & Electrical Controls & 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.) **Credit 4**

Health Systems Administration

0635-710 **Integrated Health Systems**
Examination of the history and evolution of the continuum of health care delivery in the United States and trends toward integrated health care systems. Review of general systems approach and the various elements of the health care continuum, including a study of alternate delivery systems and managed care. Analysis of emerging and evolving health care systems, their management and social issues impacting integration of health care delivery. Includes research methodologies in health administration. Class 4, **Credit 4**

0635-715 **Information Systems in Health Administration**
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**

0635-720 **Preventive Epidemiology**
Examination and use of the statistical processes employed in the evaluation and assessment of disease, morbidity and mortality of populations served by health systems in the United States. Compares and contrasts health systems status within the United States and with other industrialized countries. Appraisal of health systems research from a managerial perspective with emphasis on prevention, access, distribution, cost, efficiency and effectiveness of health care. (Statistical Concepts or Introduction to Statistics) **Credit 4**

0635-721 **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**

0635-730 **Quality Management for Health Systems**
Quality management and improvement in health systems. Course explores past and current definitions of quality and competing concepts of quality; reviews total quality movement in health care environments, reviews existing quality requirements of accrediting organizations, federal and state agencies, and third party payers; describes and explains quality improvement systems developed by health care accrediting agencies, health care regulators and researchers; application of quality tools. **Credit 4**

0635-740 **Health Systems Seminar**
Special interdisciplinary seminar course, team-taught by professionals and faculty from health care and business. Focuses on evolving trends in the areas of management decision-making tools, management science, human resource management, and technology assessment and acquisition. (Permission of program chair) **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 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. prerequisite(s): health care information systems 0635-715.90, introductory technology/systems course or relevant experience. Computer systems hardware and software in healthcare recommended **Credit 4**

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 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. EHealth topics covered will include review, discuss and analyze industry trends explore emerging ECare solutions and investigate EHealth ethical guidelines and governmental regulations established to ensure privacy, standardization and health content reputability. **Credit 4**

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

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

0635-810 **Health Systems Administration**
The development, structure and current forces transforming the health care system will be considered. Topics will include the status of the national and regional populations; manpower issues; hospital services; ambulatory care and alternative delivery systems; and mental health; long-term care. Administration in health care facilities including roles, functions, and responsibilities; organizational design and structures; problem solving; motivation; communication; leadership; change; human resources; and health care practices focusing on patient care and education.(0635-730) **Credit 4**

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

0635-820 **Health Systems Economics & 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 5**

0635-876 **Health Systems Issues**
This is the health systems administration research project capstone course, required for all graduate majors. Students will research and discuss contemporary issues of health care delivery and management. Course work from the program will be integrated by the instructor in order to reinforce a systems approach to health care administration. An original research project, which utilizes a systems approach to health care delivery or administration and culminates in a written report, is required. (Permission of program chair) **Credit 4**

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

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

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

0635-896 **Health Systems 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. **Variable Credit 4–8**

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 communications, 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**

0688-721 **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, online and multimedia proposals and technical marketing presentations. (0688-333 or equivalent or permission of instructor) **Credit 4**

0688-731 **Technical Procedures**
The 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 multimedia 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**
The management of technical and scientific communication projects and organizations. Managerial roles, practices, and responsibilities. Technological factors in the production and distribution of technical documentation. Management strategies for content and audience evolution. Management of parallel (print and online) projects, single-sourcing, and documentation localization. (0688-333 or equivalent or permission of 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 information mapping. Design and usability test considerations for multimedia and user-centered media. (0688-333 or equivalent or permission of instructor) **Credit 3**

Cross-Disciplinary Studies

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 with 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

Programs

Master of Business Administration

Master of Science degrees in:

Thomas D. Hopkins, Dean

Success in the 21st century business environment will require leadership and management attuned to rapid changes in technology and increasingly vigorous and global competition. Astute problem preventers and solvers who have gained a systems perspective will be able to convert product development and management challenges into competitive advantages. The College of Business offers a benchmarked 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 combine innovative research, teaching excellence, and personalized attention to student needs. Our setting in a technological university embarked on creative business partnering, and entailing joint programs across colleges and countries, opens unique opportunities for all partners—industry leaders, faculty, and students.

Master of Business Administration

Donald O. Wilson, Ph.D., Director

The master of business administration (MBA) degree program 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 for concentration areas and electives. All College of Business courses carry four credit hours. Students create a concentration field(s) of study by selecting a four-course sequence in a particular area of specialization. Concentrations include accounting, finance, engineering management, entrepreneurship, health systems administration, human resource management, information technology, international business, management and leadership, marketing and sales management, marketing research, e-commerce marketing, management information systems, manufacturing management, printing management, public policy, quality and applied statistics, quality and organizations improvement, technology management, and telecommunications.

The College of Business also offers specialized MBA tracks in management of technology and international business. The college offers an Executive MBA for professionals with substantial career experience. RIT also awards MBA degrees to students attending the U.S. Business School in Prague.

The College of Business is accredited by the prestigious 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.

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

Completed applications for admission should be on file in the Office of Admissions four weeks prior to registration for the upcoming academic quarter for US students 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 and a personal statement or résumé are evaluated by the Graduate Admissions Committee. International applicants must submit the results of the Test of English as a Foreign Language (TOEFL, minimum paper-based score 580 or minimum computer-based score 237) 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 nonmatriculated basis. To become a matriculated student, and admitted formally to the MBA program, the regular admissions process should be followed. Credits earned while a nonmatriculated student may be applied to the student's degree program.

Academic standards

Credit hour requirements for the MBA are normally 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 "The Steps Toward Earning Your Degree" in this bulletin.

Program completion requirement

Institute 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 before enrolling in courses. This exam is administered during orientation. 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 is equivalent to these graduate courses and occurred within the last five years. Courses may be either waived 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 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 from 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 also offers individualized career counseling, provides critical job leads, and coordinates employers' annual campus recruiting visits.

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. Graduate faculty evaluate 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 Seminars I and II, and a substantial portion of their concentration courses, and attending 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 for 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 (585-475-2186) for further information.

Study abroad programs

Matriculated MBA students have the opportunity to study for two weeks in Europe. They attend classes with their counterparts in the schools and learn first hand the European business environment. The program at the U.S. Business Schools in Prague, Czech Republic, offers a course in Business Ethics for a two-week period in the spring.

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 in the College of Business Student Services Office. 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:

		Credits
0101-703*	Financial Accounting Systems	4
0103-705*	Economics for Managers	4
0112-710*	Management Information Systems Concepts	4
0104-721*	Financial Analysis for Managers	4
0102-740*	Organizational Behavior & Leadership	4
0106-743*	Operations Management	4
0102-759	Competitive Strategy	4
0105-761*	Marketing Concepts	4
0106-782*	Statistical Analysis for Decision Making	4

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

Students with one concentration area take:

- 9 core courses
- 4 courses in a concentration area
- 5 electives, outside above concentration area. No more than 4 of these can be taken in any one discipline.

Students with two concentration areas take:

- 9 core courses
- 4 courses in a concentration area
- 4 courses in a second concentration area
- 1 elective, outside above 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

Corporate Accounting		**Credits**
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 & Theory	4
0101-708	Auditing	4
0101-709	Basic Taxation	4

If students wish to take the Certified Management Accountant (CMA) examination offered by the Institute of Management Accountants, the corporate accounting concentration qualifies them to do so.

CPA Accounting

Students wishing to take the CPA examination in New York State upon graduation from the MBA program must take 23 graduate courses rather than 18. (Note: Up to 11 courses may be waived.) The State of New York requires that a graduate degree for CPA candidates who do not have an undergraduate degree in accounting must include at least 60 semester hours (i.e., 90 quarter hours) of course work. Furthermore, the curriculum must include a specified number of hours in accounting, economics, finance, law and business electives. For the CPA option, students take the following 14 courses in addition to the nine MBA core courses:

		Credits
0101-704	Corporate Financial Reporting I	4
0101 705	Corporate Financial Reporting II	4
0101-706	Cost Management	4
0101-707	Advanced Accounting & Theory	4
0101-708	Auditing	4
0101-709	Basic Taxation	4
0101-710	Advanced Taxation	4
0101-730	Business Law I	4
0101-731	Business Law II	4
	Finance elective	4
	Economics elective	4
	Business electives	12

CPA candidates should meet with an adviser in the College of Business no later than the start of their second quarter in the MBA program to carefully plan their remaining course work and to learn about New York CPA licensure requirements. Some courses in this program are offered only once a year.

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.

		Credits
0104-722	Financial Management II	4
0104-725	Securities & Investment Analysis	4
	One advanced economics course	4
Choose two courses from the following:		
0104-724	Problems in Corporate Finance	4
0104-729	Seminar in Finance	4
0104-730	Financial Institutions & Markets	4
0104-734	Working Capital Management	4
0104-732	Portfolio Theory	4
0104-731	Problems in Investments	4
0104-740	Futures & Options	4
0104-760	Finance for a Global Business	4

Marketing and Sales Management

Marketing is the 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. Marketing professionals need to understand the customer's problems that lead to wants and needs. The organization is then able to offer the desired products and services at acceptable prices, using effective promotions, and delivering the product to the customer in a timely fashion. Overall, effective marketing must consider the target audience, along with the changing business environment and competitive pressures. These marketing basics apply to governmental agencies, not-for-profit organizations, as well as profit making firms.

		Credits
0105-762	Advanced Marketing Management	4
0105-764	Channel Management	4
Choose two from the following:		
0105-758	Seminar in Marketing: various topics	4
0105-765	Sales Management	4
0105-766	Marketing in a Global Business	4
0105-767	Marketing Communications	4
0105-770	Professional Selling	4
0105-771	Marketing Research Methods	4
0105-772	Marketing on the Internet	4
0105-773	Database Marketing	4

Marketing Research

How do you identify your customers' needs and wants and respond with the most profitable product or service? As a marketing research analyst, a student will take a leading role in identifying and defining marketing problems. Relying on communication, analytical and conceptual skills, the market researcher can evaluate the market, generate product ideas, refine the delivery process, monitor marketing performance, and improve the company's profitability. The increasing number of specialized research firms is adding additional opportunities to the traditional marketing profession.

		Credits
0105-771	Marketing Research Methods	4
0307-801	Design of Experiments I	4*
Choose two from the following:		
0105-762	Advanced Marketing Management	4
0105-772	Marketing on the Internet	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 4-credit-hour option of these courses.*

International Business

Today's successful business executives think globally. Marketing, manufacturing and finance managers must be well educated in international business in order to compete in both domestic and international environments. An MBA with a concentration in International Business is an excellent choice for any student who is seeking a career that involves global trade and assignments. At RIT an International Business concentration can be paired with a concentration in Marketing, Finance, Management or any other concentration to create a distinct competitive advantage.

		Credits
0102-780	Global Business Environment	4
0102-782	Global Issues & Strategies	4
Choose two from the following:		
0102-760	Managing in a Global Business	4
0104-760	Finance for a Global Business	4
0105-766	Marketing in a Global Business	4

Management and Leadership

The Management and Leadership concentration provides students with the leadership skills needed to be successful managers in business, non-profit, and public organizations. By choosing this concentration, students will develop the analytical and decision-making skills that are 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.

		Credits
0102-741	Managing Organizational Change	4
0102-745	Social and Political Environment of Business	4
Choose any two management electives		8

Entrepreneurship

Bringing a new product or service to market in today's fast-paced environment requires a keen knowledge of marketing and financial planning if one is to thrive in a new venture. In a world where with an increasingly educated customer that has instant access to information, it is obvious the entrepreneur needs to be more innovative to reach his or her business goals. This MBA concentration will arm you with the knowledge needed to build your entrepreneurial business.

		Credits
0102-720	Entrepreneurship & New Venture Creation	4
0102-753	Field Experience in Business Consulting	4
Choose two from the following:		
0101-709	Basic Taxation	4
0101-730	Business Law I	4
0105-763	Buyer Behavior	4
0104-722	Financial Management II	4
0102-742	Introduction to Technology Management	4
0105-772	Marketing on the Internet	4
	Other management courses (with approval of graduate adviser)	

Note: This concentration has certain restrictions. Please see a graduate adviser for details.

Technology Management

In a constantly changing environment, the ability to innovate and renew itself is critical if an organization is to survive and prosper. Technology managers are typically responsible for innovation and application of new technology; their work is 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 on how to innovate successfully. Co-op or internship experience in high-technology settings may be helpful to students pursuing a specialty in technology management.

		Credits
0102-742	Introduction to Technology Management	4
Choose one or both from the following:		
0102-762	Managing New Product & Process Development	4
0102-761	Managing Research & Innovation	4
If both courses above are taken (0102-761 and 0102-762), choose one course, otherwise choose two courses from the following:		
0106-744	Project Management	4
0102-741	Managing Organizational Change	4
0106-749	Manufacturing Strategy & Tactics	4
0102-745	Social & Political Environment of Business	4
0102-785	Ethics in Technology Intensive Environments	4

Management Information Systems

The MIS concentration is designed to enhance MBA students understanding of modern information systems. Students may elect courses dealing with: systems view of hardware and software, systems analysis and design, data management, information systems management, and integrated business systems. Students in the concentration will gain an understanding of (i) the foundations of management information systems, (ii) what is needed in the development and implementation of information systems, (iii) the elements for effective data management, and (iv) integrated large scale ERP systems such as SAP R/3."

		Credits
0112-720	Analysis, Modeling & Design	4
0112-725	Data Management	4
Choose two from the following:		
0112-700	Information Technology Hardware & Software	4
0112-735	Network Technology	4
0106-744	Project Management	4
0112-755	Information Systems Management	4
0112-760	Integrated Business Systems	4
0112-761	Business Process Design & Workflow	4
0112-745	Business Applications Programming*	4
0112-795	Seminar in MIS	4

** This course is strongly recommended for students without extensive programming experience.*

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 the enormous need to understand the implications of these shifts for strategic initiatives in marketing and advertising as well as supply chain management. This E-Business Marketing path exposes students to the uniqueness of marketing goods and services to other companies as well as individual consumers.

		Credits
0105-772	Marketing on the Internet	4
0105-773	Database Marketing	4
0105-775	Business to Business E-Commerce	4
	One Marketing Elective	4

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 sides) aspects of quality. The courses offered under this option will help them manage and lead organizational change and quality improvement projects.

		Credits
0102-741	Managing Organizational Change	4
0106-745	Quality Control & Improvement	4

Choose two from the following:

0105-771	Marketing Research Methods	4
0307-782	Quality Engineering	4*
0307-721	Statistical Process Control	4*
0307-731	Statistical Acceptance Control	4*
0625-841	Benchmarking & the Process of Continuous Improvement	4
0106-744	Project Management	4

* *Student should register for the 4-credit-hour option of these courses.*

Manufacturing Management

The manufacturing concentration is designed to enhance the student's understanding of the manufacturing function as it exists in modern business, and skills related to this area. 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.

		Credits
0106-744	Project Management	4
0106-745	Quality Control & Improvement	4
0106-749	Manufacturing Strategy & Tactics	4

Choose one from the following:

0102-742	Introduction to Technology Management	4
0101-794	Cost Accounting in the Manufacturing Environment	4
0102-741	Managing Organizational Change	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 4-credit-hour option of these courses.*

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 understanding of the basics of statistical process control, quality improvement, acceptance sampling, and off-line quality control techniques, such as the design of experiments.

		Credits

Choose any four of the following:

0106-745	Quality Control & Improvement	4
0307-782	Quality Engineering	4*
0307-721	Statistical Process Control	4*
0307-731	Statistical Acceptance Control	4*
0307-801	Design of Experiments I	4*
0307-802	Design of Experiments II	4*

* *Student should register for the 4-credit-hour option of these courses.*

Engineering Management

This concentration, although rooted in mechanical engineering, may be significantly interdisciplinary. By design, a student's program may range over several colleges of the Institute in assembling courses which will best help him or her meet professional objectives.

Health Systems Administration

This concentration is specifically designed for those students who want to pursue a career in the health care environment. Courses with state-of-the-profession content are continually developed in response to the changing health care environment. All courses are 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 HRD professionals. This concentration provides education in training, human resource management, career development, organizational development and consulting.

Information Technology

Corporations are aware of the cost savings and performance improvement possible when information technology is applied in a systematic manner to improve organizational information flow, employee learning and business performance. The future will include a mixture of computers and other multi-purpose 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 requires 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, non-profit organizations and the private sector where an understanding of the formulation and impacts of public policies are critical. This concentration will give students the skills to effectively formulate public policies and understand their impacts, particularly as related to science and technology issues. The courses focus on policy formation, implementation and analysis.

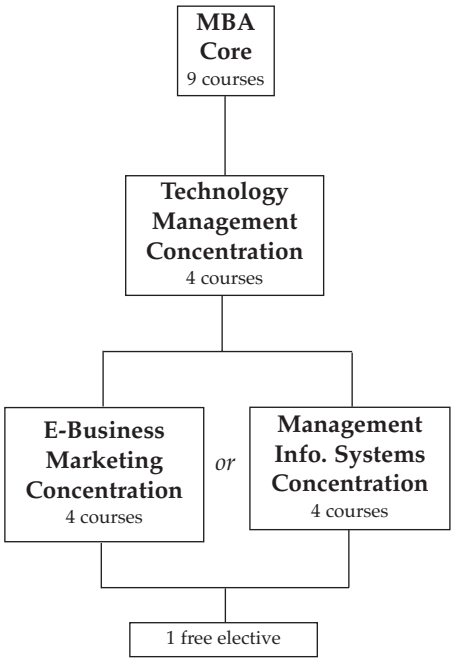
EXAMPLES OF MBA TRACKS

Students are encouraged to meet with an adviser to carefully select their two concentrations so that these areas of study are congruent with their career goals. Two related concentrations may be joined to create a specialized MBA track. Examples of these tracks follow.

Management of Technology, MBA track

This track provides students the analytical tools and skills needed to successfully manage technology intensive organizations. This is an attractive option for students interested in careers with organizations that either produce or utilize technology.

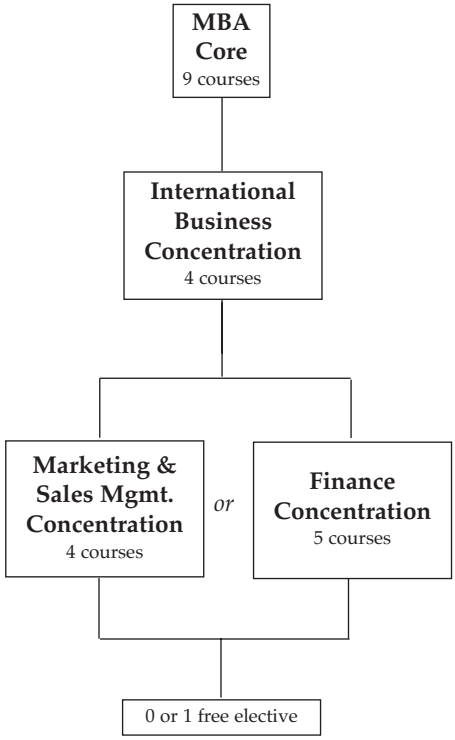
Students in the management of technology MBA track complete the nine-course core, the four-course technology management concentration and either the four-course e-business marketing concentration or the management information systems concentration. One free elective is to be chosen from courses outside the above concentrations.



International Business, MBA track

This track prepares students for the growing demand for global managers who understand the international business environment. The interdisciplinary curriculum combines international business theory and practice in addition to stressing the interrelationships among business functions such as marketing, management and finance in a worldwide economic environment.

In addition to the nine-course core, students in the international business MBA track complete a four-course international business concentration that includes courses in international marketing, international finance and international management. Students then complete a four-course concentration in marketing and sales management or a five-course concentration in finance. The free elective should be in an area outside these concentrations. To provide students with an international experience, the free elective can be taken at the U.S. Business School in Prague. Students wishing to pursue careers in international business should be proficient in a foreign language. This requirement may be satisfied by previous course work or by examination.



Executive MBA (EMBA)

Donald O. Wilson, Director

The executive MBA is an integrated, two-year 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 and traditional MBA: the differences

Executive MBA students must have a minimum of eight years of professional 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, and the emphasis is on cross-functional integration. The topics covered are those taught in the traditional MBA program.

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; and
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 and the two required summer weeks.
- Business owners or individuals may sponsor themselves

Program structure and content

The Executive MBA program consists of two summer weeks plus six weekends per quarter, for a total of 36 weekends over the program's 21 months.

The first-year curriculum focuses on core business concepts and provides fundamental skills, knowledge, and perspectives in accounting, statistics, leadership, finance, and economics. The second year extends that foundation and develops 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 an optional week-long business trip to Prague.

Curriculum

First Year, Summer
Five-Day Orientation

Quarter One, Fall
Accounting & Organizational Goals
Managerial Accounting
Microeconomics
Leadership

Quarter Two, Winter
Data Analysis
Statistics for Decision Making
Macroeconomics
Human Resources Management

Quarter Three, Spring
Valuation & Capital Budgeting
Financial Analysis & Planning
Strategic Uses of Information Systems
Business, Government & Society

Second Year, Summer
Introduction to Strategic & Cross-Functional Thinking (five days)

Quarter Four, Fall
Strategic Thinking I
Strategic Thinking II
Marketing Strategy I
Business Simulation

Quarter Five, Winter
Capstone Projects
Marketing on the Internet
Technology Management
Strategic Operations

Quarter Six, Spring
Capstone Projects
International Business
International Marketing
International Finance

Information and application

All correspondence for executive MBA admission information and for the submission of 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 Science in Finance

The master of science in finance program is designed to prepare students for managerial careers in corporate finance, investment analysis and portfolio management, financial consulting and financial institutions. Courses that clearly parallel the Chartered Financial Analyst Program 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 can enter the program 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, minimum paper-based score 580 or minimum computer-based score 237) 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:

0104-721 Financial Analysis for Managers
0104-722 Financial Management II
0104-725 Securities & Investment Analysis
0101-703 Financial Accounting Systems
0104-740 Futures and Options
0104-760 Finance for Global Business
0106-782 Statistical Analysis for Decision Making
0103-711 Microeconomics
0103-712 Macroeconomics
One finance elective
Two breadth electives

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

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

Master of Science in International Business

The master of science degree in international business addresses the growing demand for global managers who understand the international business environment. The program emphasizes both a global perspective and interrelationships among the functional areas of business. It discusses cross-boundary business processes in a worldwide environment.

Full-time students must begin studies in the fall quarter in order to complete the program in one year. Part time students can enter any quarter. Students must meet with an advisor prior to registering for courses.

Admission requirements

Applicants must have a baccalaureate degree from an accredited program. To be considered for admission, it is necessary to file an application, submit official transcripts of all previous undergraduate and graduate work, submit results of the Graduate Management Admissions Test and provide a résumé. International applicants must submit the results of the Test of English as a Foreign Language (TOEFL, minimum paper-based score 580, or minimum computer-based score 237) 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.

Students have the opportunity to take some of their course work at the University of Stratchclyde in Glasgow, Scotland.

Curriculum

The MS in international business requires 48-quarter credit hours and consists of 12 courses. Choose either the financial option or the marketing and management option.

Required Courses:

0102-780 Global Business Environment
0102-782 Global Issues and Strategy
0105-761 Marketing Concepts
0105-766 Marketing in a Global Business
0106-782 Statistical Analysis for Decision Making

Choose one from the following:
0105-771 Marketing Research Methods
0102-770 Business Research Methods

Choose either the Financial or the Marketing & Management option.

Financial Option

0101-703 Financial Accounting Systems
0103-705 Economics for Managers
0104-721 Financial Analysis for Managers
0104-760 Finance for Global Business

Marketing & Management Option

0102-740 Organizational Behavior & Leadership
0102-760 Managing in a Global Environment

Choose two from the following:
0105-772 Marketing on the Internet
0105-764 Channel Management
0105-763 Buyer Behavior

Two courses in a thesis or practicum (8 quarter hours)

Thesis: A conceptual and theoretical research project designed by the candidate and his or her advisor to explore a salient international business-oriented issue.

Practicum: A practitioner or corporate-oriented research project designed by the candidate and his or her adviser to explore a salient international business-oriented issue.

GRADUATE FACULTY

Accounting

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

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

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

Michael J. Lacina, BBA, Western Michigan University; MBA, Michigan State University; Ph.D., Purdue University; CPA, Michigan—Assistant Professor

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

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

Decision Science

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

A. Erhan Mergen, BS, Middle East Technical University, Turkey; 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—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

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

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

Thomas D. Hopkins, BA, Oberlin College; MA, Ph.D., Yale University—Professor; Dean

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—Associate Professor

Kristin Byron, BS, Emory University; MS, M. Phil., Ph.D., Georgia State University—Assistant Professor

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

Andrew J. DuBrin, AB, Hunter College; MS, Purdue University; Ph.D., Michigan State University—Professor

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

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

David McHardy Reid, BS, University of Salford; MS, University of Manchester; Ph.D., University of Edinburgh—Professor; Director, Center for International Business and Economic Growth

Sandra L. Rothenberg, BS, Syracuse University; MS, Ph.D., Massachusetts Institute of Technology—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—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., Laval University, Quebec City, Quebec—Assistant Professor

David Miller, BA, MBA, University of Rochester—Visiting Lecturer

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

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

Patricia A. Sorce, BS, Kent State University; MS, Ph.D., University of Massachusetts—Associate Professor

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

Stanley M Widrick, BS, Clarkson College of Technology; MBA, State University of New York at Buffalo; Ph.D., Syracuse University—Professor

SPECIAL APPOINTMENT

Albert J. Simone, Ph.D., Massachusetts Institute of Technology—President, Rochester Institute of Technology; Professor

Accounting

0101-703 Financial Accounting Systems
An introduction to accounting as an information system used by business entities to report their financial performance to interested outside parties. Demonstrates why accounting information is important, how accounting information is produced, and how it is used. The course will focus on financial statements that are generated under Generally Accepted Accounting Principles. Issues will include income determination, valuation of assets and liabilities, revenue and expense recognition, analysis of cash flows and the analysis and interpretation of financial statements. **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
A thorough study of the principles and techniques used to accumulate costs for inventory valuation and managerial decision making. Includes problems and procedures relating to job order, process and standard costs systems, with particular attention to the problems of overhead allocation, activity-based costing, measuring the costs of quality and control. (0101-703) **Credit 4**

0101-707 Advanced Accounting and Theory
Analysis and evaluation of current accounting thought relating to the nature, measurement and reporting of business income and financial position; concepts of income in relation to the reporting entity; attention to special areas relating to consolidated statements, foreign currency statement translation, governmental and not-for-profit accounting. (0101-705) **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
Study of federal income taxation, emphasizing tax planning for individuals and unincorporated businesses. Topics covered include income measurement and the 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. This course 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**

0101-730 Business Law I
An introduction to law and ethical considerations in the areas of contracts, creditors' rights, agency, partnership, corporations, bailments, and international law in a global economy. **Credit 4**

0101-731 Business Law II
Topics of business law with ethical considerations intended to help prepare students for the CPA exam. Topics from the Uniform Commercial Code include: sales, commercial paper and secured transactions, and personal and real property. Regulation of the securities market, liability of accountants, and international law also are discussed. (0101-730) **Credit 4**

0101-794 Cost Accounting for Manufacturing Environment
A first course in accounting for students specializing in computer integrated manufacturing systems (CIMS) or Manufacturing Management and Leadership (MM&L). The course will introduce the routine internal accounting systems and accounting processes used by manufacturing firms, specialized techniques used to evaluate efficiency and effectiveness of manufacturing operations, form and content of manufacturing financial statements and additional topics relevant to manufacturing firms. The course should not be taken by those with a program concentration in accounting. **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 analyze a case, oral and written communication, working in a team environment, and academic ethics. This five week course was designed to complement Professional Skills seminar II. Two hours per week. **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 Skills Seminar II, students become familiar with career management strategies, including resume writing, interviewing techniques, career planning, and how to search for a job of 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. Two hours per week. **Credit 0**

0102-720 Entrepreneurship & 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 & 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 the various theories and approaches currently used by behavioral science practitioners to assist organizations in implementing change. The features of successful change in organizations will be discussed, with an emphasis on the structural, technological, motivational, interpersonal, and social aspect of organizational change. Other topics include methods of managing the change process in organizations, overcoming resistance to change, the role of the change agent, organizational restructuring and business process re-engineering. (0102-740) **Credit 4**

0102-745 Social & Political Environment of Business
The course illuminates the role of ethics, social ideology and government policy and regulation in guiding business decisions and in providing the conditions for successful competitive activity. Special attention is given to the role of business in assessing technological opportunity and risk, managing product liability and victim compensation, directing the corporation in a manner consistent with the public policy on the natural environment and developing policies that assure fair treatment of the diverse individuals in the workplace. **Credit 4**

0102-746 Management & Career Development
Study and application of current methods of developing managers, with a primary emphasis on career development of both managerial personnel in general and the person taking this course. Implications of current technological developments for training, replacement, and advancement of managerial personnel are discussed. Insight is also provided into the organizational function of management development. (0102-740) **Credit 4**

0102-750 Human Resource Management
This course focuses on the importance of managing human resources with an awareness of the needs of the business and of the legal and regulatory environment. Attention is given to the increasing organizational need to have greater cooperation among top management HR managers, line managers and employees. Students will become familiar with the functions of staffing, appraising and compensating employee performance, training and organizational development and establishing and maintaining effective work relationships. (0102-740) **Credit 4**

0102-753 Field Experience in Business Consulting
Students nearing the completion of their program work in consulting teams to assist local small firms and entrepreneurs. Problems are isolated and solutions then developed. A team consultant's report is prepared for the firms/entrepreneurs. (0101-703, 0104-721, 0105-761) **Credit 4**

0102-756 Power & 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**

0102-757 Management & Leadership
Interpersonal aspects of managerial work, managing key individual work relationships (bosses, peers and subordinates), use of communication and leadership skills as a key aspect of effective management. The course deals with individual, interpersonal, group and organizational aspects of leadership. (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 Business
An analysis of business behavior and organization in the European Community, Eastern bloc countries, the Pacific Basin, and the U.S. 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**

0102-763 Behavioral Skills for Managers & Professionals
The 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 given 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 administrative 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. **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; whistle blowing; 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**

0102-785 Ethics in Technology Intensive Environment
The course confronts graduate student with a wide variety of ethical dilemmas in business and other professional career environments, including government and not-for-profits, which are inherently technologically intensive; areas such as information technology and the life sciences. This exposure is important, even vital, as individuals are likely to encounter such difficult situations throughout their careers. More than their technical proficiency, their ability to effectively deal with ethical dilemmas will shape their professional successes and failures. **Credit 4**

0102-799 Independent Study
A supervised investigation and report within a business area of professional interest. The exact content should be contained in a proposal for review, acceptance, and assignment to an appropriate faculty member, who will provide supervision and evaluation. Appropriateness to written objectives and ability of faculty will be included in the review and consideration for acceptance. (Permission of instructor and graduate department)

Technology Management

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 for business majors; permission of instructor for students in other colleges) **Credit 4**

0102-761 Managing Research & 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 for business majors, permission of instructor for students in other colleges.) **Credit 4**

0102-762 Managing New Process & 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 for business majors; permission of instructor for students in other colleges) **Credit 4**

International Business

0102-760 Managing in a Global Business
An analysis of business behavior and organization in the European Community, Eastern bloc countries, the Pacific Basin, and the U.S. 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**

0102-780 Global Business Environment
The course focuses on issues related to business political economy and the complexity of international business. Topics include trade theory; evolving political, regulatory, and economic environments; the multinational corporation; host country relations; direct foreign investment; and managing across national boundaries. (0103-705) **Credit 4**

0102-782 **Global Issues & Strategy**
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 international business. 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 international business-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 international business-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)**

0104-760 **Finance for Global Business**
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. (0104-721) **Credit 4**

0105-766 **Marketing in Global Business**
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**

Economics

0103-705 **Economics for Managers**
This 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 business decision making.(0106-066 algebra or equivalent) **Credit 4**

0103-711 **Microeconomics**
This is an intermediate microeconomic theory course with applications. The fundamentals of consumer behavior theory, market demand, and the theory of the firm are stressed with applications. Also, resource allocation and product distribution as fundamentals to management and to understanding the role of a firm in an economy. **Credit 4**

0103-712 **Macroeconomics**
This is an intermediate macroeconomic theory course with applications. A basic framework of product and money market equilibrium is explored with applications in fiscal and monetary policy. An understanding of major aggregate economic relationships is developed, as well as economic policy. **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 Manager**
An examination of basic financial theories, techniques, and practices relating to the valuation, pricing, and selection of capital/financial assets and the definition, evaluation, and management of corporate risk. Topics include: time value of money, valuation, capital asset pricing, risk and diversification, cost of capital, capital budgeting techniques. (0101-703 prerequisite, 0103-705 or 0103-711 and 0106-782 as pre or co-requisite) **Credit 4**

0104-722 **Financial Management II**
This course emphasizes the theories, techniques, and practices associated with capital structure decisions, equity and debt restructuring, dividend policy, financial forecasting, working capital management, financial analysis, financial control, and leasing. (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, 722) **Credit 4**

0104-725 **Securities and Investments**
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 & 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 Theory**
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**.

0104-740 **Futures & Options**
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**

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
This course examines the process involved in the creation, distribution and sale of products and services. The objectives of the course are to introduce students to the tasks and decisions facing marketing managers and to the elements of marketing analysis including customer analysis, competitor analysis, and company analysis. The course is structured around the managerially controllable elements of product, price, promotion and distribution, plus the interrelationships of these elements, within the context of a changing business environment. (0105-761) **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 and the role of total quality management in the development, implementation, and control of marketing plans. (0105-761) **Credit 4**

0105-763 Buyer Behavior
The course reviews the major theories that frame the understanding of both consumer (end-user) and business buying behavior. Topics include the buying decision process, the impact of emotion, product knowledge and product involvement on purchasing decisions. In addition, behavioral and social psychology perspectives will be discussed. All perspectives will be applied to designing marketing strategy. (0105-761) **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 inter-organizational system involved with the task of making goods, services and concepts available for consumption by enhancing their time, place and possession utilities. The course focuses on 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, Student may not also take Business to Business E-Commerce-0105-775) **Credit 4**

0105-765 Sales Management
A course centered around the role, activities, and tools employed by sales force managers. The importance of continuous improvement and of defining and meeting the requirements of both internal and external customers is presented as the foundation of effective sales management. (0105-761) **Credit 4**

0105-767 Marketing Communications
This course presents an in-depth view of the promotional tools of advertising, sales promotion, and public relations. Students will develop a comprehensive promotion plan, beginning with the marketing strategy and ending with implementation and evaluation. (0105-761) **Credit 4**

0105-770 Professional Selling
A critical examination of the challenges and opportunities provided by professional selling. Selling concepts, tools, strategies and tactics will be discussed, observed and practiced. Students are exposed to and experience some of the problems faced and rewards earned by those in professional sales. **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 Marketing on the Internet
This course is designed to expose students to the many ways in which marketing concepts and strategic marketing issues can be enhanced through effective use of the internet and related technologies. The course focuses on both business to consumer and business environments. Specific attention is given to the understanding and implementation of on-line competitive advantage through successful brand management, effective competitive intelligence and the pursuit of a customer focused digital marketing mix. The course emphasizes practical application in the form of research papers and real world domestic and international consultancy assignments. (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 Microsoft ACCESS software program, after which they will apply the information from an analysis of a database to design a relationship marketing plan. (0105-761, 0106-782) **Credit 4**

0105-775 Business to Business E-Commerce
An overview of the business commerce transition from paper-based to electronic processes, with particular emphasis on the reasons behind the transition, the strategies employed, and the resulting impact on the enterprise. (0105-761, student may not also take Channel Management-0105-764) **Credit 4**

Production & Operations Management

0106-743 Operations Management
Study of the management of production/operations and improvement of processes. Encompasses both manufacturing and services. Topics include operations strategy, quality planning, control and improvement, project management, planning for and control of job, batch and high volume operations (forecasting, capacity and materials planning, scheduling, inventory management, JIT, supply chain management), international operations, and current issues. (0106-782 or equivalent, pre- or corequisite) **Credit 4**

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

0106-745 Quality Control & 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. Views are: (1) manufacturing strategy from a business prospective, (2) business process improvement, including change management, (3) human resource management-current relationships between companies and employees, issue of compensation and diversity, and personal career management, (4) risk management—how to identify, access and control those risks which are key, and (5) value/supply chain management, including strategic make-buy decisions, types of cooperative relationships with other firms, and related planning/control systems. (For MS in Manufacturing Management and Leadership) **Credit 4**

0106-749 Manufacturing Strategy & 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**

Decision Sciences

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**

0106-782 **Statistical Analysis in Decision Making**
A course in applied statistics emphasizing inference (estimation and testing). Topics to be covered include sampling distribution, estimation, test of hypothesis for single and two populations, statistical quality control methods, linear, multiple regression and model-building methods. (0106-066, statistics or equivalent) **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**

Management Information Systems

0112-700 **Information Technology Hardware & Software**
This course is designed to present the issues of rapid computer system changes, increased computer power and speed, reduced computer size, new peripherals and changes in user interaction. This course presents these issues of computing systems architectures and operating system software using a systems view. (0112-710) **Credit 4**

0112-710 **Management 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. Due to the importance of managing business processes, enabling e-commerce and leveraging Enterprise Resource Planning (ERP) systems in modern organizations, special emphasis will be given to them throughout the course. **Credit 4**

0112-720 **Analysis, Modeling & 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. Provided students 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**

0112-735 **Network Technology**
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. (0112-700, 0112-710) **Credit 4**

0112-745 **Business Applications Programming**
Managing in today's technological environment requires an understanding of and an ability to communicate with technical professionals. This course explores the fundamental concepts and techniques of computer programming in a modern Object Oriented language. By the end of the course, students will demonstrate core programming skills and will be able to write simple business applications. Most importantly, students will develop knowledge to communicate more effectively about programming issues. This course assumes no prior programming knowledge. **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, 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 provides hands-on experience with the navigation of the SAP R/3 systems and the concepts and technologies associated with enterprise systems integration. Topics include an overview of Enterprise Resource Planning (ERP) systems, the concepts and technologies required to integrate the systems of large business organizations, and hands-on experience using SAP software. (0112-710) **Credit 4**

0112-761 **Business Process Design & Workflow Analysis**
This course focuses on the procedures, tools, and concepts necessary for evaluating, building, and revising business processes within an organization. It introduces the standard systems analysis and design life cycle for defining and refining processes. Tools used in the course include object-oriented workflow design tools selected from ARIS, Rational Rose, Vision Professional and the workflow design tools that are part of SAP R/3. (0112-760 or permission of instructor) **Credit 4**

0112-795 **Seminar in MIS**
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

Jorge L. Díaz-Herrera,
Dean

The B. Thomas Golisano College of Computing and Information Sciences (GCCIS) offers master of science degrees in computer science, information technology, and software development and management and an advanced certificate in interactive multimedia development. The programs offer the most current computing technology and are supported by extensive laboratory facilities. Courses are offered during the day and evening, allowing full- or part-time study. Information technology and software development and management are also offered online.

GCCIS is the newest college at RIT, having been formed in the summer of 2001. It focuses on the computing disciplines in the broadest sense. Included in the college are the departments of computer science, information technology, and software engineering and the Lab for Applied Computing. Interdepartmental and intercollege cooperation are basic to its function. The college has more than 90 faculty, 3,000 students, more than 40 technical and support staff, and extensive facilities dedicated to teaching, research, and development.

The computer science and information technology departments have degree programs at the associate, baccaluareate, and master's levels. Both offer extensive evening courses that allow these degrees to be full- or part-time. Software engineering offers a bachelor of science degree.

Programs

Master of Science Degrees in:

Advanced Certificates available in:

⇆ *Online learning option available*

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 course sections. Internet, dial-up network, and Web access are also provided, insuring that our students have the tools necessary to complete their assignments and projects.

To provide space for this equipment, a new 126-thousand-square-foot building was completed in 2003. This allows for both general-use and specialized labs, such as networking security 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.

Computer Science Department

Walter A. Wolf, Ph.D., Chair
Hans-Peter Bischof, Ph.D., Graduate Program Chair

The computer science MS program at RIT has a core curriculum, which is designed to give students a solid background in the theoretical principles underlying the field, and a wide variety of electives, which provide the opportunity to become proficient in current software technology. The core ensures that graduates take with them the intellectual tools necessary to keep up-to-date in this rapidly evolving discipline, while the electives prepare our graduates to engineer modern computing systems and contribute in all aspects of the systems' life cycles. Students can also prepare for academic or research careers in computer science or a related discipline as well as further academic study.

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) and 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 Ultra 10 and Sun Blade 150 workstations
- a networking/distributed systems lab with 10 dual processor Pentiums and its own internal network
- specialized labs in vision, security, wireless networks, and artificial intelligence

These computers operate under the UNIX operating system.

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.

Ethernet is used to integrate the above systems and to connect the Graduate Computer Science Laboratory with other RIT computing facilities. 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.

Graduate students have Internet access and are encouraged to use home computers. (The RIT bookstore carries computer equipment and software and provides discounts for RIT students.)

Master of Science in Computer Science

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) scores. (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 (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

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.

B. Thomas Golisano
College of Computing and Information Sciences

Mathematics

1016-251, 252, 253	Calculus
1016-351	Probability & Statistics (Calculus based)
1016-265	Discrete Mathematics

Computing

4003-231	Computer Science I
4003-232	Computer Science II
4003-233	Computer Science III
4003-334	Computer Science IV
	or
4003-234	Accelerated Computer Science I
4003-235	Accelerated Computer Science II
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 has been admitted on the condition that he or she will successfully complete the bridge program courses with a 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 is composed of the computer science graduate core, electives, advanced electives and a thesis paper or project for a total of 45 credits.

There are two tracks to the degree, the thesis track and the project track.

The thesis track consists of:
- Six required ("core") courses (22 credits),
- Electives (8 credits),
- Advanced electives (8 credits),
- Master's thesis (7 credits).

The project track consists of:
- Six required ("core") courses (22 credits),
- Electives (12 credits),
- Advanced electives (8 credits),
- Master's project (3 credits).

The computer science core consists of six courses:

4005-700	Foundations of Computing Theory
4005-710	Programming Language Theory
4005-720	Computer Architecture
4005-730	Distributed Operating Systems I
4005-800	Theory of Computer Algorithms
4005-893	Graduate Seminar

Students with a strong background in a core area may receive permission from the program coordinator to replace a core course with some other course, generally in the same area.

A subset of electives and advanced electives is shown below; advanced electives are indicated by "†."

4005-704	Complexity & Computability
4005-705	Cryptography
4005-709	Topics in Computer Science Theory †
4005-711	Compiler Construction †
4005-719	Topics in Programming Languages
4005-729	Topics in Computer Architecture †
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 & Networks I
4005-741	Data Communication & Networks II
4005-749	Topics in Data Communications †
4005-750	Introduction to Artificial Intelligence
4005-751	Knowledge-Based Systems †
4005-755	Neural Networks and Machine Learning †
4005-756	Genetic Algorithms †
4005-757	Intro. to Computer Vision †
4005-759	Topics in Artificial Intelligence †
4005-761	Computer Graphics I
4005-769	Computer Graphics II †
4005-771	Database Systems
4005-772	Database System Implementation

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 may not be 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

Jim Leone, Chairperson

The information technology (IT) department offers an MS degree in information technology, an MS degree in software development and management, and a program of study leading to an advanced certificate in interactive multimedia development. Graduate courses are given at times of the day convenient to both part-time and full-time graduate students—usually late afternoon and evening. Both MS degree programs will take at least five or six quarters to complete. The advanced certificate may be accomplished in one calendar year.

The master of science 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 to contemporary problems, including business and education. All students develop a plan of study that focuses on specific areas of interest within the IT discipline. They could develop skills in needs analysis for information technology. They could design and develop interactive, multimedia-based information applications. Students could 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 master of science in software development and management provides students with state-of-the-art preparation for a broad spectrum of software development-related IT careers. 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 also offered in a distance delivery 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 theme of our work is the enhancement of human communication in electronic environments. Students explore related issues through a series of six core courses in interactive multimedia development.

Laboratory facilities

The computing facilities of the department of information technology are driven solely by curricular needs.

Many of our courses are laboratory-based. In these courses, students have scheduled laboratory time each week with an instructor. The instructor provides a structured laboratory experience, reinforcing concepts covered in lecture. Some courses are taught in "studio format," in which the course meets in a specially designed classroom that supports integrated lecture and hands-on learning.

Due to our cross-platform commitment, our labs contain Windows and Macintosh platforms; Unix is used in several specialized labs. Students use these labs to design and develop cross-platform applications. From the capture of media (sound, video, and print materials) to the production of Web sites and computer based training, IT has ample resources on both platforms for editing and creating content as well as authoring multimedia for stand-alone computers and delivery via the Internet.

Open labs provide students with access to computing resources outside of scheduled lab time along with technology similar to what they will use after graduation. Many of our students not only use the labs, but also work as lab assistants, adding a practical dimension to their experiences.

In addition to general laboratory facilities for student support, the IT department has developed specialized laboratories for its concentrations in the areas of networking, system administration and security, multimedia, human-computer interaction, programming and database implementation and administration.

The IT networking lab is designed to facilitate network exploration. Each lab station consists of three PCs, a layer-3 switch, a router, and a hub. Each of the PCs runs "sniffer" software, making each a network analyzer. Additional equipment can be brought to the station from the equipment cage as needed for labs, including cable testers, breakout boxes, additional hubs, crimping tools, V.35 cables for serial routing, etc. In addition, each station is cabled to the lab infrastructure to allow each station to be its own sub-network in the lab network, or to be directly connected to the lab network, which provides many possible topologies.

The IT systems administration lab is designed to facilitate experimentation in network management and system administration. Each station contains four PC compatible computers. 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. Images of the machines can be quickly saved and restored to make 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 IT security lab is designed to facilitate student learning and experimentation in the expanding field of information security. Each student station consists of four 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, etc., may be checked out of the networking equipment cage.

The IT database labs are designed to facilitate experimentation with client/server database concepts. The lab consists of stations with a Unix-based ORACLE server and Windows-based servers that can be configured to support a Web server or one of several database packages or a client machine. Students begin by configuring single-user one-tier environments and progress to multi-tier networked configurations, where multiple clients interact with a backed database through a Web server.

Many IT programming and multimedia courses are taught in specially designed "studio labs" in which each student has a computer station. Lecture material and examples can be displayed on one or more large screens at the front of the room. Courses are structured in alternating lecture and hands-on exercise sessions. In addition to the course instructor, a teaching assistant is available to answer questions and provide help during class time.

The IT Entertainment Technology Lab boasts a complement of high performance PC and Macintosh computers with an exceptional suite of software for 3D modeling, computer game and virtual world development, and other interactive media projects. Many workstations have dual monitors to provide developers with an unobstructed view of their content. Some computers are configured to facilitate group work and team projects. The lab also has equipment for the acquisition of broadband digital media in diverse formats.

The Streaming Media Lab houses the department's video and audio studios. The digital video production studio has a "talk-show-style set" for streaming video productions and a blue screen for Quicktime VR production. The lab's audio studio is designed for both voiceover/narration work for groups of three or four performers to record music or do dialog work. The two studios are linked by a digital control room that also houses the lab's dedicated media servers and video routing equipment.

Each of the IT department's two usability testing labs consists of two parts separated by a one-way mirror: a testing room and an observation area. Each testing room has state-of-the-art networked PC and Macintosh computers with a selection of input devices such as touch screens, joysticks, haptic mice, track balls, etc. The testing room also has two security-style video cameras that can send video to VCRs on the observer side, a high-quality desk microphone to record the user's comments (and to act as an intercom), a microphone/headset for speech input, and one scan converter for feeding video from an active subject computer to a VCR. The observation side has a monitor for display of the user's screen, headsets for the observers, a PC for note taking, a microphone to the testing room, and VHS and audio recorders.

The IT computing facilities are connected to the gigabit RIT campus backbone with an OC3 connection to the Internet. Students have access to our facilities via Ethernet in their dorm rooms or vial dial-up PPP connections from off-campus locations. DSL and high speed cable modem access is available in the surrounding community. Institutional facilities provide a location for students to develop their own presence on the Web. The overall campus facilities have consistently been rated in the top twenty universities by national surveys.

The general and specialized IT laboratory facilities makes our environment one of the most up-to-date for undergraduate and graduate exploration of Web site design, networking and software development in any university in the United States.

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 Software Development and Management

The software development and management degree program 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 designed for part-time study at a distance (on-line learning).

Admission requirements

Applicants should have a baccalaureate or equivalent degree from an accredited institution and a minimum cumulative grade point average of 3.0 (B). Applicants must submit two professional recommendations.

Applicants from foreign universities must submit Graduate Record Examination (GRE) scores. The GRE score is also recommended from those whose undergraduate grade point average is less than 3.0. Since this is a part-time program, visa forms can not be issued by RIT.

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 along with a reduced program course load.

Prerequisites

Students wishing to enter the master's program must have at least two years of employment experience in the software development process and a solid background in object-oriented programming (Java).

If a student does not have the necessary Java 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 through study, taking one or more of the following RIT courses, as prescribed by the graduate program coordinator.

Java programming language

4002-217 Programming for Information Technology I*
4002-218 Programming for Information Technology II*
or
4002-318 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 ways different from that described above. 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 48 quarter credit hours comprising the project management cluster, the software development cluster, the application development cluster, two professional electives and the software development project. An optional cooperative work experience is possible.

The **project management cluster** consists of three courses:

4002-830 Project Management
4002-831 Process Management
4002-820 Economics of Software Development

The **software development cluster** consists of three courses:

4002-710 Object Technologies
4002-720 Data Object Development
4002-725 Component Development

The **integration technology cluster** consists of three courses:

4002-819 Integration Technologies
4002-821 Data Architecture & Management
4002-825 Systems Architecture

Two professional electives

4002-895 Software Development *and* Management Capstone

Note: The SD&M program is currently under review by the IT faculty for possible revision during the upcoming academic year. The new design will not change the intent of the degree. Contact the IT graduate coordinator for more information.

Electives (8 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.

Master of Science in Information Technology

The MS in information technology is a unique and flexible program that allows the student to craft his or her own program of study within the broad range of computing disciplines. Students build upon a core requirement in current themes in information technology. The specialty areas include Web site design and multimedia development, game programming, application development, software project management, electronic commerce, learning and performance technology, human-computer interaction, and networking. In addition, students have the option of choosing courses from among the wide variety of fields offered within RIT, such as computer animation, computer graphics design, telcommunications 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 (B). Applicants must submit two professional recommendations.

Applicants from foreign universities must submit Graduate Record Examination (GRE) scores. These scores may be required from 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 along with a reduced program course load.

Prerequisites

It is expected that students wishing to enter the master's program will have a background in fundamental information technology concepts including object-oriented programming, computer hardware and software architecture, networking, and Web site 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 industrial experience does not satisfy the prerequisite 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
4002-318 Java for Programmers*(requires prior programming experience)
or
4002-714 Java Programming (requires prior programming experience)

Hardware

4002-340 Computer Concepts and Software Systems
or
4002-709 Fundamentals of Computer Hardware

Networking

4002-341 Data Communication and Computer Networks
or
4002-733 Fundamentals of Computer Communication

Multimedia and Web site Design

4002-320 Intro. 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.*

The bridge program courses, other than 4002-714, Java Programming, 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 grade point average if taken *before* matriculation; they are included if taken *after* matriculation.

A bridge program can be designed in ways different from that described above. Other courses can be substituted, or courses at other colleges can be applied. Contact the graduate program coordinator for approval.

Curriculum

The master of science in information technology consists of 48 credit hours of graduate study. The curriculum consists of a core course with a choice of concentrations and electives.

Core course (available in distance format)		**Credits**
4002-718	**Current Themes in Information Technology**	**4**

Concentrations (36 credits)

Course numbers in parenthesis indicate required prerequisite courses.

Application Development (available in distance format)

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 at a minimum a 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**

Networking

4002-815	**Intro. to Routing & Switching (4002-342)**	**4**
4002-816	**Intro. to Network Administration (4002-342 and 4002-402)**	**4**
4002-822	**Intro. to Network Programming (knowledge of programming and 4002-815)**	**4**

Prerequisites: This concentration has four prerequisite courses: 4002-340, Computer Concepts and Software Systems, (prerequisite to MS program); 4002-733, Fundamentals of Computer Communication (a prerequisite to the MS program), and 4002-342 Internetworking Lab (undergraduate course), or 4002-746 Telecommunications Network Protocols (for individuals with hands-on networking experience.) These must be taken before any of the courses and is another prerequisite to the MS program.

The course 4002-402, OS Scripting, will count as an elective for your MS program or can be part of another concentration.

System Survivability

4002-421	**System Administration I (4002-402)**	**4**
0501-707	**Computer Crime**	**4**

And one of the following:

4002-780	**Computer System Security (4002-421 and 0501-707)**	**4**
4002-877	**Secure E-Commerce (4002-875)**	**4**

Prerequisites: This concentration requires the 4002-342, Internetworking Lab, and 4002-402, OS Scripting, as prerequisites. If the maximum allowable number of IT undergraduate courses (three at the 4xx or 5xx-level) has not been exceeded, 4002-402 can be counted towards the MS/IT degree.

E-commerce courses require completion of the MS/IT prerequisite bridge and core course, 4002-718, or equivalent pre-approved background experience.

Web Site and Multimedia Development

Study in Web site and multimedia development can be focused in several areas as described below.

Interactive Multimedia Development

4004-745	**Foundations of Human-Computer Interaction**	**4**
4004-737	**Web Site Design and Technology (4004-741)**	**4**
4004-730	**Interactive Media Implementation (4004-741 and a two-course programming sequence)**	**4**

Prerequisite: 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 Web site 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

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.

Multimedia Authoring

4004-742	**Interactive Multimedia Development (4004-741 and 4004-745)**	**4**
4004-728	**Writing for Interactive Media (4004-742)**	**4**
4004-535	**Network-based Multimedia (4004-737)**	**4**

Prerequisites: 4004-741, which is a prerequisite course, and 4004-745 and 4004-737, which are part of the introductory concentration above.

Web Application Development

4004-739	Programming for the World Wide Web (4004-737 and a two-course programming sequence)	
4004-751	Web-Database Integration (4004-739 and a database course)	
4004-xxx	an advanced elective in Web development	

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

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.

Game Programming

4004-729	Introduction to VRML (4004-737 & 4004-746)	4
4002-734	2D Graphics Programming (4002-714 or 4004-746)	4
4002-735	3D Graphics Programming (4002-734)	4

Prerequisites: Completion of a two-course programming sequence or equivalent background/experience plus 4004-741, 4004-730, and 4004-737 or equivalent.

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

Prerequisites: 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.

Learning and Performance Technology

4002-722	Fundamentals of Instructional Technology	4
4002-723	Interactive Courseware (4002-722)	4
4002-724	Performance Support Systems Design	4

Project Management (available in distance format)

4002-830	Project Management	4
4002-831	Process Management	4
4002-820	Economics of Software Development	4

Prerequisites: This concentration requires employment experience in the software development process plus intermediate-level programming skill. The faculty recommend that 4002-820 be taken after the other two courses.

Electronic Commerce Management (available in distance format)

4002-871	Information Technology and Organizational Process	4
4002-872	Inter-Enterprise Computing	4
4002-873	IT and Strategic Opportunity	4

Technical E-Commerce (available in distance format)

4002-872	Inter-Enterprise Computing	4
4002-875	E-Commerce Implementation (4004-741, 4002-720)	4
4002-877	Secure E-Commerce (4002-875)	4

Prerequisites: These concentrations require completion of all prerequisite and core courses or equivalent pre-approved background experience. Students need a solid background in programming, Web technology, data communications, and experience in the issues relevant to the field of information technology.

Concentrations offered by other RIT departments

Students are permitted to complete one concentration (up to a maximum of 12 graduate credits) from another department at RIT with the permission of the graduate program coordinator.

Concentrations in the following areas are available:

- Technology management (College of Business)
- Information systems (College of Business)
- Telecommunications technology (ECT Engineering Technology Department)
- Computer integrated manufacturing (department of manufacturing and mechanical engineering technology)
- Health systems administration (department of hospitality and service management)
- Animation (School of Film 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 in systems administration or database may be used as a concentration with prior approval.

Electives (0 or 4 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 (4 or 8 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 faculty members (project) or three faculty members (thesis) 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.

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ADVANCED CERTIFICATE IN INTERACTIVE MULTIMEDIA DEVELOPMENT

As interactive technologies advance, the content and form of projects change—the theme becomes one of enhancing human communication within electronic environments. This certificate provides an opportunity for students to gain first-hand knowledge and expertise in the art and science of interactive multimedia design. In this program, students explore the theories of interactive computing, 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 degree from an accredited institution and a minimum cumulative grade point average of 3.0 (B). Two professional recommendations must be submitted.

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 along with a reduced program course load.

Since this is a part-time program, visa forms cannot be issued by RIT.

Prerequisites

With the advance of the multimedia field, knowledge of programming has become necessary to complete all of the courses. Students must have programming skills equivalent to one undergraduate course. Bridge courses are available to complete this requirement.

The curriculum

Projects include the development of Web sites and interactive multimedia applications. The curriculum consists of six courses:

		Credits
4004-741	**Fundamentals of Web-Based Multimedia**	**4**
4004-730	**Interactive Media Implementation**	**4**
4004-737	**Web Site Design & Technology**	**4**
4004-742	**Interactive Multimedia Development**	**4**
4004-745	**Foundations of Human-Computer Interaction**	**4**
4004-xxx	**Multimedia Elective**	

The curriculum can be completed in as few as three quarters.

Students have at their disposal a variety of computer, video and digitizing equipment. State-of-the-art laboratory facilities are provided.

GENERAL INFORMATION

Financial aid

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

Cooperative education

Optional cooperative educational experience (co-op) is available for those students who wish to participate in order to gain industrial experience. Students register for course 4002-999, Graduate Cooperative Education, for 0 credits and 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.

Information

Additional information may be obtained by contacting each department's graduate program coordinator at:

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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, Lab 0, Credit 4**

4002-714 Java Programming
An introduction to the Java programming language for experienced programmers. Topics include: basic language concepts (declaring and evaluation of data, statements, expressions, control flow, and input/output), the development environment, the essentials of applet programming (URL, audio, image, test, animation), classes and objects, error handling, debugging, threads, and the client/server environment. Programming projects will be required. (Two-course object-oriented programming sequence not in Java) **Class 4, Lab 0, Credit 4**

4002-716 C++ Programming
A workshop in the C++ programming language intended for students to gain programming experience. This course will focus on modern programming concepts such as reusability, data abstraction, information hiding, exception handling and object-oriented design. Programming projects will be required. (4002-710 or permission of instructor) **Class 4, Lab 0, 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, Lab 0, 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 project is required. (Completion of SD&M bridge) **Class 4, Lab 0, Credit 4**

4002-722 Fundamentals of Instructional Technology
The world of information technology offers the possibility of transforming the way that instruction is designed and delivered. However, few information technology professionals understand the methods and materials of instructional design. As a professional in information technology, a student may be responsible for designing instruction—either in a business or an educational context. This course enables the student to be able to plan, organize, and systematically develop instructional materials. The course uses an Instructional Systems Design (ISD) model to analyze, design, deliver, and evaluate instruction. **Class 4, Lab 0, 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, Lab 0, 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, Lab 0, 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, Lab 0, Credit 4**

4002-727 Digital Audio & 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, Lab 0, Credit 4**

4002-733 Fundamental of Computer Communication
An introduction to data communications and network technology using the OSI model as a framework. The concepts and mechanisms underlying data communications and networking are explained. Fundamental issues related to data communications hardware and software are also explored. (4002-340) **Class 4, Lab 0, Credit** 4

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, Lab 0, 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, Lab 0, Credit 4**

4002-746 Telecom 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. Distance Learning. **Credit 4**

4002-752 Themes Software Development & 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, Lab 0, Credit 4**

4002-760 Computer Virus & 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. (Completion of bridge of MS in information technology) **Class 3, Lab 2, 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) **Credit 4, Lab 0, Class 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) **Studio 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) **Studio 4, Credit 4**

4002-772 XML Transform & 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) **Studio 4, Credit 4**

4002-780 Computer System Security
This course proposes to increase the understanding of the student in the areas of liability, exposure, opportunity, ability and function of various weaknesses and forms of attack and the detection of defense of the same. The issues and facilities available to both the intruder and administrator will be examined and evaluated with appropriate laboratory exercises to illustrate their effect. (4002-421, 0501-507; corequisite: 4002-580) **Class 4, Lab 2, Credit 4**

4002-787 Database Performance and Tuning
Students will explore the theory and application of performance monitoring and tuning techniques as they relate to database systems. Standard topics in DBMS performance will be 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) **Class 4, Lab 0, Credit 4**

4002-810 Simulations & Learning
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**

4002-815 Introduction to Routing & 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. (4002-342, corequisite: 4002-815 lab) **Class 3, Lab 2, Credit 4**

4002-816 Introduction to Network Administration
An investigation of key network services. Topics include DHCP, DNS, LDAP, NetBIOS and SNMP. As time allows, other related topics such as finger, ph, and who is will be explored. This course involves significant laboratory work. (4002-342 and 4002-402, co-requisitie: 4002-816 lab) **Class 3, Lab 2, Credit 4**

4002-819 Integration Technologies
This course is an in-depth study of the major interoperability technologies. Exercises are used to illustrate how modern integration technologies address the economic and technical issues related to the development of integrated systems. Programming projects are required. (Completion of the SD&M software technology cluster) **Class 4, Lab 0, Credit 4**

4002-820 Econ of Software Development
This course is an analysis of the factors that determine software cost, quality, and time to delivery. Topics include fundamentals of software development, identification of cost drivers, and analysis of productivity and quality data. Students use models to estimate software cost, delivery time, and operational reliability. (2+ years of software development experience and SD&M bridge) **Class 4, Lab 0, Credit 4**

4002-821 Data Architecture & 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, Lab 0, Credit 4**

4002-822 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 4002-815; co-requisitie: 4002-816 lab) **Class 4, Lab 0, Credit 4**

4002-825 Systems Architectures
A programming course focused on the application of interoperability technologies. Students develop integrated systems based on software components, applications, databases, web sites, heterogeneous operating systems and networks. (4002-819) **Class 4, Lab 0, Credit 4**

4002-830 Project Management
This is a course in the methods and techniques of managing a software development project. Topics include defining project goals, work breakdown structure, defining tasks, project plans, estimation and scheduling techniques, work monitoring and measurements. (Two+ years of software development experience & SD&M bridge) **Class 4, Lab 0, 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. (Two+ years of software development experience & SD&M bridge) **Class 4, Lab 0, Credit 4**

4002-841 Advanced Computer Forensics
This course is intended to provide students with knowledge and understanding of computer forensics. This course will provide students with the theoretical foundation on techniques and methods needed for the extraction of information from digital devices. Students will examine methods used to hide and subvert information on digital devices. This course will discuss the necessary procedures for admissibility of the evidence. (4002-581 and Programming Skills in C++) **Class 4, Lab 0, Credit 4**

4002-850 Network Planning & Control
This course will examine the issues related to planning new enterprise wide networks as well as implementing changes to existing networks. Students will learn to design a network based on identified needs and constraints. WAN technologies such as ATM and Frame Relay will be combined with LAN technologies in the design of an enterprise internetwork. (4002-745 and 4002-733) **Class 4, Lab 0, Credit 4**

4002-871 IT & Organization Process
The topic of process reengineering 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. (MS/IT core or equivalent background/experience) **Class 4, Lab 0, Credit 4**

4002-872 Interenterprise 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. (MS/IT core or equivalent background/experience) **Class 4, Lab 0, Credit 4**

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4002-873 IT & 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. (MS/IT core or equivalent background/experience) **Class 4, Lab 0, Credit 4**

4002-875 eCommerce Implementation
This course focus will be 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, Lab 0, Credit 4**

4002-877 Secure eCommerce
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, Lab 0, Credit 4**

4002-882 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. (4002-815, 4002-816) **Class 4, Lab 0, Credit 4**

4002-883 Enterprise Networking
This course will provide students with the knowledge and understanding to apply modeling and simulation techniques to predict throughput in large-scale enterprise networks. Theoretical concepts of large-scale networks will be discussed and students will create software models based on this theory. This course will provide students with the knowledge needed to apply available tools for modeling network functionality to determine the impact of network infrastructure modification, device reconfiguration, and the impact of new application rollout. Modeling/simulation projects required. (4002-850) **Credit 4, Lab 0, Class 4**

4002-890 Graduate Seminar in IT
This is the IT seminar course to allow for special one-time offerings of graduate topics or to allow faculty to pilot new graduate offerings. Specific course details (such as the course topics, format, resource needs, and credit hours) will be determined by the faculty member(s) who propose a given special-topics offering. Prerequisites: as appropriate for topic proposed (Corequisite: As appropriate for topic proposed) **Credit 2–8**

4002-892 CSCW and Groupware—Exploring the Role of IT in Collaborative Environments
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 WWW, conferencing and enhanced messaging. (4004-745) **Class 4, Lab 0, Credit 4**

4002-893 Seminar Thesis and Project Preparation
This course provides a structure, methodology and forum for the capstone experience proposal development and committee selection. (Two-thirds of graduate course work—not including prerequisite courses) **Class 2, Lab 0, Credit 2**

4002-895 Software Development & 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, Lab 0, Credit 4**

4002-897 MS Thesis
Capstone experience for the master of science in information technology program. Student 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 Writing for Interactive Media
As more of our communications are delivered on interactive, non-linear platforms, the information should be developed in ways that take advantage of these technologies. This course will focus on the creation of a variety of different hypermedia/multimedia documents designed, drafted and delivered in hard copy and/or digital form. (4004-742) **Class 4, Lab 0, 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, Lab 0, Credit 4**

4004-730 Interactive Media Implementation
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 4002-231or 4002-218, or a two-course programming sequence) **Class 4, Lab 0, Credit 4**

4004-737 Web Site Design & Technology
Assuming a basic knowledge of HTML coding and web page design, this class moves into large-scale site development, and an introduction to advanced web technologies. Building on the web page design concepts introduced in 4004-741, this course focuses on site design issues, including scalability, maintenance, and integration of web technologies into the business or organizational context. Technologies introduced include cascading style sheets, dynamic HTML, basic JavaScript, and streaming media. (4004-741) **Class 4, Lab 0, Credit 4**

4004-738 Multi-User Media Spaces (MUMS)
The 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) **Class 4, Lab 0, Credit 4**

4004-739 Programming for WWW
The World Wide Web is no longer just linked, 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, Lab 0, 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, Lab 0, 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, Lab 0, Credit 4**

4004-743 Interactive Multimedia Project
The project course is a capstone experience. Having achieved some proficiency with the tools and concepts of interactive multimedia, students are expected to produce a 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, Lab 0, Credit 4**

4004-745 Foundations of Human-Computer Interaction (HCI)
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, Lab 0, 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. The 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 iterative design involving users. Learning will be project-based and, whenever possible, directly related to ongoing projects. (4004-730) **Class 4, Lab 0, Credit 4**

4004-747 Topics: 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, Lab 0, 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, Lab 0, 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 Statistics) **Class 4, Lab 0, 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 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, Lab 0, Credit 4**

4004-755 Advanced Topics in Human Computer Interaction (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, Lab 0, Credit**

Computer Science

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) **Class 4, Credit 4**

4005-704 Complexity & 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. The 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**

4005-709 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) **Class, Credit variable, 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, 710) **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**

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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. (4003-708, 4003-710, 4003-707, 4003-717) **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 resister 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 software 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 on 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 metrics, parallel languages, network topology, granularity, applications, parallel programming design and debugging. Programming projects will be required. (4003-713) **Class 4, Credit 4**

4005-736 **Parallel Computing II**
A study of selected topics in parallel algorithm design through the analysis of algorithms used in various areas of application. The 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) **Class, Credit 1–4**

4005-740 **Data Communications & 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. The 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 Communications & 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, 740) **Class 4, Credit 4**

4005-742 **Ad-Hoc Networks**
This course explores server-less ad-hoc networks. Topics include authentication, confidentiality, routing, service discovery, middleware and key generation and key distribution. Programming objects are required. (Data Communications I)

4005-749 **Topics in Data Communications**
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**

4005-755 **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. Completion of Bridge; 4005-700) **Class 4, Credit 4**

4005-756 **Genetic Algorithms**
Generic 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. The 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, 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**

4005-759 **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 non-interactive 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 4003-233) **Class 4, Credit 4**

4005-762 Computer Graphics II
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 various rendering tools and libraries available for image synthesis. The student will put theory into practice via programming assignments and a capstone project. Topics will include light and color, three-dimensional scene specification, camera models, surface materials and textures, rendering (local, ray tracing, radiosity), procedural shading and modeling, tone reproduction, and advanced rendering techniques. (4005-761 or 4002-735) **Credit 4**

4005-769 Topics in Computer Graphics
This project-oriented course builds on topics developed in 4005-761, Computer Graphics I. Expanded topics include 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 or 4003-707) **Class 4, Credit 4**

4005-772 Database Systems Implementation
An examination of the technical issues related to the implementation of shared access databases. Topics include concurrency control, transaction processing, reliability and recovery. Extensions to the distributed processing environment also are covered. Programming projects will be required. (4005-771) **Class 4, Credit 4**

4005-800 Theory of Computer Algorithm
A study of techniques to design and analyze the complexity of algorithms. The 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 1016-265 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) **Credit 2**

4005-898 Independent Study
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**

Kate Gleason College of Engineering

Programs

Master of Science degrees in:

Master of Engineering degrees in:

Advanced Certificates available in:

Doctor of Philosophy available in:

⇆ *Online learning option available*

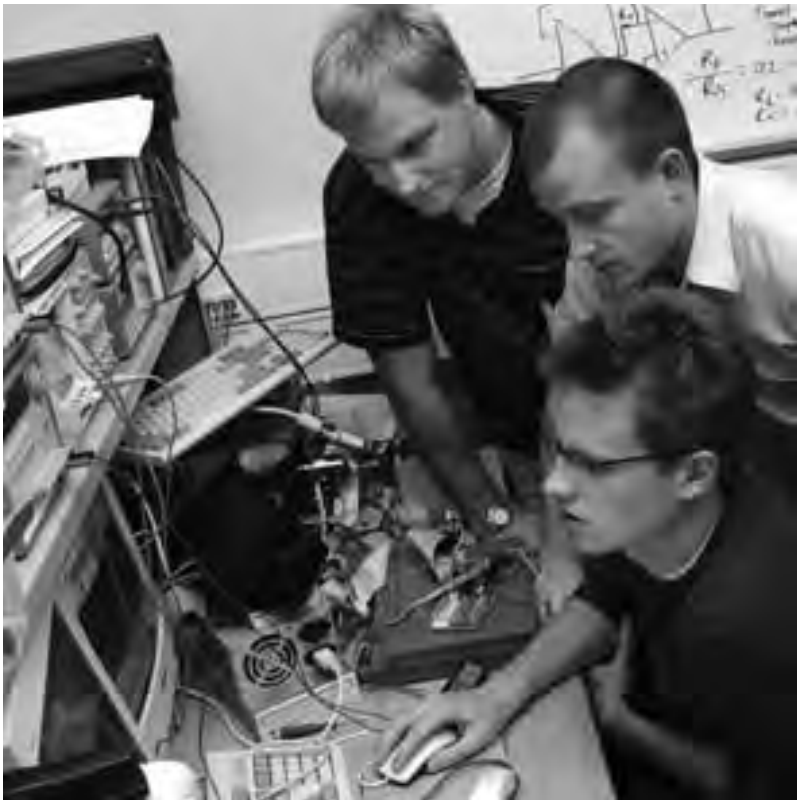
Harvey J. Palmer,
Dean

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. degree 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.

Classes are flexible, with day, late afternoon, and evening classes 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, follow. For information about the interdisciplinary master of science degree in materials science and engineering, offered jointly with the College of Science, see page 139.



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 also on their research or graduate project activity.

A full-time student in a master of engineering degree program may choose to alternate academic quarters with his or her internship. A full-time student can normally complete the degree requirements in one calendar year.

Part-time study

The 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 work at their place of employment. Consequently, many of the courses in the graduate programs in engineering are normally scheduled in the late afternoons or early evenings.

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 in full-time industry must obtain the permission of his or her adviser and the approval of 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.

Off-site graduate courses

To enable the practicing engineer to take graduate courses with the minimum amount of inconvenience, a number of courses for RIT credit are offered in selected industrial locations at the request of industry.

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 is admitted 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, and if an examination of the required documents indicates the qualifications to undertake a graduate program.

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 will be required to 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 applicant is permitted to 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.

An applicant who wishes to enroll in a graduate course as a nonmatriculated student must obtain permission from the person in charge of the graduate program in each department and the appropriate faculty member.

Graduate Record Examination

The College of Engineering does not require graduate applicants to take the Graduate Record Examination for master's degree programs. The exam is required for admission into the Ph.D. degree 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 own interests and directed toward their own 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 Institute. To be considered for transfer credit, the course 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 as a nonmatriculated or regular student. 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 graduate faculty is appointed as a faculty adviser for each graduate student. The faculty adviser supervises the progress of the student towards the master's degree. For the master of engineering student, 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. Nonmatriculated students should direct their questions to either the department head or the chairperson of the department's Graduate Committee.

Grade requirements

The average of the grades for all courses taken at the Institute and credited toward the master's degree must be at least a "B" (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 Institute 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 the ME student, an industrial internship of duration equivalent of up to two academic quarters in a full-time engineering position 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. The internship is selected to reflect each student's primary professional interest and is integrated with his or her curriculum.

In a limited number of cases, where a regular internship is not practical due to extraordinary circumstances, case studies may be substituted for internship. Such a substitution has to have the prior approval of the department head.

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 Institute 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 Institute 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	**475-2987**	**(Savakis)**
Electrical Engineering	**475-2165**	**(Bowman)**
Industrial and Systems Engineering	**475-2598**	**(Mozrall)**
Mechanical Engineering	**475-5788**	**(Hensel)**
Microelectronic Engineering	**475-6065**	**(Kurinec)**
Microsystems	**475-2295**	**(Abushagur)**
Applied Statistics	**475-6990**	**(Voelkel)**
Product Development	**475-7971**	**(Smith)**

Questions on course schedules and registration:

Computer Engineering	**475-5873**
Electrical Engineering	**475-2164**
Industrial and Systems Engineering	**475-2598**
Mechanical Engineering	**475-5788**
Microelectronic Engineering	**475-6065**
Microsystems Engineering	**475-2145**
Applied Statistics	**475-2033**
Product Development	**475-7102**

Computer Engineering Department

Andreas Savakis, Department Head

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. It is expected to accommodate recipients of BS degrees in electrical engineering or computer science after some additional course work. The degree requires 45 quarter credits starting at the four-course core curriculum. The requirements also include an area of concentration, graduate electives subject to faculty adviser's approval and nine quarter credits of master's thesis. Both the area of concentration and the thesis project must be approved by a student's graduate committee consisting of at least three faculty members, the majority of whom are computer engineering faculty. This allows a student to pursue an area of specialization in the field of computer engineering by completing a cohesive set of two courses apart from the background core requirements. The chairperson of the student's graduate committee will normally serve as the student's faculty adviser. The intent is to allow students reasonable creativity in articulating an area of concentration.

SCHEDULED COURSE OFFERINGS 2004-2005

Focus Area	Fall 20041	Winter 20042	Spring 20043
Communications	702 Random Signals & Noise 703 Matrix Methods in EE 729 Antenna Theory & Design 794 Information Theory	702 Random Signals & Noise 703 Matrix Methods in EE 717 Microwave Circuit Design 753 Optimization Technique 763 Stochastic Estimation & Control	710 Advanced Electromagnetic Theory 796 Multiuser Detection
Control Systems	702 Random Signals & Noise 703 Matrix Methods in EE 769 Fuzzy Logic & Applications	703 Matrix Methods in EE 753 Optimization Techniques 761 Modern Control Theory	764 Digital Control Systems 768 Adaptive Signal Processing
Signal and Image Processing	702 Random Signals & Noise 703 Matrix Methods in EE 803 Digital Image Processing II	703 Matrix Methods in EE 753 Optimization Techniques 823 Digital Video Processing II	768 Adaptive Signal Processing
Integrated Electronics	703 Matrix Methods in EE 711 Advanced Carrier Injection Transistors 821 High-Performance Semiconductor Devices	703 Matrix Methods in EE 712 Advanced. CMOS Devices & IC Fabrication Tech. 726 Mixed Signal IC Design	713 Solid State Physics 730 RF IC Design 741 Design for Testability 820 Modeling & Simulation of Semiconductor Process & Devices
Digital Systems	703 Matrix Methods in EE 810 Advanced Computer Arch. 812 Advanced Topics in IC Physical Implementation	703 Matrix Methods in EE 732 Advanced Topics in Digital Systems Design 742 Advanced. Topics in Embedded Systems SW Design	741 Design for Testability
MEMS	702 Random Signals & Noise 703 Matrix Methods in EE 729 Antenna Theory & Design 789 Fundamentals of MEMS 794 Information Theory	703 Matrix Methods in EE 712 Advanced CMOS Devices & IC Fabrication Tech. 717 Microwave Circuit Design 732 Advanced Topics in Digital Systems Design	710 Advanced Electromagnetic Theory 768 Adaptive Signal Processing 798 Microfluidic MEMS 799 Nano- & Microengineering

Please note that these course offerings are subject to adequate enrollment.

Master's of Science in Computer Engineering

Master's degree in computer engineering core courses:

0306-730 VLSI Design
0306-740 Analytical Topics for Computer Engineers (W)
0306-759 Principles of Digital Interfacing (F)
0306-756 Multiple Processor Systems (S)

The graduate curriculum will require the following courses above a BS degree in computer engineering:

4 courses in core (16 quarter credits)
2 courses in graduate electives (8 quarter credits)
3 courses in concentration (12 quarter credits)
9 credits in master's thesis project
45 quarter credits total

The area of concentration builds some expertise in preparation for conducting a successful graduate thesis project in an area within the discipline of computer engineering. The student may choose graduate electives subject to the approval of his or her faculty adviser. The total of all graduate courses transferred from other appropriate institutions of higher learning may not exceed nine quarter credits and the total of 600-level courses applicable to the program will not exceed eight quarter credits. No graduate credit will be considered for courses below the 600 level. The usual RIT graduate school requirements will apply, such as a 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 Department

Robert Bowman, Department Head

Focus areas

Within electrical engineering, a student can specialize in one of five separate areas for the MS degree: *control systems, communications, digital systems, integrated electronics, and signal and image processing.*

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's of Science in Electrical Engineering

Admission requirements

Admission into graduate studies leading to the MS degree in electrical engineering requires a BSEE 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 arrange to 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 MSEE degree must satisfactorily complete the core course 0301-703, Matrix Methods in Electrical Engineering. Students are expected to take the course immediately after entering the program, since it is 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 0301-702, Random Signals and Noise. Students who want to develop minors 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 (9 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 (5 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 nine credit hours can be earned from courses available from other departments within RIT with the prior approval of the faculty/department adviser. For students transferring credits from other universities (limited to a maximum of nine hours), the total number of credits transferred from all sources outside the electrical engineering department cannot exceed nine.

Under some extraordinary circumstances, a resident full-time student may appeal the EE department and the Graduate Council for additional transfer credits.

Those electrical engineering students who have an interest in computer science as a minor 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.

Schedule of graduate courses, 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 & Applications**
0301-789	**Fundamentals of MEMS**
0301-794	**Information Theory**
0301-803	**Digital Video Processing I**
0301-810	**Advanced Computer Architecture**
0301-821	**High-Performance Semiconductor Devices**

Winter Quarter

0301-702 Random Signal and Noise
0301-712 Advanced CMOS Devices and I.C. Fabrication Technology
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
0301-823 Digital Video Processing II

Spring Quarter

0301-710 Advanced Electromagnetic Theory
0301-713 Solid State Physics
0301-730 Advanced Analog IC Design
0301-741 Design for Testability
0301-764 Digital Control System
0301-768 Adaptive Signal Processing
0301-796 Multiuser Detection
0301-798 Microfluidic MEMS
0301-799 Nano- and Microengineering
0301-820 Modeling & Simulation of Semiconductor Devices

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 & Systems
0301-630 Biomedical Instrumentation
0301-632 Fundamentals of Electrophysiology
0301-633 Biomedical Signal Processing
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 Digital Filters and Signal Processing
0301-679 Analog Filter Design
0301-685 Principle of Robotics
0301-686 Microelectromechanical Devices
0301-692 Communication Networks
0301-693 Digital Data Communications

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 about a month before the beginning of each academic quarter. Course offerings are subject to minimum enrollment requirements.

Industrial and Systems Engineering Department

Jacqueline Reynolds Mozrall, Department Head

The ISE Department 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 accelerated dual degree programs, which combine the undergraduate degree (BSIE) with each masters degree program listed above (e.g., BS/MS, BS/MEIE, BS/MESE, BS/MEEM). There is also an accelerated dual degree offered jointly with business (BS/MBA). These programs have different credit hour/degree requirements that are described in detail in the department web page (www.rit.edu/ise). The student, in conjunction with his or her advisor, formulates a program of study based on the individual's academic background, professional goals, and degree requirements.

Master of Science in Industrial Engineering

The MS in Industrial Engineering allows graduate students to customize their graduate coursework while working closely with IE faculty in a contemporary, applied research area. Current IE faculty research interests 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 will be awarded upon successful completion of a minimum of 45 credit hours that is equivalent to 9 courses and a 9-credit hour thesis.

Master of Engineering Degrees

The Master of Engineering (ME) degrees in Industrial Engineering, Systems Engineering, and Engineering Management allow graduate students to align their graduate coursework 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 their 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.

Other courses will be taught on demand

SCHEDULED COURSE OFFERINGS/EVEN YEARS (e.g., 04/05, etc.)

Fall 20041

0303-625	Concepts in Manufacturing Eng.
0303-701	Linear Programming
0303-727	Advanced Manufacturing Engineering
0303-729	Advanced Systems Integration
0303-760	Product/Process Development & Design
0303-775	Data structure Using C++
0303-790	Fundamentals of Sustainable Design

Winter 20042

0303-620	Engineering Economy
0303-702	Integer & Nonlinear Programming
0303-710	Systems Simulation
0303-734	System Safety Engineering
0303-758	Design of Experiments
0303-765	Databases for IS
0303-784	Project Management

Spring 20043

0303-711	Advanced Simulation Techniques
0303-732	Biomechanics
0303-750	Management of Quality Systems
0303-766	Manufacturing Systems
0303-801	Design for Manufacture

SCHEDULED COURSE OFFERINGS/ODD YEARS (e.g., 05/06, etc.)

Fall 20051

0303-625	Concepts in Manufacturing Eng.
0303-701	Linear Programming
0303-727	Advanced Manufacturing Engineering
0303-729	Advanced Systems Integration
0303-760	Product/Process Development & Design
0303-790	Fundamentals of Sustainable Design

Winter 20052

0303-702	Integer & Nonlinear Programming
0303-710	Systems Simulation
0303-726	Contemporary Production Systems
0303-731	Advanced Topics in Ergonomics & Human Factors
0301-758	Design of Experiments
0303-765	Databases for IS
0303-784	Project Management

Spring 20053

0303-720	Production Control
0303-750	Management of Quality Systems
0303-766	Manufacturing Systems
0303-801	Design for Manufacture

Master of Engineering in Industrial Engineering

Master of Engineering in Industrial Engineering 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, and requires a variety of skills in the academic study 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 is a discipline that 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 courses and courses from the College of Business 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 research programs, including 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. These labs are fully accessible to all ISE students.

There are ample computing facilities within these specialized labs as well as a dedicated computer PC 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., Office), database management (e.g., ACCESS, FoxPro), data acquisition (e.g., Lab View) statistical analysis (e.g., Minitab, SAS), facilities layout (e.g., AutoCAD, Factory Flow, Factory Plan), systems simulation applications (e.g., ProModel, Arena), and manufacturing software (e.g., MasterCam, material selection software).

Please note that scheduled course offerings are subject to adequate enrollment. Additional courses may be offered in addition to those listed here.

SCHEDULED COURSE OFFERINGS 2004-2005

Fall 20041		Winter 20042		Spring 20043	
0304-701	Research Methods	0304-871	Mathematics for Engineers II	0304-710	Fuel Cell Technology
0304-730	Design Project Management	0304-885	Advanced Mechanics of Solids	0304-865	Computer Implementation FEM
0304-870	Mathematics for Engineers I	0304-823	Systems Modeling	0304-816	Finite Elements
0304-758	Engineering Vibrations	0304-851	Convective Phenomena	0304-743	Control Systems
0304-840	Signal Processing	0304-847	Microscale Transport Phenomena	0304-830	Introduction to CFD Analysis
0304-838	Ideal Flows			0304-875	Advanced Aerodynamics
0304-810	Introduction to Continuum Mechanics				

SCHEDULED COURSE OFFERINGS 2005-2006

Fall 20051		Winter 20052		Spring 20053	
0304-730	Design Project Management	0304-710	Fuel Cell Technology	0304-701	Research Methods
0304-870	Mathematics for Engineers I	0304-871	Mathematics for Engineers II	0304-865	Computer Implementation FEM
0304-758	Engineering Vibrations	0304-885	Advanced Mechanics of Solids	0304-816	Finite Elements
0304-840	Signal Processing	0304-823	Systems Modeling	0304-743	Control Systems
0304-838	Ideal Flows	0304-851	Convective Phenomena	0304-830	Introduction to CFD Analysis
0304-810	Introduction to Continuum Mechanics	0304-834	Boiling & Condensation	0304-875	Advanced Aerodynamics

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

Edward Hensel, Department Head

The graduate faculty of the mechanical engineering department is dynamic and committed to professional growth. Some of the current research activities include finite elements, vibrations, robotics, signal processing and system modeling, turbomachinery flows, laser-based flow measurement, applications of computational fluid dynamics, heat transfer, and computer-aided design and manufacturing. Research also is conducted in areas such as vibration damping, micro-channel heat transfer and thermal simulation of heat exchangers and electronic devices, non-linear dynamics, and fracture mechanisms in materials. Also, there is interest in software design and development for engineering applications, experimental heat transfer, developing techniques for airfoil optimization, flow in time-varying boundaries, two-phase heat transfer, heat and moisture transport in porous media, characterization of intermetallic materials, flow boiling and fluid mixing. 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

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); ProEngineer and IDEAS (CAD/CAE software).

Master of Science in Mechanical Engineering

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, while MS thesis work carries a minimum of five credits and a maximum of nine credits.

A maximum of nine quarter credits may be transferred from graduate courses taken outside the Institute provided such courses will 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.

Kate Gleason
College of Engineering

Admission requirements

1. A bachelor of science degree in engineering or science is required.
2. If an applicant has a BS degree, but not in 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 Masters 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 & 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 & 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 & 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 & Selection
0307-712 Fundamentals of Statistics II
0307-770 Design of Experiments for Engineers

Students deficient in computational techniques are strongly advised to take 0304-874, Numerical Analysis, 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 Institute. Graduate students are allowed to take a maximum of two upper-level undergraduate (0304-6XX) electives in mechanical engineering specified in the course description section of the Undergraduate Bulletin. 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 & Air Conditioning
0304-671 Aerostructures
0304-672 Dynamics of Machinery
0304-675 Aerodynamics
0304-678 Propulsion
0304-682 Flight Dynamics
0304-694 Stress Analysis

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, energy methods in mechanics, analytical mechanics, nonlinear mechanics, fracture mechanics, heat transfer, fluid mechanics, thermodynamics, control systems, optimal control, thermal stresses, composite materials, biomechanics and viscoelasticity.

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 given at least every other year. For further information on current course offerings, the student should contact the office of the mechanical engineering department, 475-5788 or 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 advisor. An acceptable proposal, signed by the student and approved by faculty advisor and department head, is required prior to registering for thesis credits. Requirements for the degree must be complete 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

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 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 Master of Engineering 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 Engineers I
0304-823 Systems Modeling
0304-865 Computer Implementation of FEM

The program, although rooted in engineering, will be significantly interdisciplinary. By design, a student's program may range over several colleges of the Institute in assembling courses that will best help him or her meet his or her 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 (0304-870, 0304-823, and 0304-865), must be taken in the mechanical engineering department. Some possible concentration areas are in business, controls, manufacturing, materials science, thermo/fluids, and design engineering. A minimum of 48 credits are required for the master of engineering degree. Students may complete the Master of Engineering degree as a course-only program of study, with a capstone design project in a graduate elective course. Students may choose to complete a 3 month industrial internship worth 4 elective credits, or a project with paper worth 4 elective credits as one of their elective courses.

Master of Engineering in Manufacturing Engineering

This program is offered jointly by the departments of mechanical engineering and industrial and systems engineering. In this 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 a core course: 0304-801 Design for Manufacture. 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 C++ programming, engineering materials, manufacturing processes, and probability and statistics.

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.

Assistantships and scholarships

Some assistantships and scholarships may be available for full-time students. Appointment as a teaching assistant carries a 20-hour per week commitment to a teaching function and usually permits a student to take graduate work for eight credits per quarter. Appointment as a research assistant usually permits taking eight credits per quarter while the remaining time is devoted to the research effort, which often serves as a thesis subject. Information on tuition scholarships may be obtained from the Office of Part-time and Graduate Admissions, 475-2229.

Microelectronic Engineering Department

Santosh Kurinec, Department Head

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 master's 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 the master's thesis. Both programs are intended to prepare students for careers in the semiconductor industry.

The integrated circuit technology makes use of many diverse fields of science and engineering. The 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 surface 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 extraordinary 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. The undergraduate and graduate laboratories at RIT, designed for the microelectronic engineering programs, are among the best in the nation. The microelectronics engineering programs at RIT offer an unparalleled opportunity for students to prepare for professional challenge and success in one of the leading areas of engineering of our time.

Master of Engineering in Microelectronics Manufacturing Engineering

The master of engineering in microelectronics manufacturing engineering program offered by the department of microelectronic engineering at Rochester Institute of Technology provides a broad based education to students with a bachelor's degree in traditional engineering or science disciplines 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 5 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, a chemistry major 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 microelectronic related field. Elective courses may be selected from a list that includes courses such as defect reduction and yield enhancement, 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, 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. They learn how to utilize most of the semiconductor processing equipment and how to develop and create a process, manufacture and test their own integrated circuits.

Microlithography

The microlithography courses are advanced courses in the chemistry, physics and processing involved in microlithography. Optical lithography will be studied through diffraction, Fourier and image assessment techniques. Scalar diffraction models will be utilized to simulate aerial image formation and influences of imaging parameters. Positive and negative resist systems, as well as processes for IC application, will be studied. Advanced topics will include chemically amplified resists; multiple layer resist systems; phase shift masks, and electron beam, x-ray and deep UV lithography.

Laboratory exercises include projection system design, resist materials characterization, process optimization, 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 the lecture and laboratory. 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 at RIT. 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.

Master of Engineering schedule **Credits**

Fall

0305-701,	Microelectronics I, Lab	4
0305-721,	Microlithography Materials and Processes, Lab	4
	Transition	4

Winter

0305-702,	Microelectronics II, Lab	4
0305-731,	Microelectronics Manufacturing I, Lab	4
	Transition	4
0305-xxx	Elective 1	4

Spring

0305-703	Microelectronics III, Lab	4
0305-722,	Microlithography Systems, Lab	4
0305-732,	Microelectronics Manufacturing II, Lab	4
0305-xxx	Elective 2	4

Summer

	Internship	5

Master of Science in Microelectronic Engineering

The objective of the master of science program is to provide an opportunity for students to perform a master's level research as they prepare for entry into the semiconductor industry or a Ph.D. program. The program requires strong preparation in the area of microelectronics, takes two years to complete and requires a thesis.

The prerequisites include a BS in engineering (such as electrical or microelectronic engineering), including one year of study of device physics and fabrication technology. Students from RIT's BS in microelectronic engineering will meet these prerequisites. Students who do not have all of the prerequisites can take these courses at RIT and still complete the master of science program in two years. The prerequisite courses completed during the first few quarters at RIT will not count toward the 36 credits worth of graduate courses required for the MS degree.

The program consists of eight master's level (700 level or higher) courses, including five core courses and three elective courses. In addition, all graduate students in this program are required to take a variable-credit (1 or 0 credits) seminar/research course each quarter that they are at RIT. Up to 4 credits will be allowed to count toward the required 36 hours. A nine-credit thesis will be required of all students in this program that includes dissertation submission and oral defense. The total number of credits needed for the master of science in microelectronics manufacturing engineering is 45.

Sample MS schedule

(For those who are not graduates of RIT's microelectronics engineering program)

Fall		Credits
0305-701	Transition Microelectronics I, Lab	4
0305-721	Transition Microlithography Materials and Processes, Lab	4
0305-560	Transition Device Physics	4
0305-801	Seminar/Research	1

Winter

0305-702	Transition Microelectronics II, Lab	4
0305-731	Microelectronics Manufacturing, Lab	4
0305-801	Seminar/Research	1
	Full time Equivalency	3

Spring

0305-703	Transition Microelectronics III, Lab	4
0305-xxx	Elective I	4
0305-732	Microelectronics Manufacturing, Lab	4
0305-801	Seminar/Research	1

Summer

Research

Fall

0301-711	Physics of Bipolar Devices	4
0305-xxx	Elective 2	4
0305-801	Seminar/Research	1
0305-889	Thesis	3

Winter

0301-704	Semiconductor Process and Device Modeling	4
0301-712	Physics & Scaling of CMOS	4
0305-801	Seminar/Research	1
0305-899	Thesis	3

Spring

0301-713	Solid State Physics	4
0305-801	Seminar/Research	1
0305-899	Thesis	3
0305-xxx	Elective 3	4

Sample MS schedule

(For RIT microelectronics engineering graduates)

Fall		Credits
0301-711	Physics of Bipolar Devices	4
0305-801	Seminar/Research	1
0305-xxx	Elective I	4
	Full-Equivalency	3

Winter

0301-712	Physics & Scaling of CMOS	4
0305-704	Semiconductor Process and Device Modeling	4
0305-801	Seminar/Research	1
	Full-time Equivalency	3

Spring

0301-713	Solid State Physics	4
0305-732	Microelectronics Manufacturing, Lab	4
0305-xxx	Elective	4
0305-801	Seminar/Research	1

Summer

Research

Fall

0305-xxx	Elective 3	4
0305-801	Seminar/Research	1
	Full-time Equivalency	4
0305-889	Thesis	3

Winter

0305-801	Seminar/Research	1
0305-899	Thesis	3
	Full-time Equivalency	8

Spring

0305-801	Seminar/Research	1
0305-899	Thesis	3
	Full-time Equivalency	8

Core courses

0305-704 Semiconductor Process and Device Modeling
0301-711 Physics of Bipolar Devices
0301-712 Physics & Scaling of CMOS
0301-713 Solid State Physics
0305-732 Microelectronics Manufacturing II, Lab

Elective courses

0305-707 Nanoscale CMOS
0305-708 Non Classical Nanoelectronic Devices
0305-722 Microlithography systems, Lab
0305-830 Defect Reduction and Yield Enhancement
0305-870 Microelectromechanical Systems
0305-890 Special Topics

Examples of recent graduate theses topics

The Integration of Si-Based Resonant Interband Tunnel Diodes with CMOS
Process Development of a Novel Pseudo Two-Phase CCD Pixel
Concept, Design, Simulation, and Fabrication of an Ultra-Scalable Vertical MOSFET
Modeling and Fabrication of Optically Resonant Periodic Structures
Electrical Characterization and Pulsed DC Sputtered Zirconium Oxide

Admission requirements

Applicants must hold a baccalaureate degree in electrical, chemical engineering, materials science and engineering, physics or the equivalent, from an accredited college or university in good academic standing. 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 support the candidacy.

Plan of study

The student, in consultation with his or her advisor, formulates a plan of study based on the student's academic background, program objectives, degree requirements and course offerings and submits to the department office within the first year. If necessary, the plan of study may be requested for revision with the recommendation of the advisor.

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. Appointment as a research assistant also permits taking up to 12 credits per quarter while the remaining time is devoted to the 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 stipend. Applicants for financial aid should write directly to the department head for details.

The John D. Hromi Center for Quality and Applied Statistics

Donald D. Baker, Director
Joseph G. Voelkel, Chair

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 at RIT, 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 an advanced certificate in statistical quality for students whose primary interest is in the field of quality.

The distinguished faculty members of the center include winners of the American Society for Quality's Shewhart Medal, Grant Award, Brumbaugh Award and Shewell Award, and fellows of ASQ and the American Statistical Association.

Masters of Science in Applied Statistics

The MS degree program, which requires 45 credits (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 BS/MS program. Cooperative education options are also available. The MS degree is also available in a distance-learning format, which is especially appealing to students who are unable to attend classes on campus.

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 for their companies. Those who do not fit the full-time professional category typically use the degree to gain employment either as statistical consultants or quality engineers.

The MS program is primarily intended for those 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.

ADVANCE CERTIFICATES IN APPLIED STATISTICS

Two advanced certificate programs, in statistical quality and in statistical methods for product and process improvement, are also available. Each requires 18 credits (equivalent to six courses) and is available to part-time students. In both programs, the courses are a subset of the MS program courses and are offered both on campus and in the distance-learning format. The advanced certificate in statistical quality is aimed primarily at quality managers and quality engineers, or those who aspire to such positions. The advanced certificate in statistical methods for product and process improve-ment is especially designed for engineers who want a good education in those 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.

Full time or part time

Full-time students (four courses per quarter) complete the MS degree in one year if they make normal progress. 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 RIT's departments of Mathematics and 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 quarters of work and study.

Distance learning

Since 1979, when the university offered its first distance-learning course, RIT has been a leader in the use of electronic forms of communication for course interaction. Our distance-learning courses have the same objectives, rigorous workload, tuition, and academic credit as our on-campus courses. Both the MS degree and the advanced certificate are available through distance learning. No distinction is made between taking courses on campus or through distance learning. In particular, programs earned partly or entirely through distance learning are registered by the New York State Education Department and are accredited by the Middle States Association of the Council for Higher Education. Every distance-learning course offered by the center meets RIT's rigorous standards. Each course features either videotapes or CDs, professionally prepared for distance learners, not simply videos of recent lectures captured on tape. Courses also include weekly live chat sessions or asynchronous discussion groups, using an electronic medium that allows students and instructor to interact.

Because distance-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 holders of a baccalaureate degree from an accredited college or university who have an acceptable GPA and mathematics credits, including acceptable grades in university-level calculus through multiple integration, and acceptable probability and statistics college credits, equivalent to 0307-711 and 712. Admission to the certificate program in statistical quality requires a baccalaureate degree with the probability and statistics requirement 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 (or a computer-based TOEFL of at least 213). Courses are offered on an open-enrollment basis, which supports RIT's commitment to recurrent education.

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 waived.

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.

Nonmatriculated 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.

ADVANCED CERTIFICATE IN STATISTICAL QUALITY

Requirements

1. Basic familiarity with statistical software
   Students should have basic familiarity with MINITAB, or equivalent, statistical software. This may be obtained by self-study; by 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 0307-742 Statistical Computing, 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 of 3.0 (B) for graduation; 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, or equivalent, statistical software. This may be obtained by self-study; by 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 0307-742 Statistical Computing, 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

Three elective courses, selected from this list with the help of an adviser:

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
0307-782 Quality Engineering

The reliability course also requires calculus with integration as a prerequisite.

3. Other requirements
   The candidate must attain an overall average program grade of 3.0 (B) for graduation—see the department secretary for more details.

Master of Science in Applied Statistics

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. Each of the following four career options allow students to specialize:

Quality Engineering

0307-721 Statistical Process Control
0307-731 Statistical Acceptance Control
0307-781 Quality Management
0307-782 Quality Engineering

Industrial Statistics

0307-856 Interpretation of Data
0307-862 Reliability Statistics I
0307-875 Empirical Modeling
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

Reliability

0307-762 Reliability Management
0307-824 Probability Models
0307-862 Reliability Statistics I
0307-863 Reliability Statistics II

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 advisor. 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 the advisor's 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 average program grade 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 process further in the program. The exam 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.

Procedure

To be considered for admission, prospective students must file an 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:

Director of Graduate Enrollment Services
Rochester Institute of Technology
Bausch & Lomb Center
58 Lomb Memorial Drive
Rochester, NY 14623-5604

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. Nonmatriculated students seeking advisement should contact the department secretary.

Faculty

Both full-time and adjunct faculty 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.

More information

More information, including course schedules and interim updates to this information, is available from the center's Web site, www.rit.edu/eng/cqas.

Design Development and Manufacturing Department

Master of Science in Product Development

Mark W. Smith, Director
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 R&D, 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—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. Companies need innovative leaders who have the systems perspective necessary to commercialize products and services. The master of science in product development (MPD) program at RIT provides the educational foundation that technical professionals need for high-impact roles in product and technology innovation.

The master of science in product development program is for engineers, scientists, and technical professionals who aspire to product development leadership positions throughout their organizations. Emphasis is placed on cross-functional, end-to-end product development and the integrated systems perspective needed to conceive, create, launch, and support complex products. The two-year program, beginning each December, has been designed in an executive format where students continue to work at their companies while taking classes on Friday each week.

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. (See Web site for more information.)

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.

Kate Gleason
College of Engineering

Format
The two-year MPD program begins each December and continues for eight consecutive instructional 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 who offer the product development program. See the MPD Web site for descriptions of prior trips.

Curriculum
The MPD program is a 60-credit program 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 ("cohort" model).

Core Courses

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 Financial Accounting Systems

Elective courses
Electives 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 another from engineering. Recommended electives may include such offerings as Management of Technology, Managing Research and Innovation, New Venture Creation, Integrated Product and Process Design, Systems Dynamics, Sustainable Design, advanced Topics in Product Development, and others.

Capstone Project
Students complete a project (eight credits) during the final two quarters of the MPD 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 Web site 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 their students 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 directly related to product development. This experience must reflect continued growth and professional 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; and
- 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 Web site.

For further information about the MPD program:

Rochester Institute of Technology
Product Development Program
111 Lomb Memorial Drive
Rochester, NY 14623-5608

585-475-7971
585-475-7955 (fax)
mpdmail@rit.edu
www.mpd.rit.edu

Master of Science in Manufacturing Leadership (MML)

Mark W. Smith, Director
Christine Fisher, Coordinator
585-475-7971, mml@rit.edu, www.mml.rit.edu

The master of science in manufacturing leadership was developed jointly by the College of Business and the Kate Gleason College of Engineering to educate graduates to lead manufacturing teams and organizations for successful competition in a global economy. It is targeted at experienced professionals moving to mid- and senior-level positions in manufacturing, operations, supply chain management, and process improvement. The program is especially valuable for those who have responsibility for the development and leadership of business or technical processes. Many tools and techniques involved in "black belt" improvement training are integral to the program. The curriculum includes business and engineering courses with a strong emphasis on integration. Unifying themes include leadership and teaming, total quality, manufacturing engineering, process engineering, total cost, and operations strategy.

The MML program is designed to accommodate part-time students and is usually completed in two academic years, but students may register during any quarter and take more time to complete the program if necessary. A capstone project, oriented to the solution of a manufacturing management problem or to a technically related business process, enables students to apply new skills and capabilities to the solution of a pressing real-world problem.

Curriculum

The graduate program of study consists of 48 credits of engineering and business courses and an integrative capstone project. The courses are:

0102-740 Organizational Behavior and Leadership
0303-625 Concepts in Manufacturing Engineering
0303-784 Systems and Project Management
0303-766 Manufacturing Systems
0102-747 Managing Manufacturing Resources
0303-750 Management of Quality Systems
0101-794 Cost Accounting in the Manufacturing Environment
0303-760 Product/Process Development Design
0303-720 Production Control
0303-762 Manufacturing Systems Modeling & Performance Analysis
0303-723 Facilities Planning
0303-891 Capstone Integrative Project

Format

The MML program was designed to be completed in two academic years (excluding summers), where each new class is admitted in the fall quarter and continues throughout the program as a cohort group. Classes are held in the late afternoon and evening on two days each week, 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, consistent with time or financial restrictions. Candidates should follow the normal admission process. Contact the program office for more information.

Students may also take a reduced number of 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 (B); at least two years experience in a manufacturing-related organization or related 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; and
- An interview with the MML admissions team (after other application materials are received).

All application materials are available from the MML program office or Web site.

Prerequisite knowledge

Admitted students must possess knowledge and skills at the introductory course level in:

- Probability and statistics
- Engineering economy or basic finance
- Basic properties of materials
- 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

585-475-2287 or 585-475-7971
585-475-7955 (fax)
mml@rit.edu

Microsystems Engineering Department

Doctor of Philosophy in Microsystems Engineering

Dr. Mustafa A. G. Abushagur, Director

The integration of entire systems into micron scale devices and the sensing technology to interface these devices to the real world is 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 chip to sense, analyze, and communicate. This enabling technology will add functionality and reduce cost 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.

Rochester Institute of Technology offers a unique educational and research program that leads to a Ph.D. in Microsystems Engineering. This multi-disciplinary 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 Rochester Institute of Technology to combine resources and create the Doctoral Program in Microsystems Engineering. This multidisciplinary degree provides the student with a fundamental background in sciences and engineering which should prepare the student for a successful career.

The mission of the Ph.D. 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-, sub-micron-, 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 seeks to become nationally and internationally recognized 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 Ph.D. Program in Microsystems Engineering Committee, which includes Core Faculty members from 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 Ph.D. in Microsystems Engineering is first of its kind in the nation.

Curriculum

A total of 92 quarter credit hours of graduate course work are required of which 36-quarter credit hours are in designated microsystems core courses. An additional 24-quarter credit hours (minimum) are expected in dissertation research. Students are also required to complete three quarters of Seminar (1 credit per semester) in their home departments. 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 sitting for 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 & 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
  - 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
  - At least one of the sequences is chosen outside of the student's department

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 will be allowed).

Goal of the Preliminary Examination

- To determine the student's ability to conduct independent research
- To 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, and 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 advisor, 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 (which includes a Focus Area). Much of this course work will support the dissertation research conducted in Phase III. This phase will be completed when the student has finished most of 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 advisor 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

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Swaminathan Madhu, MA, University of Madras; MS, University of Tennessee; Ph.D., University of Washington—Professor, Signal Processing

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Brian K. Thorn, BS, Rochester Institute of Technology; MS, Ph.D., Georgia Institute of Technology—Associate Professor, Applied Statistics, Sustainable Design

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Moises Sudit, BS, Georgia Institute of Technology; MS, Sanford University, Ph.D., Purdue University—Visiting Associate Professor, Operations Research

Mechanical Engineering Department

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Elizabeth A. DeBartolo, BS, Duke University; MS, Ph.D., Purdue University—Assistant 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, India; Ph.D., Mississippi State University—Professor, Computational Fluid Dynamics, Aerodynamics

Surendra K. Gupta, B.Tech., Indian Institute of Technology, India; MS, University of Notre Dame; Ph.D., University of Rochester—Professor, Materials Science, Computer Software, Image Processing

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Mark Kempski, BS, Purdue University; MS, Ph.D., State University of New York at Buffalo—Professor, Biomechanics

Kevin Kochersberger, BS, MS, Ph.D., Virginia Polytechnic Institute and State University—Associate Professor, Signal Processing, Structural Dynamics, Design

Jeffrey D. Kozak, BS, Gannon University; MS, Ph.D., Virginia Polytechnic and State University of Virginia—Assistant Professor, Aerodynamics and Turbomachinery

Alan H. Nye, BS, MS, Clarkson College; Ph.D., University of Rochester—Associate Department Head; Professor, Solar Physics, Lasers

Ali Ogut, B.Ch.E., Hacettepe University, Turkey; MS, Ph.D., University of Maryland—Professor, Fluid Mixing, Thermal Fluid Sciences

Brett J. Pokines, BS, MS, State University of New York at Buffalo; Ph.D., Virginia Polytechnic Institute and State University—Assistant Professor, Microelectromechanical Systems

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Frank Sciremammano Jr., BS, MS, Ph.D., University of Rochester—Professor, Geophysical Fluid Dynamics and Environmental Engineering

Josef S. Torok, BS, University of Akron; MS, Ph.D., Ohio State University—Professor, Theoretical and Applied Mechanics, Applied Mathematics, Dynamic Systems

P. Venkataraman, B.Tech., Indian Institute of Technology; MS, Ph.D., Rice University—Associate Professor, Optimal Control, Fluid Mechanics, Optimal Design

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Microelectronic Engineering Department

Santosh Kurinec, BS, MS, Ph.D., University of Delhi, India—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, BS, MS, Rochester Institute of Technology; Ph.D., University of Rochester—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—Professor, Advanced Microlithography

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, Statistical Consulting, Nonparametric Methods, Categorical Data Analysis, Visualization Methods, Exploratory Data Analysis

Anne M. Barker, BA, Nazareth College; MS, Rochester Institute of Technology; Ph.D., University of Rochester—Assistant Professor, Taguchi Methods, Design of Experiments, Statistical Process Control, Regression Analysis

Thomas B. Barker, BS, MS, Rochester Institute of Technology—Associate Professor, Statistical Experimental Design, Taguchi Methods, Psychometric Scaling, Regression Analysis

Stephen M. LaLonde, BS, State University of New York College at Potsdam; MS, Ph.D., Syracuse University—Assistant Professor

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

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, Microsystems Engineering Ph.D. Program, Professor

Kate Gleason
College of Engineering

Note: Prerequisites are within parentheses at the end of the course description.

Electrical Engineering

0301-702 Random Signals & 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) **Credit 4**

0301-703 Matrix Methods in Electrical Engineering
This course deals with the elements of discrete transforms and linear algebra. Topics include: discrete-time signals and systems, the Z-transform and its application, solution of difference equations, concepts of stability, discrete Fourier analysis, DFT, FFT algorithms, topics in linear algebra and matrices, eigenvalues and eigenvectors, functions of matrices, matrix transformations and operations, matrix poly-nominals and the Cayley-Hamilton theorem, state variables, relation between transfer functions and state variable representation of LTI systems, state transition matrix, and solution of state equations. **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 semi-conductor 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 waveguides, 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. (0301-724, 670 and a course in computer architecture) **Credit 4**

0301-729 Antenna Theory & Design
The primary objective is to study the fundamental principles of antenna theory applied to the analysis and design of antenna elements and arrays including synthesis techniques and matching techniques. Topics include antenna parameters, linear antennas, array theory, wire antennas, microstrip antennas, self and mutual impedances, equivalence principle, Huygen's principle, aperture antennas, traveling wave antennas, reflector antennas. (0301-703) **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) **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, 345, 347, 365, 545) **Class 4, Credit 4**

0301-733 Robust Control
One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop system to continue performing satisfactorily despite large variations in the (open-loop plant dynamics. This course will provide an introduction to the analysis and design of robust feedback systems. Topics include overview of linear algebra and linear systems, H_2 and h∞ control, spaces, modeling and paradigms for robust control; internal stability; nominal performance (asymptotic tracking); balanced model reduction; uncertainty and robustness; H_2 optimal control; H∞ 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) **Credit 4**

0301-742 Advanced Topics in Embedded Systems SW Design
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) **Credit 4**

0301-749 Speech & 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, sampling 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 non-uniform, 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 are involved. **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 nonsmooth 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. (0301-700, 701, 513) **Credit 4**

0301-763 Stochastic Estimation & 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 noncasual 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) **Credit 4**

0301-764 Digital Control Systems Design
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) **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) **Credit 4**

0301-769 Fuzzy Logic & 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. **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) **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) **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) **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 & 703 or permission of instructor) **Class 4, Credit 4**

0301-798 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 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 & Microengineering
This course focuses on analysis and synthesis of nano- and microelectromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and microengineering, 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 - introduction and fundamentals. Time varying image formation models including motion models and geometric image formation. Spatio-temporal sampling including sampling of analog and digital video, two-dimensional rectangular and periodic sampling, sampling of 3-D structures, and reconstruction from samples. Sampling structure conversion including sampling rate change and sampling lattice conversion. Two-dimensional motion estimation including optical flow based methods, block-based methods, Pel-recursive methods, Bayesian methods based on Gibbs Random Fields. Three-dimensional motion estimation and segmentation including methods using point correspondences, optical flow and direct methods, motion segmentation, and stereo and motion tracking. (0301-779 or permission of instructor) **Class 4, Credit 4**

0301-810 Advanced Computer Architecture
This course covers advanced topics in computer and processor architecture. Topics include: pipeline and parallel processor design, branch tables and prediction algorithms, single issue versus multiple issue processor architectures (VLIW, SIMD, superscalar), cache architectures, quantitative and qualitative evaluation of instruction set architectures. For specific evaluation and grading contact the assigned instructor before registration. (0301-240, 345, 347, 365, 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 & 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. (0301703 and 615 or 761) **Class 4, Credit 4**

0301-820 Modeling & Simulation of Semiconductor Process & Devices
Semiconductor process and device simulation techniques are introduced. Standard process simulators—ATHENA is used for modeling and simulation of process technologies—crystal growth, 0301821eposition, 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 High-Performance Semiconductor Devices
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. (graduate standing, 0301-713, 820) **Class 4, Credit 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 subbanding 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 & 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 nano-electromechanical 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. (0301-460, 544, 610, 631 and permission of instructor) **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 minimum of 6 credits and a maximum of 12 credits. The usual is 9 credits. **Credit variable**

Industrial & 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. **Credit 4 (F)**

0303-702 Integer & 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 Logistics Management
This course is designed to give students the knowledge and experience of logistics problem solving. Attention is given to such problems as transportation and network planning, inventory decision-making, facility location planning, vehicle routing, and logistics forecasting. Students will learn to use several quantitative tools commonly used in the field of logistics, which include algebra, geometry, differential calculus, and mathematical programming. (0303-701 and 702 or equivalent) **Class 4, Credit 4 (S)**

0303-710 Systems Simulation
Methods of modeling and computer simulation of stochastic and dynamic manufacturing systems are discussed. A high-level simulation language such as ProModel, ARENA, etc., will be used to model the system and examine system performance. Model validation, design of simulation experiments, variance reduction techniques and random number generation will be discussed as time permits. (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. JOT/Lean, agile manufacturing), job shop scheduling, aggregate production planning, and Material Requirement Planning (MRS II). 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. (Requires acceptance into the MML program or permission of instructor; 060106-747, 0303-701, 1016-352) **Credit 4 (W-MML only)**

0303-723 Facilities Planning
This course addresses the planning, design, and utilization of fixed assets such as buildings, capital equipment, tooling, offices, storage space, and other support equipment. Activities involved in facilities planning include manufacturing, storage and warehousing, and support functions such as design, engineering, and maintenance. Topics include: strategic considerations in facilities planning; product, process, and schedule design; determining flow, resource, and space requirements; layout at the plant, department and workplace level; design of storage and retrieval policies; incorporating lean principles; quantitative design and analysis tools; and implementation. Students will understand facilities planning from a strategic and tactical perspective as well as the link between business goals and design and engineering activities. Visits to local companies 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. (Fifth-year standing or permission of instructor) **Class 4, Credit 4**

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 placed 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, 525, 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 (F)**

0303-730 Ergonomics & 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/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 NIOSH Guidelines and various hazard analysis and utilization techniques. Students also are exposed to various theories of accident causation, research methodology and ways of evaluating safety programs and related research. Professional elective. **Class 4, Credit 4 (S) (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)**

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 is a survey course designed to expose upper-level students to managerial aspects of quality control systems. 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. (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 & Development
This course covers the principles of product, manufacturing process and supply chain development in an integrated fashion. It will draw on Fine's FAT 3DCE and double helix models as frameworks within which to examine 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. Requires acceptance into the MML program or permission of instructor; 0303-625, 0303-766 or 0303-764) **Credit 4 (F)**

Kate Gleason
College of Engineering

0303-762 Manufacturing Systems Modeling & Performance Analysis
This course comprises a study of two interrelated subjects to manufacturing and service delivery systems: mathematical modeling (queuing at the awareness level), and manufacturing simulation modeling and analysis at the application level. A high-level manufacturing system modeling language will be utilized to model systems and examine performance. The course also introduces the methods used to establish and analyze manufacturing performance measures, including methods engineering; manufacturing performance measurement systems and value-added performance measures. (Requires acceptance into the MML program or permission of instructor; 0106-747) **Credit 4 (W)**

0303-764 Operations Management & 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, systems 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 or instructor permission) **Credit 4**

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 (W)**

0303-766 Manufacturing Systems
The 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 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**

0303-779 Engineering Capstone
For the Master of Engineering programs in Industrial Engineering, Engineering Management, and Systems Engineering. Students in these programs must demonstrate leadership in a field related to industrial engineering, engineering management, or systems engineering through the investigation of a discipline-related topic (i.e., requires a presentation/seminar and paper on discipline-related topic). The general intent of the engineering capstone is to demonstrate the students' knowledge of the integrative aspects of a particular topic area. The capstone should draw upon skills and knowledge acquired in the program. (restricted to MEIE, MEEM, MESE) **Credit 0 (F, W, S, SU)**

0303-780 Foundations in Product Development
A modular course designed to lay the groundwork for the rest of the program and its overarching 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 cores, 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 & 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, lean thinking, cost, schedule planning and control, structuring of performance measures and metrics, technical teams and project management, information technology support of teams, risk management, and process control. Course delivery consists of lectures, speakers, case studies, and experience sharing, and reinforces collaborative project-based learning and continuous improvement. (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 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**

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. (Requires acceptance into the MPD program or permission of instructor) **Credit 4 (F)**

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, genetic algorithms), 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**

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 (F, W)**

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 causal 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 790 **Fundamentals of Sustainable Design**
The product life cycle is reviewed from various perspectives and highlights the leverage over material, process, and environmental costs available at the design phase. **Class 4, Credit 4 (F)**

0303-791 **Lifecycle Assessment/Costing**
This course will introduce students to the challenges posed when trying to determine the total costs and environmental impacts associated with a product/process design across its entire lifecycle. Various assessment and costing models and their inherent assumptions will be reviewed and critiqued. A Life Cycle Engineering and Economic Decision System will be introduced. **Class 4, Credit 4 (S)**

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. **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 instructor) **Class 4, Credit 4 (W)**

0303-890 **Research & 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 (0–9) (F, W, S, Su)**

0303-891 **Capstone Integrative Project**
For the MS program in manufacturing management and leadership (MML). The purpose of the capstone Capstone project Project is for students to demonstrate integrative applications of knowledge and skills that they have acquired through the program. A capstone project will be 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 multidisciplinary or multifunctional in nature and will have significant impact on one or more competitive capabilities of the organization. A suitable project will constitute the equivalent of one quarter course workload per student, but could be larger. Individual effort and team performance will be assessed. (Requires acceptance into the MPD MML program) **Credit 4 (W)**

0303-892, 893 **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 their Master of Science degree. This course is specifically designed for students enrolled in the dual degree BS/MS 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 electrochemical 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. (permission of instructor) **Class 4, Credit 4**

0304-730 **Design Project Management**
Training for multidisciplinary studies in project management for leadership of product development and design. Topics include product and systems development processes, organization and teams, intellectual property, the business case for product development, defining customer needs, defining systems and module requirements and functions, reverse engineering, benchmarking, concept generation and selection, product portfolios, project and system architectures, and performance modeling. Students use the concepts and tools discussed throughout the course in a team-based environment with the goal to guide and lead a senior project. **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**

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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 & 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 **Fundamentals of Aerosol Mechanics in Biologic Systems**
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 matrix 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 & 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 & 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 microscale 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 Thermo 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
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 and 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) **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 & 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, layouts, 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 (F)**

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 is 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 is 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 IC fabrication. A thorough overview of vacuum technology is presented to familiarize the student with the challenges of creating and operating in a controlled environment. Chemical Vapor Deposition (CVD) and electroplating technologies are discussed as methods of film disposition. 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 disposition and plasma and reactive ion etching. **Class 3, Lab 3, Credit 4 (S, SU)**

0305-704 Semiconductor Process & 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)**

0305-707 Nanoscale CMOS
An in-depth study of principles and practice of scaling-driven CMOS front and back end processing. Front end processing involves steps up to the fabrication of active devices that include wells, isolation, gate insulator, gate electrode, and source/drain formation. Many device effects observed in submicron MOSFETs are impacted by the process technology used to fabricate them. Back end topics include interconnect modeling and delay, Low-k dielectric and copper damanscene processes. The use of novel substrates such as strained silicon, SiGe and Ge will be described. Introduces students to the Semiconductor Industry Association (SIA) International Technology Roadmap for Semiconductors (ITRDDS). Exposes students to research in the next-generation of nanometer-scale CMOS with device concepts that take advantage of quantum mechanical phenomena 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 gates, and ultra shallow source/drains. Back end topics include interconnect modeling and delay, Low-k dielectric and copper damanscene processes. The use of novel substrates such as strained silicon, SiGe and Ge will be described. (0305-560, 701, 702, 703) **Class 4, Lab 0 Credit 4 (W)**

0305-708 Non-classical Nanoelectronic Devices
This course will introduce students to the material contained in the Emerging Research Devices section of the ITRS roadmap. The ERD section of the roadmap is divided into two general areas: near-term structures (FinFETs, dual-gate planar FETs, etc.) and CMOS replacement ideas (resonant tunneling devices, single electron transistors, carbon nanotube field effect transistors). For each technology entry, students will be exposed to the physical principles underlying the operation of the devices, as well as the pros and cons of the structures from the industry standpoint. The course will culminate in a final project paper/presentation where students will debate the merits of the various technologies, and make their own predictions as to how the roadmap will shape together in 15 years. (0305-560, 701, 702, 703) **Class 4, Lab 0, Credit 4 (S)**

0305-721 Microlithography Materials & 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)**

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)**

0305-731 Microelectronics 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 Microelectronics 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 intended only 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 Defect Reduction/Yield Enhancement
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 micro-sensors, probes, lasers, and actuators. Topics include basic principles of MEMS and fabrication methodologies. The accompanying laboratory will carry out design and fabrication of MEMS structures/devices using microfabrication techniques. **Class 3, Lab 3, Credit 4 (W, S)**

0305-890 Special Topics
This is a variable credit, variable special topics course that can be in the form of a regular course or independent study under faculty supervision. Some of the topics are SOI device technology, compound semiconductors and devices, quantum devices, and Nanotechnology. **Class 4, Lab 0, Credit 4**

0305-899 Thesis
The master's thesis in microelectronic engineering requires the student to prepare a written thesis proposal for approval by the faculty; select a thesis topic, adviser and committee; present and defend thesis before a thesis committee; submit a bound copy of the thesis to the library and to the department; prepare a written paper in a short format suitable for submission for publication in a journal; complete course work and thesis within a seven-year period; register for one credit of Continuation of Thesis each school term (except summer quarter) after the 45 credits required for the master's degree until the thesis is completed. (Graduate standing in MS in microelectronic engineering) **Class 0, Lab 0, Credit variable 0–9 (F, W, S, SU)**

Computer Engineering

0306-710 Network Modeling, Design & Simulation
The course comprises theories for network design and modeling and case studies to apply the theories. Mathematical models, such as queuing theory, graph theory, and optimizing 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 for 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**

0306-720 Electronic Design Automation
The creation of large, complex electronic systems has grown beyond the capabilities of any number of people 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 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. (0306-561 or equivalent; 0306-630/730 also suggested) **Class 4, Credit 4 (F, W)**

0306-722 Advanced Computer Architect
This course will emphasize the impact of VLSI and communication issues on computer architecture. Topics covered will include highly concurrent, multiprocessor and fault-tolerant computer systems as well as data flow architectures. Modeling techniques for system verification will also be included. (0306-551 or 0605-720) **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. **Class 4, Lab 2, Credit 4 (F, S, SU)**

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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. **Class 4, Lab 2, Credit 4 (W, 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 will include techniques for analyzing discrete time signals and systems. Other major course areas are symbolic logic and discrete optimization techniques, including computer representations of networks, shortest-path problems and minimum spanning tree problems. (1016-265 or 0602-705 and preferably 0605-700) **Class 4, Credit 4 (W)**

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. **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 typology of interconnection networks used in the design. The suitability of various architectures in meeting demands is studied in depth including the study of representative examples of current commercial machines. Students will complete programming assignments on a parallel computer illustrating practical issues. A review and analysis of a commercial parallel processor system or an active research area is required; written review presented in class. (0306-722) **Class 4, Credit 4 (S)**

0306-758 Fault Tolerant Digital Systems
Formal models and concepts in fault diagnosis. Test generation. Design for testability techniques. Design techniques to achieve fault tolerance. System evaluation techniques. The design of practical fault-tolerant systems. Fault-tolerant design of VLSI circuits and systems. (0603-400 or 0301-650 or 0301-750 or 0306-561, 0306-550 or 0603-720) **Class 4, Credit 4**

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 (W)**

0306-762 Concurrent & Embedded Software 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 sections, producers and consumers, and resource allocation are examined. Practical examples and exercises are used to illustrate key points and evaluate design tradeoffs. (Permission of instructor) **Class 4, Credit 4 (S)**

0306-763 Embedded & Real-time Systems
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) **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 hands on 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)m navigation (formulating a plan to get where we want to go) and control (following a desired path) will be given. The emphasis will be on algorithms and techniques. (0306-452) **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. (0306-553, 1016-331, fifth-year standing in computer engineering 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. (0306-553 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 Master's 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 0–4**

0306-795 Advanced Networking
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, 0306-740, 4003-318 or equivalent) **Class 4. Credit 4**

0306-800 Graduate Project
This course will fulfill the graduate project requirement under the non-thesis option of the MS degree in computer engineering. The student must obtain departmental approval as well as approval from the appropriate faculty members who supervise the project before registering for this course. **Credit 0–5**

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**

Quality & Applied Statistics

0307-701 Statistical Concepts
A service course, designed for those not majoring in statistics, that emphasizes statistical thinking instead of mathematical manipulations. This is a concept-based introduction to the subject. Topics include sampling and experimentation, methods of displaying and summarizing data, probability, correlation, and formal statistical reasoning. This course is given as an online learning course only. It does not count as credit for, and is not a prerequisite for, either the advanced certificate or the MS degree. (None) **Credit 4**

0307-711 Fundamentals of Statistics I
For those taking statistics for the first time. Topics: organizing observed data for analysis, insight, and understanding of variability; learning to understand probability as the science of uncertain events; concepts of random variables and their associated probability models; meaning and practical use of the central limit theorem. This course does not count as credit for either the advanced certificate or the MS degree. (Consent of department) **Credit 3 or 4**

0307-712 Fundamentals of Statistics II
Continuation of 0307-711. Topics: concepts and strategies of statistical inference for making decisions about populations on the basis of sample evidence; tests for independence and for adequacy of a proposed probability model; separation of total variability of a system into identifiable components through analysis of variance; regression and correlation models for studying the relationship of a response variable to one or more predictor variables. This course does not count as credit for either the advanced certificate or the MS degree. (0307-711 or consent of department) **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 consent of department) **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. (0307-712 or consent of department) **Credit 3 or 4**

0307-742 Statistical Computing
A course in statistical computing using SAS and MINITAB statistical software. The course will cover basic procedures; the creation, manipulation and analysis of data; graphics; and macros. (0307-712 or consent of department) **Credit 3**

0307-751 Math for Statistics
This is a survey of mathematical tools of some of the more mathematically rigorous statistics courses of the MS program. The topics include partial and higher-order differentiation, various methods of integration, the gamma and beta functions, and a brief overview of linear algebra, all in the context of application to statistics. (The course assumes calculus prerequisites for the program have been met; it is not a substitute for the program's calculus requirements.) (0307-712) **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) **Credit 3**

0307-770 Design of Experiments for Engineering & 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-CQAS students. It does not count as credit for either CQAS advanced certificates or the CQAS MS degree. (1016-314 or 1016-351 or 1016-391 or 0307-712 or equivalent) **Credit 4**

0307-772 Applied Survey Design & Analysis
This course is an introduction to sample survey design with emphasis on practical aspects of survey methodology. Topics include: survey planning, sample design and selection, survey instrument design, data collection methods, and analysis and reporting. Application areas discussed will include program evaluation, opinion polling, customer satisfaction, product and service design, and evaluating marketing effectiveness. Data collection methods to be discussed will include face-to-face, mail, Internet and telephone. (0307-712) **Credit 3 or 4**

0307-781 Quality Management
This course focuses on ASQ's Certified Quality Manager body of knowledge and introduces process improvement methodologies, including the Six-Sigma framework. Topics include quality standards and awards, organization for quality, customer satisfaction, continuous improvement, team management, quality costs, project management, process improvement methodologies. **Credit 3 or 4**

0307-782 Quality Engineering
This course, in conjunction with 0307-781, covers the non-statistical elements in ASQ's Certified Quality Engineer body of knowledge. Topics include quality philosophies, elements of a quality system, quality planning, supplier management, quality auditing, quality and management tools, process and material control, measurement systems, and safety and reliability. **Credit 3 or 4**

0307-784 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) **Credit 3 or 4**

0307-802 Design of Experiments II
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 non-standard 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 nonstandard 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. (1016-253 or equivalent and 0307-712 or equivalent) **Credit 3**

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0307-822 **Theory of Statistics II**
Building on foundations laid in the first course, this second course in statistical theory answers some of the "How?" and "Why?" questions of statistics. Topics include the sampling distributions and the theory and application of point and interval estimation and hypothesis testing. (0307-821) **Credit 3**

0307-824 **Probability Models**
An introduction to stochastic processes, this course is intended to encourage a greater appreciation of statistical theory, 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 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. 0307-801 is useful; 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 software. Topics include principal components, factor analysis, canonical correlation, discriminant analysis, cluster analysis and scaling. (Basic matrix algebra; 0307-712. 0307-830 is useful.) **Credit 3 or 4**

0307-834 **Multivariate Statistics-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 CQAS advanced certificates or the CQAS 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; 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, 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 cannot be made, with an emphasis on applications. This includes certain analyses of ranked data and ordinal data. The course provides a review of hypothesis testing and confidence-interval construction. Topics include sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, run tests, chi-square tests, rank correlation, rank order tests and Kolmogorov-Smirnov statistics. (0307-801) **Credit 3**

0307-856 **Interpretation of Data**
How to use statistics in troubleshooting processes and interpreting data. Topics include coordination of use of statistical measures, employing control charts in data analysis, outlier tests, analysis of small-sample data, narrow-limit gauging, analysis of means for variables and attributes data, identification of assignable causes. (0307-801) **Credit 3**

0307-862 **Reliability Statistics I**
A methods course in statistical aspects of reliability. Topics include applications of normal, log-normal, exponential and Weibull models to reliability problems; censored data; probability and hazard plotting; series systems and multiple-failure modes; strength and stress models; maximum likelihood estimation; introduction to accelerated-life models and analysis. (1016-252 or equivalent, 0307-801, 841; 0307-822 is recommended as 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, Mood's theorem, attributes plans, variables plans for process parameters and proportion nonconforming, sampling schemes including Dodge-Romig and ANSI/ASQC 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 and 0307-824) **Credit 3**

0307-867 **Decision Making with Bayesian Methods**
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. (0307-712) **Credit 3**

0307-872 **Survey Sampling & Estimation**
This course focuses on sample size determination and parameter estimation in complex sample 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) **Class 3**

0307-873 **Time Series Analysis & 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**

0307-874 **Stochastic Process Control**
The aim of statistical process control is to detect process instability, find its cause, and eliminate it. In contrast, stochastic (or engineering, or automatic) process control (APC) is designed to automatically react to process instability by adjusting the process back to target. This course shows how to build empirical models to develop control algorithms to design robust process-adjustment schemes. Topics include interface between SPC and APC; transfer functions; fundamentals of APC, such as feedback control, feedforward control, comparison to classical feedback control approaches (including PID controllers); advanced APC topics. (0307-873) **Credit 3 or 4**

0307-875 **Empirical Modeling**
A course in model building based on the application of empirical data gathered through appropriate experimental design and analyzed through regression techniques. Topics include choosing the appropriate response variable; psychometric scaling; experimental design methods, including response surface and methods of steepest ascent/descent; deconfounding methods in fractional/factorial designs. A major project involves the development of a product from initial market research through specification setting via experimental design, and manufacturing quality assurance through process simulation. (0307-802 and 841) **Credit 3**

0307-880 Design & 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; major/minor 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 utility function, parameter design and tolerance design leading to improved products and processes at lower costs. During the presentations of the Taguchi concepts, full attention is given to the controversial aspects of these methods, the basis for the controversies, and alternatives to the methods that follow better statistical protocol. Students get to see the power of Robust Design in a set of carefully constructed exercises that illustrate the major components of parameter design and tolerance design. (0307-802) **Credit 3**

0307-886 Sample Size Determinant
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 advisor 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 department) **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) **Credit 3, 6 or 9**

0307-899 Individual. Achievement Project
Research project under faculty supervision for students working for the MS degree. (Consent of department) **Credit 1–9**

Microsystems Engineering

0308-711 Microsystems 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 microoptoelectromechanical (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 microoptical 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 Ph.D. 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 mircosystems 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 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 microelectromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and microengineering, 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**

0308-811 Microsystems Design & Packaging
Design considerations; design process; mechanical design; photonic design; modeling; system integration; packaging technologies; microsystems packaging; assembly of microsystems; testing; design case studies. (0308-711) **Class 4, Credit 4**

0308-821 Micro-optics & 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 & 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**

0308-890 Dissertation & Research
Research in an appropriate topic as arranged by doctoral candidate and dissertation advisor in fulfillment of the dissertation requirement. Department approval required. **Credit 0–4**

0308-990 Doctoral Dissertation I
Research in an appropriate topic as arranged by doctoral candidate and dissertation 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**

College of Imaging Arts and Sciences

Programs

Master of Fine Arts in Imaging Arts

Master of Fine Arts

Master of Science for Teachers

Master of Science

Advanced Certificate

⇆ *Online learning option available*

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: the 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 and 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. Graduate students in the college received the prestigious Graduate Film Honorarium of the Princess Grace Award; a computer graphics design alumnus was awarded a Golden Globe; an emerging filmmaker was awarded the overall grand prize in the Adobe Flash Point Student Design Contest for multimedia projects; four computer graphics design students have won awards in the Macromedia Student Web Design Contest, and two computer graphics design alumni received awards of excellence from the Society of Technical Communications, both locally and internationally, in 2003. Students also received a "finalist" designation in the People's Choice Awards at the Macromedia International User Conference and Exhibition. 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 baccaluareate 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 involves 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 may be admitted who needs additional undergraduate study requirements. 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 is 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 nonmatriculated student

Students who have a baccalaureate degree and who wish to take particular courses may be admitted as nonmatriculated students to courses for which they are qualified. They may receive graduate credit, but it may not be submitted toward degree requirements. Students deficient in admission requirements or competence may take undergraduate courses, as advised, to qualify for admission.

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. (See also 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 total) or 213 (computer-based total). 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 page six of 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, so 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 as indicated on page 9 of the admissions application. This statement should indicate in what manner the Institute's graduate program would assist in attaining these goals. See the application form for directions.
- **Portfolio:** See below.

Portfolio guidelines for graduate applicants

Graduate students applying for admission into the School of Art, School of Design or School of American Crafts, 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 name and address (and e-mail address if available). While every precaution is taken to ensure proper care and handling, the Institute assumes no responsibility for loss 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. Please include project name, date, media used to create it, and purpose.

Please send portfolio and application materials to:

Office of Graduate Enrollment Services
Rochester Institute of Technology
58 Lomb Memorial Drive
Rochester, NY 14623-5604
585-475-2229

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.)

School of Design

The portfolio should contain samples of your work including a combination of drawings, 2D design, 3D design, photo imaging, web site 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, or DVD, or a combination of these is acceptable. They must be stand-alone files that will run on a MAC or PC.

School of Photographic Arts and Sciences, Imaging Arts-Photography

The portfolio must consist of 20 examples of the applicant's best work, 35 mm slides are preferred, displayed in 9 1/2" x 11" vinyl protective slide pages. CD-ROM and DVD are also acceptable if applicant's work warrants their use. For more information on the application process, see page 107.

Bevier Gallery

During the year, the Bevier Gallery presents a continuing series of important exhibitions planned to present new directions in the fields of the arts, design and the crafts, as well as to honor the works of the past. The gallery, architecturally impressive and a part of the college, serves to enrich the cultural life of the community and the Institute at large and 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

Graduate work pursued at other institutions to the extent of 12 quarter hours (nine semester hours) 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 one and one-half 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 to complete assignments, will be taken into consideration in grading.

Graduate scholarships, assistantships, and other financial aid

If you are interested in being considered for a graduate scholarship, check the box on page 7 of the graduate application packet and submit with the other required application materials by February 15.

Applications for graduate and teaching assistantships are usually mailed out 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, 585-475-5778; Imaging Arts-Photography, 585-475-2884; Imaging Arts-Animation, Film, Video, 585-475-7403.

Need-based financial aid such as loans and grants may be investigated through the Office of Financial Aid.

School of Art

Master of Fine Arts in Studio Art

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 to 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:

Major Concentration	**Credits**
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 in their portfolio through accurate translations 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:

Major Concentration	**Credits**
Major	36
Minor	15
Electives	15
Humanities	10
Thesis	14
Total	90

Entrance Requirements

One year of biology

Three of the following:

Histology	**Embryology**
Immunology	**Genetics**
Pathology	**Cellular Physiology**

Admission requirements

For U.S. and Canadian students, 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. (See also 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 total) or 213 (computer-based total). 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 Studio

The master of science for teachers studio offers a major in the fine arts studio program with supporting courses, if desired, from graduate offerings in other schools and departments of the Institute. Major fine arts studio classes focus on painting, printmaking, sculpture, drawing, and new forms. This MST may lead to permanent teacher certification if provisional or temporary certification was earned as an undergraduate. The MST is also suitable for the BA or BFA student wishing more advanced study. This program may be completed in one year and may start or be completed in summer sessions.

Teacher education and certification

The teacher of arts and crafts in college or high school, the teacher or administrator of art programs in schools and community centers, the instructor in occupational skills and the private teacher of art will find in the depth and breadth of the master's program a way of extending and improving the skills and content background necessary for effective teaching. The student who possesses a baccalaureate degree with provisional certification for the teaching of art of industrial arts in the State of New York can achieve permanent certification within the structuring of the master of science for teachers program.

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 or art education.

A student is accepted into the program with the understanding of full-time status unless granted part-time status at admission.

The following general pattern of studies covers degree requirements:

Major Concentration	Credits
Fine Arts Studio	24
Humanities, Art History	8
Forms of Inquiry	2
Minor Concentration	9
Electives	5
Total	48

MST Art Education

The MST-Art Education concentration leads toward permanent art N-12 certification to teach in the public schools of New York State 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:

MAJOR CONCENTRATION	Credits
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

ADVANCED CERTIFICATE IN NON-TOXIC INTAGLIO PRINTMAKING (GCNIP)

To offer technical training and retraining for artists and printmaking professionals who want to gain a comprehensive working knowledge in non-toxic intaglio printmaking techniques, which includes a study of methodology and aesthetic applications.

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		48

School of Design

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 MFA programs take the following courses: Design History Seminar, Design Theory and Methods Seminar, Design Issues Seminar, and Design Research. These cross-disciplinary courses help to foster a sense of community among students and faculty and encourage dialog 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 individual 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

Nancy Ciolek, Coordinator
585-475-7472, nacfad@rit.edu

An exciting, internationally recognized graduate program, the computer graphics design MFA combines knowledge of design theory, methodology, and aesthetics with skills in the application of current software and hardware developments. Technology has changed how society communicates and this has affected how designers integrate knowledge and skills with technology. The MFA program will help you develop an understanding of advanced design principles, visualization, semiotics, aesthetics, and digital technology to be successful in developing computer-based design applications.

The program represents and fosters a multimedia approach to the design of electronic communication that synthesizes interface design, sound, animation, three-dimensional modeling, human factors, semiotics, authoring languages, digital video and imaging. Our students focus on experimental and practical approaches toward the design of interactive digital media, including: exhibit design, training and educational modules, and web site development. All students are required to complete a thesis project.

As part of the entrance requirements, applicants 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.

Master of fine arts in computer graphics design

Major	55
Elective/Minor	15
Design Core*	12
Thesis	8
Total	**90**

Master of Fine Arts in Graphic Design

Deborah Beardslee, Coordinator
585-475-2664 E-mail: 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.

Master of fine arts in graphic design

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 deign work with respect to environmental issues, the meaning of artifacts, and critical analysis. Extensive course work using 3D 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.

Master of fine arts in industrial design

Major	42
Electives/Minor†	18
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 Institute. This is done with approval from the individual programs' graduate adviser/coordinator: The minor should support the goal of the MFA degree.*

School for American Crafts

The 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, etc. 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 the 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, etc. 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.

Master of fine arts

Major	42
Humanities	10
Graduate Forum	3
Electives (optional minor)	15 (18)
Thesis	18
Total	**90**

Admission requirements

For U.S. and Canadian students, 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. (See also 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 total) or 213 (computer-based total). 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 about to enter 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. All aspects of metalsmithing are explored. 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, teaching, etc., 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

The School of Print Media offers a master of science degree program in print media. For the latest information, visit our Web site: www.rit.edu/~spms.

Admission requirements

Prior to being admitted to a master of science degree program, applicants must satisfy 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 on the 4.0 scale.
- A completed application form, including official transcripts, personal statement, and two letters of recommendation.

GRE requirements

- Applicants from foreign universities should submit Graduate Record Examination (GRE) scores, as should students with transcripts using grading metrics other than the 4.0 GPA model. These scores also can be considered for applicants whose grade point average is below 3.0.
- International students must submit TOEFL scores of 550 or higher (paper-based test) or 213 or higher (computer-based test).

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 March 1. Applications received later than March 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)**
2081-xxx	**ST: Print Media Graduate Foundation**
2082-303	**Professional & Technical Writing**

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. The Print Media Graduate Foundation, must be taken at RIT.

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 you with an in-depth understanding of technical printing and imaging concepts and exposure to high-level research methods. Although this program provides a broad exposure to the graphic communications 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 graphic design, depending upon interest and aptitude.

Curriculum

2081-701	**Research Methods in Graphic Arts**	**4**
2081-709	**Trends in Print Technology Research**	**4**
2081-711	**Tone & Color Analysis**	**4**
2081-716	**Grad Materials and Processes I**	**4**
2081-717	**Grad Materials and Processes II**	**4**
2081-XXX	**Cross-Media Workflow I**	**4**
2081-XXX	**Cross-Media Workflow II**	**4**
0307-712	**Fundamentals of Statistics II or equivalent**	**4**
2081-890	**Thesis**	**4**
	Minor Concentration/Electives	**12**
Total		**48**

Minor concentrations and elective options

Minor concentration and elective 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. Recent students have focused on information technology or business, depending upon interest and aptitude. 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 coordinator.

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 communications 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.

Online option

The digital revolution has begun. 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 every before.

The master of science degree is available online. For working professionals who do not 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 present 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 towards 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)

2080-717	**Markets for Print & Graphic Media**	**4**
2081-709	**Trends in Print Technology Research**	**4**
2081-711	**Tone & Color Analysis**	**4**
2081-721	**Digital Printing & Publishing**	**4**
2081-723	**Contemporary Publishing**	**4**
2081-728	**Database Publishing**	**4**
2081-742	**Document Processing Languages**	**4**
2081-xxx	**Technical Practicum**	**4**
2081-840	**Research Projects**	**4**
	Electives	**12**
Total		**48**

The fast track

The graphic communications industry is large and extremely varied and continues to be driven by changes in technology. Graduates from our master's program are working as professionals in production management, marketing, technical sales, research and development, quality assurance, administration, teaching and other areas. A graduate degree from RIT's School of Print Media pays off by attracting leading employers from every graphic discipline. The program placement rate has been close to 100 percent for the past several years.

A graduate degree from the School of Print Media can be your road map 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.

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. You'll 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. There are more than 500 computer workstations dedicated for student use in the College of Imaging Arts and Sciences alone.

Prepress & Publishing Lab (PPL)

The PPL features 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 & Color Lab

This lab contains 21 fully configured and networked flat-screen "superdrive" Macintosh G4 computers loaded with the latest design, imaging, and multimedia software.

Advanced Publishing Lab

This lab contains 14 fully configured and networked Macintosh G4 computers loaded with cutting edge graphics, imaging, and database publishing software.

Color Proofing Lab

This lab features the Kodak Approval digital color proofing system, in addition, to other state-of-the-art color proofing systems.

Desktop Scanning Lab

This facility reflects the growing range of image capture tools available to professionals, including high-end flatbed and drum scanners.

Color Measurement Lab

This lab addresses the growing industry focus on managing color. This facility contains spectrophotometers, colorimeters and color profiling and color analysis software.

Digital Printing Lab

RIT's digital printing lab is one of the few educational facilities in the world that houses a full array of digital color printing equipment.

Web Offset Lab

In 2001, Heidelberg announced a partnership with RIT based on the donation of a world-class Sunday 6-color commercial web offset press.

Integrated Printing Lab

This lab contains a Heidelberg Speedmaster six-color press, a Komori perfecting press, a QuickMaster-DI press, and a Creo Trendsetter. For flexography, there is a Mark Andy multicolor web press.

School of Film and Animation

The School of Film and Animation offers the master of fine arts in imaging arts with concentrations in computer animation, traditional animation, and film.

Master of Fine Arts in Imaging Arts Animation, Film, Video Production

Malcolm Spaull, Coordinator, MFA Program, Film and Animation
585-475-7403 E-mail: mgscdm@rit.edu

The master of fine arts program in imaging arts emphasizes a broad interpretation of animation and filmmaking 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 2D computer animation; 3D computer animation; drawing for animation;, stopmotion animation; and documentary, experimental, and narrative film are available. Successful completion of the program enables a student to seek careers in film or animation production.

Program goals

1. Provide students the opportunity to use animation, filmmaking, and other imaging arts as a means to pursue a career and earn a livelihood.
2. Provide students 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 then 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 2D and 3D 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 in Computer Science and Information Technology. 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 work in three areas of study:

	Credits
1. Concentration (computer animation) designed to give depth of experience in the area of the student's primary interest. All students complete required course and other course work is selected from many flexible alternatives.	**40**
2. History and aesthetics of film and related art forms	**14**
3. Programming	**4**
4. Electives	**14**
5. Research Seminar, Graduate Seminar, and Research & Thesis	**18**
Total	**90**

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 work in three areas of study:

	Credits
1. Concentration (film) designed to give depth of experience in the area of the student's primary interest. All students complete required course; other course work is selected from many flexible alternatives.	**40**
2. History and aesthetics of film and related art forms	**19**
3. Electives	**15**
4. Research Seminar, Graduate Seminar, and Research & Thesis	**16**
Total	**90**

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 12 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, and School for American Crafts as well as from 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. Personal interviews, whether in person or by phone, 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 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 to graduate study, students must submit an official transcript of their undergraduate degree(s), an acceptable portfolio (slides, videotape, CD, 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 director 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 B or better graduate work is transferable toward the 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 to submit their best visual work in their portfolio whether computer generated or not. Photography, painting, film, animation, illustration, Web page 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.

1. 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.
2. 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. Admission to the animation program occurs on a rolling basis; that is, students can be admitted in any quarter, although fall is preferable. 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 candidate at the top of the list.

Submit a list of work included on video with any tapes, which includes the title and length of the work as well as your role in production. Include a table of contents on a CD or DVD. Slides should be submitted in sleeves, **not** in a carousel.

Submit the portfolio with the application material to Graduate Enrollment Services. Send your materials to:

Rochester Institute of Technology
Office of Graduate Enrollment Services
58 Lomb Memorial Drive
Rochester, NY 14623-5604

585-475-2229
gradinfo@rit.edu

Grades and time limit

The average of all grades for graduate credit taken at the Institute 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 Web page design. The Rochester area is enhanced by such outstanding resources as the International Museum of Photography and Film at the George Eastman House and the Visual Studies Workshop and has historically been noted as a center for experimental film.

The MFA program in imaging arts computer animation at RIT is unique in that it is the only such program housed in a School of Film and Animation with full production facilities and the additional support of highly specialized faculty in photography, imaging science, computer science and information technology, and printing.

School of Photographic Arts and Sciences

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 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. Successful completion of the program enables a student to seek careers in education, museum or gallery work or as a self-employed professional.

Photography

This concentration provides students with the opportunity to pursue a rigorous course of study in fine art photography and related media. Contemporary fine art photography incorporates the study of practice, history and criticism, from the beginnings of photography to present-day digital and experimental techniques. 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 in photography-related studies.

Art electives

Elective courses are available in animation, video, multimedia, screen writing, 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 the opportunity to use photography as a means to pursue a career and earn a livelihood.
2. Provide students the opportunity to use photography 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.

The faculty

The MFA in imaging arts program is supported by a staff of 40 full-time faculty members from the School of Photographic Arts and Sciences and adjunct faculty members from the George Eastman House, International Museum of Photography and the Visual Studies Workshop, as well as RIT's Image Permanence Institute.

Faculty and course work are also available from the School of Print Media, School of Art, School of Design and School for American Crafts, as well as from the College of Liberal Arts.

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, a statement of purpose detailing what attributes they bring to graduate study, as well as expectations and professional goals they wish to achieve, and a minimum of three letters of reference. All correspondence concerning applications or catalogs should be addressed to the director 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 B or better graduate work 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 imaging 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 35mm slides or a CD.
- Submit no more than 20 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.
- Do not use glass slide mounts or thick tape to label or mask slides.
- Number slides 1 to 20 in the order you wish them projected.
- Include a slide list.
- Include a self-addressed, STAMPED envelope for the return of your slides. We cannot return slides lacking sufficient postage or adequate packaging. We will retain the slides of admitted applicants.
- Submit your portfolio with the application material to:

Rochester Institute of Technology
Office of Graduate Enrollment Services
58 Lomb Memorial Drive
Rochester, NY 14623-5604

585-475-2229

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 Master of Fine Arts in Imaging Arts: Photography

The MFA degree encompasses work in three areas of study:

	Credits
1. Concentration designed to give depth of experience in the area of the student's primary interest. All students complete required courses and other course work selected from many flexible alternatives.	**40**
2. History and Aesthetics and History and Criticism of Imaging Arts and related media	**15**
3. Electives	**19**
4. Research Seminar, Graduate Seminar and Research & Thesis	**16**
Total	**90**

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 Institute 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.

SPAS Photography Gallery

The SPAS Photography Gallery supports the exhibition of graduate thesis work, student work and works of contemporary imagemakers. Students who wish to exhibit their work in the gallery are required to adhere to the published gallery guidelines.

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 directions are available in the MFA Guide for Students and Faculty.

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 and exhibition purposes. Graduates must also leave the school one set of not less than 20 slides or a videotape or CD 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 area in art institutions and 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 at RIT, there are resources to be found in two major additional institutions heavily involved in photographic education and innovation: George Eastman House, International Museum of Photography and the Visual Studies Workshop.

The MFA program in imaging arts at RIT 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.

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 College at Geneseo; MFA, Syracuse University—Assistant 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; Master's in Studio Art, New York University—Associate Professor

Thomas R. Lightfoot, BA, BFA, University of Connecticut; MFA, Instituto Allende, San Miguel de Allende, Gto., Mexico; M.Ed., Ed.D., Columbia University Teachers College—Associate Professor

James Perkins, BA, Cornell University; ABD, University of Rochester; MFA, Rochester Institute of Technology—Assistant Professor

Luvon Sheppard, BFA, MST, Rochester Institute of Technology—Professor

Alan D. Singer, BFA, Cooper Union; MFA, Cornell University—Professor

Bruce Sodervick, BS, Indiana University; MFA, Southern Illinois University—Professor

Carole Woodlock, BFA, Alberta College of Art; MFA, Concordia University—MST Program Coordinator; Assistant Professor, Art Education

School of Design

Deborah Beardslee, BFA, Syracuse University; MFA, Virginia Commonwealth University—Associate Professor, MFA Program Coordinator, Graphic Design

Nancy A. Ciolek, BFA, MFA, Indiana State University—Associate Professor, MFA Program Coordinator, Computer Graphics Design

Chris B. Jackson, BFA, Alfred University; MFA, Rochester Institute of Technology—Assistant Professor, Computer Graphics Design

Robert M. Kahute, BID, BFA, Syracuse University; MFA, Rochester Institute of Technology—Professor, Industrial Design

Robert P. Keough, BFA, MFA, Rochester Institute of Technology—Professor, Computer Graphics Design

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—Administrative Chairperson, School of Design; Associate Professor

Bruce I. Meader, BFA, MFA, Carnegie Mellon University—Associate Professor, Graphic Design

David Morgan, BFA, Brigham Young University; MFA, Rhode Island School of Design—Assistant Professor; MFA, Program Coordinator, Industrial Design

Marianne O'Loughlin, BA, St. Bonaventure University; BFA, MFA, Rochester Institute of Technology—Associate Professor; Program Chair, New Media Design and Imaging, BFA

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—Associate Professor; Director of Visualization

James C. Ver Hague, BS, Massachusetts Institute of Technology; MS, Rensselaer Polytechnic Institute; BA, MFA, State University of New York at Buffalo—Professor, Computer Graphics Design

School for American Crafts

Andy Buck, BA, Virginia Commonwealth University; MFA, Rhode Island School of Design—Assistant 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 College at Alfred—Assistant Professor, Glass

Wendell Castle, BFA, MFA, University of Kansas—Artist-in-Residence; Professor; Chair in Contemporary Crafts

Julia Galloway, BFA, New York State College of Ceramics; MFA, University of Colorado—Assistant Professor, Ceramics

Richard Hirsch, BS, State University of New York College at New Paltz; MFA, Rochester Institute of Technology—Professor, Ceramics

Max L. Lenderman, BS, MS, Indiana State University; MFA, University of Kansas—Professor, Weaving and Textile Design

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—Associate Professor; Chair, School for American Crafts

Richard Tannen, BS, Cornell University; Cert. of Mastery, Boston University—Professor, Wood

Leonard A. Urso, BFA, MFA, State University of New York College at New Paltz—Professor, Metals

School of Film and Animation

Cat Ashworth, MA, State University of New York at Buffalo—Assistant Professor

Carl (Skip) Battaglia, BA, Boston College; MS, Syracuse University; MFA, State University of New York at Buffalo—Professor

Jack Beck, BA, Denison University; MFA, University of Iowa—Assistant Professor

Johannes Bockwoldt, MA, Temple University in Philadelphia—Visiting Assistant Professor

Adrianne Carageorge, MFA, Ohio University—Film/Video Production Program Chair; Associate Processor

Tereza Flaxman, BFA, University of Oregon; MFA, School of Visual Arts in NYC—Visiting Assistant Professor

Stephanie Maxwell, BA, University of California at Los Angeles; MFA, San Francisco Art Institute—Associate Professor

Howard Lester, BA, Cornell University; MFA, University of California at Los Angles—Administrative Chair; Professor

Naomi Orwin, MA, Institute of Transpersonal Psychology; BA, University of Chicago—Visiting Assistant Professor

Duane Palyka, BA, BFA, Carnegie Mellon University; MFA, University of Utah—Associate Professor

Lorelei Pepi, BFA, Rhode Island School of Design; MFA, California Institute of the Arts—Assistant Professor

Johnny Robinson, BFA, MFA, Syracuse University—Animation Chair, Assistant Professor

Arnie Sirlin, BA, University of Maryland—Visiting Assistant Professor

Malcolm Spaull, MFA, Rochester Institute of Technology—MFA Coordinator, Professor

College of Imaging Arts and Sciences

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—Assistant Professor

Dan Larkin, BFA, Rochester Institute of Technology; MFA, Bard College—Assistant Professor

Therese Mulligan, BA, University of Missouri; MA, Michigan State University; Ph.D., University of New Mexico—Professor; Program Chair

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

E. Kenny 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—Assistant Professor, Print Media Management; Graduate Program Chair

Franziska Frey, Ph.D., Swiss Federal Institute of Technology—Assistant Professor, Materials and Digital Imaging

Michael Kleper, MS, Rochester Institute of Technology—Paul & 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; Program Chair, Graphic Media

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—Associate Professor, Pre-press Imaging

Franz Sigg, BS, MS, Rochester Institute of Technology—Research Associate, Test Targets

Mark Watts, BFA, MS, Rochester Institute of Technology—Assistant Professor, Electronic Imaging; New Media Program Chair

Interdisciplinary Studies

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**

Graduate Study

2037-785 **Forms of Inquiry**
The exploration and organization of forms of inquiry in the fields of art, craft, 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, 702 **Art Education Methods/Materials**
Intensive study of curriculum in terms of teaching materials for both studio and appreciation aspects of elementary, early secondary and high school art education. Includes studio and elementary school teaching experience. **Credit 5 (F, W) (offered on sufficient demand)**

2011-820 **Seminar in Art Education**
Evaluation and study of the practice teaching experience. Discussion of the professional role of the art teacher in terms of professional associations, supervision, teacher training and research. A final project on some intensively studied aspect of art education is required. **Credit 3 (S) (offered on sufficient demand)**

2011-860 **Practice Teaching**
A seven-week full-time practice teaching experience in secondary school, including professional duties of the art teacher in humanities courses, publication advising, audiovisual work and supervision. Supplements the studio-theoretical education. Meets the state education requirements. **Credit 9 (S) (offered on sufficient demand)**

Illustration

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**

Medical Illustration

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 software and hardware as a resource for generating titles, charts and graphs, schematics and illustrations as vehicles to meeting instructional and communicative needs. Students will learn the various techniques available and will apply those techniques while designing pamphlets, in-house publications and poster exhibits. **Credit 3**

2020-783 **Anatomical Studies**
Sketches drawn from human dissection are translated into instructional illustrations using watercolor wash and 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 I 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 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 & 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. **Credit 3–14 (offered every quarter)**

Fine Arts

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: Litho 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 3 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 3 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. (Completion of Non-Toxic Intaglio Printmaking I or portfolio review) **Credit 4**

2021-743 Non-toxic Intaglio Printmaking III
The third of 3 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 handetching techniques. (Completion of Non-Tox Intaglio Printmaking I & II) **Credit 4**

2021-761, 762, 763, 764 Fine Arts Studio Graduate Elective
Traditional sculptural concepts will evolve through a variety of processes and materials-predominately clay, plaster, cement, stone, paper and metal. The human figure is presented as a subject for study and for use as a springboard to invention. **Credit 3**

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**

2021-790, 791, 792 Fine Arts Studio Graduate II
Fine Arts Studio: enter into a critical discourse and examination of ideas and relationships in the fine arts. Critiques, guest artists, lectures and discussion along with studio production. Painting: develop painting skills in oil, acrylic, watercolor, drawing through individual studio investigation under the direction of fine art faculty. Sculpture: sculpture concepts are explored through a variety of processes and materials, including clay, plaster, cement, stone, wood and metal. These concepts reveal themselves through separate sections devoted to the human figure, installation, public art or other contemporary manifestations of sculpture. Printmaking: non-toxic printmaking techniques and processes are the means for students to develop along independent lines and directions for contemporary fine art printmaking. All areas: **Credit 3/qtr**

2021-890 Research & 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 & 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, 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. (Image Forms, Design Research) **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-generation tools range from traditional to electronic media as appropriate for specific projects. An extended studio project in form analysis and articulation is the primary activity. **Credit 4**

2010-717 Graduate Systems Design
This course investigates various approaches toward visually and conceptually organizing components of graphic design problems (i.e. words, photographs, illustrations, diagrams, abstract shapes, textures, lines, colors, 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. (Image Forms, Design Theory and Methods Seminar, Graduate Typographic Design) **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, wayfinding systems, graphic user interfaces). (Image Forms, Design Research, Design Theory and Methods Seminar, Graduate Typographic Design, Graduate Design Applications, Design History Seminar, Graduate Systems Design) **Credit 4**

2010-721 Project Development & Evaluation
This course involves the application of theory and methods to the planning of a design project. Each student is responsible for formulating a comprehensive project development plan, including the use of evaluation method(s) during appropriate stages of the project. **Credit 3**

2010-722 Graduate Graphic Design Applications
This course requires students to apply formal aesthetic principles in systematically solving applied problems on thematic, content-intensive topics. Actual design assignments may include both digital and/or print applications. Emphasis is placed on the relationship between form and communication. Projects are defined, structured, and implemented by the students. (Image Forms, Design Research, Design Theory & Methods Seminar, Graduate Typographic Design) **Credit 4**

2010-724 Graduate Graphic Design Topics
This course is tailored to the specific needs of the students enrolled. Potential topics may include: design planning, human factors, interface design, writing and design, design for new media, etc. This course involves research, processes, and design applications relevant to the selected course topic. (Image Forms, Design Research, Design Theory and Methods Seminar, Graduate Typographic Design, Graduate Design Applications, Design History Seminar, Graduate Systems Design Project Development and Evaluation, Graduate Information Design) **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**

2010-731 Graduate Design Forum
This course will introduce School of Design graduates to the graduate programs, foster a sense of community among students and faculty, acquaint students with various resources within the Institute and Rochester and encourage an on-going dialog on the commonality of design philosophy, process, practice and goals across the design disciplines. Through the lectures, selects readings, a team project, presentations, and writing assignments, students will use this forum to become more familiar and comfortable with a free exchange of ideas about design, broaden their awareness of important interdisciplinary design considerations, and sharpen their communication and design criticism skills. **Credit 3**

2010-761 Graphic Design Elective
Please refer to description for Graphic Design (MFA Major) below. **Credit 3 (offered every quarter)**

2010-861 Graphic Design Thesis Planning
This is the first in the sequence of courses focused on the initiation of the thesis project. Students are exposed to strategies to establish project content, planning and scheduling, and research. The product of the course is a fully articulated thesis plan. (Image Forms, Design Research, Design Theory & Methods Seminar, Graduate Typographic Design, Design Issues Seminar, Design History Seminar, Graduate Systems Design, Graduate Design Applications) **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. (Image Forms, Design Research, Design Theory & Methods Seminar, Graduate Typographic Design, Design issues Seminar, Design History Seminar, Graduate Systems Design, Graduate Design Applications, Project Development & Education) **Credit 4**

2010-863 Graphic Design Thesis Implementation
This is the third and 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 is also a focus of this course. (All major graduate graphic design studio courses) **Credit 4**

2010-890 Thesis: Graphic Design
The development of a thesis project initiated by the student and approved by a faculty committee is required. Primarily the solution of an applied design problem, the thesis must also include a written report and participation in a graduate thesis show. **Credit 3–14 (offered every quarter)**

Computer Graphics Design

2014-701 Introduction to Computer Graphics
New opportunities are available to computer graphics designers that did not exist just a few years ago. During the quarter, students will be introduced to the ideas, concepts, uses, and general principles of computer graphics systems and interactive media as it relates to the rapidly growing communications media. Through visual semiotics, the course will provide a conceptual framework to designing and implementing multimedia applications. The students will be expected to complete assigned projects and readings. (First year computer graphics design major or permission of the instructor.) **Credit 4**

2014-711 Digital Video
Use of digital video cameras for motion recording and the use of storyboarding, titling, editing, and software to create and format digital Quick Time movies for multimedia productions. (First year computer graphics design major or permission) **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. **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. (First year computer graphics design major or permission of instructor) **Credit 4**

2014-718 QTVR & 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 3D 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. **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. **Credit 4**

2014-781 Authoring Computer Graphics Design
Exposure to computer graphic algorithms, design heuristics, design methodology and program structures of two-dimensional imagery for multimedia design. Projects involve programming in an authoring language. **Credit 3**

2014-782 3-D Computer Graphics Design
This course is an introduction to desktop 3D visualization. It also expands on previous visualization skills and design experiences to include fundamentals for more advanced studies in 3D animation, virtual spaces, and multi-dimensional navigation spaces. (First year computer graphics design or permission of instructor) **Credit 4**

2014-784 Digital Typography
A study of today's digital typography. Hands-on experiences in the production of type messages for digital video, special effects, instructional media, and the web. This will include an understanding of type as a dynamic element. A number of software will be used in the production of these type messages. **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. (First year computer graphics design major or permission of instructor) **Credit 4**

2014-786 **Computer Generated Animation**
This course will cover two-dimensional key frame, film loop, real-time recording and other digital techniques to automatically create animation applications for film, video, interactive, and multimedia and Web presentations. (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 2D/3D visual concepts, virtual reality, interactivity and sound to develop games of their own. (Second-year 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, software, and hardware can be introduced in a timely manner. **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. (First year computer graphics design major or permission of the 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. (Second year computer graphics design major or permission) **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. **Credit 4**

2014-831 **Thesis Planning**
This lecture and research 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**

2014-840 **Thesis Project 1**
This course enables the student to research and develop their thesis project. Research, surveys, resource investigation, time management, project organization, dialogue and meetings with thesis advisors are part of the course content. (Design Research Seminar and Thesis Planning) **Credit 3**

2014-841 **Thesis Project 2**
This course is the culmination of the final thesis project. Usability testing, project refinement, time management, project documentation, dialogue and meetings with thesis advisors are part of the course content. Participation in a thesis defense, final thesis documentation, and presentation are required. (Thesis Research, Thesis Planning, and Thesis Project I) **Credit 3**

2014-890 **Thesis: Computer Graphics Design**
The development of a thesis project initiated by the student and approved by a faculty committee. Primarily a creative production, the thesis must also include a project report and participation in a graduate thesis show. **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**

2035-708 **Furniture Design Graduate**
Experience in the design of furniture for a defined sector of the contract market is acquired through a project exercise involving industry collaboration. **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 software tools competency through assigned exercises and creative projects. The objective is student understanding of the nature, location, and use of all tools commonly available at the professional level for electronic surface modeling in degree 3 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 3 and higher B-spline curves and surfaces. (Advanced Computer Modeling 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 software competency directed toward team working. The emphasis is in strategizing the process of modeling complex and difficult shapes to achieve results typically expected by professional project team members, through assigned exercises and creative projects. Included are the methods and techniques for flawless transferring of design intent of these electronic surface models to and from other professional-level surface and solids software. (2035-721 or 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 **Industrial Design Graduate Elective**
The reasoned application of theoretical and practical background to advanced projects in industrial design. **Credit 3 (offered every quarter)**

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 ID 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 **Ceramics 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**

2040-781 **Graduate Ceramics Studio I**
This is the first of a four-quarter sequential class 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 class covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation techniques, design fundamentals and encouragement of personal expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-783 **Graduate Ceramics Studio III**
This is the third of a four-quarter sequential class covering the advanced aesthetics and techniques in ceramics. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. The student will begin to seriously experiment with issues and themes that may prove relevant to their final selection of a thesis topic. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-784 **Graduate Ceramics Studio IV**
This is the fourth of a four-quarter sequential class covering the advanced aesthetics and techniques in ceramics. This is the culmination, prior to the thesis studio course, of the program developed on the basis of the individual student's needs, interests and background preparation as they have been determined through faculty counseling. The student will seriously pursue issues and themes that are relevant to their final thesis topic. The student will be encouraged to utilize new techniques, materials and concepts. This sequence leads to the master's thesis, proposed by the student and approved by the faculty. Materials fee required. **Credit 9**

2040-890 **Ceramics Graduate Thesis**
The development of an acceptable thesis project initiated by the student and approved by the student's thesis committee and chairperson of the school. Primarily a creative production resulting in a body of work, the thesis will include a written report, 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**

2041-781 **Graduate Glass Studio I**
This is the first of a four-quarter sequential class 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 class 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. **Credit 9**

2041-783 **Graduate Glass Studio III**
This is the third of a four-quarter sequential class 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. **Credit 9**

2041-784 **Graduate Glass Studio IV**
This is the fourth of a four-quarter sequential class 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. **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**

2042-781 **Graduate Metals Studio I**
This is the first of a four-quarter sequential class covering the advanced aesthetics and techniques in metals. This program is structured on the 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 class covering the advanced aesthetics and techniques in metals. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation 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**

2042-783 **Graduate Metals Studio III**
This is the third of a four-quarter sequential class covering the advanced aesthetics and techniques in metals. This is a continuation of the program developed on the basis of the individual student's needs, interests and background preparation as they may be determined through faculty counseling. 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 class 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. **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**

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**

2044-781 **Graduate Wood Studio I**
This is the first of a four-quarter sequential class 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 class 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. **Credit 9**

2044-783 **Graduate Wood Studio III**
This is the third of a four-quarter sequential class 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 class 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 & Animation

2065-701, 702, 703 **History & 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 (F, W, S)**

2065-711, 712, 713 **Film & 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. **Credit 4 (F, W, S)**

2065-716 **Digital Audio Tools/Animation**
Students in this course 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. **Credit 2 (F)**

2065-721 **Animation & 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. (No prerequisites required). **Credit 4 (F, S)**

2065-722 **Animation & Graphic Film 2**
A continued introduction to the techniques and practice of graphic and animated film production. This course provides training and practical experience in a number of approaches to single-frame film making in addition to those covered in 2065-721. Some techniques covered in the course are: three-dimensional animation; optical printing; computer animation; and hand-drawn sound. Screenings of professionally made films will illustrate each technique. Proficiency in drawing is not required. (2065-721) **Credit 4 (W)**

2065-723 **Animation & Graphic Film 3**
This course provides practice in all phases of single-frame film production. Students produce a 16mm, 90-second graphic film with sound, utilizing one or more techniques learned in the preceding two quarters. (permission of instructor) **Credit 4 (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 **Film & Video: Tools & Technology**
An intensive tools and technology course that will allow the student to work in the digital video format. This course will examine 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 (2065-203). **Credit 5 (F, W)**

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. The class also includes a brief exploration of non-fictional writing, examining preparation, information gathering techniques, and methods of investigation. Both non-fiction and fiction are treated as expository, story-telling 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 Scriptwriting I or equivalent) **Credit 3**

2065-737 **2-D Computer Animation I**
Students in this course create animated sequences and projects using a commercial animation software package for a popular microcomputer. In addition to mastering specific software, students learn the principles of digital computer operation and how those principles apply to the problems of animation with computers. (2065-721) **Credit 4**

2065-738 **2-D Computer Animation II**
This course focuses on the integration of computer animation into film and video. Students produce a finished animated project on film or videotape with sound, which can be used as a portfolio piece. Emphasis is placed upon various postproduction strategies which involve such techniques as combining computer animation with live action, the addition of film and video special effects and combining computer animation with existing film or video imagery. (2065-721) **Credit 4 (S)**

2065-741 **Graduate Drawing for Animation: Dynamics**
This advanced course focuses on drawing of drawn animation and is one of the three different courses in drawing for animation offered. Each course provides a different focus. The courses do not need to be taken in sequence. 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 and is one of the three different courses in drawing for animation offered. Each course provides a different focus. The courses do not need to be taken in sequence. Flexibility is provided for students at different stages of development. Students learn how to break a scene into shots and storyboard the sequence. They learn to compose the frame for action and juxtapose one shot against the next. Students learn to use exposure sheets to plan out animation, and animate short sequences using acquired skills. A variety of examples drawn animation will be screened in class. Gesture drawing from live models may be included. (Figure in Motion) **Credit 3**

2065-743 **Graduate Drawing for Animation: Characters**
This advanced course focuses on character development for animation and is one of three different courses in drawing for animation offered. Each course provides a different focus. The courses do not need to be taken in sequence. 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**

2065-747 **Introduction to 3-D Computer Animation**
This course is an introduction to 3D computer animation. Topics will include modeling using NURBSs 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. (Introduction to 3D Computer Animation) **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 & 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**
This is 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 4 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 3-hr classes will be held alternately at all three schools. Enrollment is open to graduate students from the 3 schools. Transportation will be provided. (Grad 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 & 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 3D forms, object deconstruction, problem-solving, modeling methodologies, and the advantages and disadvantages of various construction methods. Lighting and texturing techniques will be incorporated into 3D 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 3D modeling exercises and create 3D projects including a complex object and a humanoid character. (Introduction to 3D animation 2065-747 or 457, 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 & 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 or 2065-731 Video Tools and Technology or 2065-431 Introduction to 16mm Film Production) **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. (Video Tools 2065-731) **Credit 4**

2065-771, 772, 773 **Graduate Seminar I**
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 (F, W, S)**

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 (F, W, S)**

2065-786 **Contemporary Issues**
A study of current issues relevant to fine art photography and filmmaking, how they relate to broader historical/cultural issues and how they might suggest future directions. **Credit 2**

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**

2065-841, 842, 843 **Research Seminar**
This seminar serves as a planning stage for preparing a research thesis proposal and for an ongoing critique and discussion of the research in progress. Issues related to exhibitions, publications, distribution, and gallery also are covered. (JPHC) **Credit 2 (F, W, S)**

2065-890 **Research & Thesis: Film & 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**

Photographic Arts

2066-701, 702, 703 **History & 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**

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. On successful completion of the required core courses in the first year, students are eligible to be considered for advancement into thesis. **Credit 4**

2066-750, 751, 752, 753 **Special Topics Workshop**
Advanced topics of current or special interest designed to broaden and advance the student's ability to use photography and related media. Recent topics include, Women and Visual Imaging, Warhol and Beuys, Art and Censorship, Digital Media Cafe, Negotiating Identity and Mural Photography. **Credit 4**

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 and laboratory practice and critical readings are used. Workshops may be taught as a theme class or on an individual basis to provide students with critical feedback on projects. Recent theme classes include: Digital Media Cafe, Web Seminar, Electronic Arts Seminar, and Imaging the Self. **Credit 4**

2066-760 **Photo Workshop For Teachers**
A graduate course in the principles and practices of photography designed especially for the high school or community college teacher, counselor, or adviser, who may be involved in instruction or career guidance in photography or film/video. Both black-and-white and color photography are presented and applied in actual picture-making experiences. Both the aesthetic and the technical aspects of photography are emphasized. Teaching methods, course development and ideas in visual communications are examined. Career opportunities in photography are explored. **Credit 6 (not offered every year)**

2066-762 **Dadaism, Surrealism & 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**

2066-764 **Minor White Seminar**
A study of the photography and philosophy of Minor White and his contribution to photographic publications, photographic education and photography as an art form. **Credit 3 (not offered every year)**

2066-765 **Photography Extensions**
Strip photography, slit/scan photography and stroboscopy are used to probe and artistically manipulate spatial and temporal dimensions in order to create unseen poetic expressions of a space/time continuum. Perceptual principles and technical problems associated with the production and exhibition of such images are studied. **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. (No prerequisite; 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). **Credit 3**

2066-778 **Modernism: Photography, Art & Culture**
Modernism is a term used to describe how life in Europe and America from the 1880's to the 1960's 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 (prerequisites none). **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**

2066-791 **Photography Preservation I**
Introduction to the basic philosophy, ethics, concerns and methods of conservation. This course will cover the various materials, sources of supply, workshop design, examination methods, documentation style, monitoring systems, utilized in the protection of photographs. **Credit 4**

2066-792 **Photography Preservation II**
Introduction to the tools, materials and methods of providing intimate protection for photographs through proper mounting, housing and stabilization intervention. Special focus is given to the development of practical skills in protective housing construction utilized in display and storage. **Credit 4**

2066-793 **Chemistry: Photography Deterioration**
Introduction to the environmental factors and underlying chemical mechanisms that cause photographs to stain, fade, or otherwise deteriorate while in storage or on exhibition. Students will use actual samples in laboratory sessions to illustrate the forms of deterioration, learn about heat, light, humidity, pollution, and their effects on photographs. Emphasis will be placed on determining appropriate storage conditions for photographs of various types. **Credit 4**

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, 842, 843 **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 & 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 & Analyzing - Graphic Art 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 & 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. A core part of this course is the student's participation in an actual company project where recommendations for new marketing approaches and initiatives will be developed and presented to a panel consisting of the company's key decision makers. **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**

2081-706 **Introduction to Graphic Media Research**
This course exposes graduate students to the broad range of technological, managerial, and business trends associated with the growth and evolution of graphic media industry. Students are expected to engage in dialog and debate regarding the inter-related, multi-faceted forces driving the dynamic change in the scope, nature and structure of the graphic media industry. **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 & 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 & Process 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**

Printing Graduate Foundation Courses

2082-303 **Graduate Materials & Process I**
Students will develop writing skills for business correspondence, proposals, and technical reports. considerations of techniques, organization, format and style based on appropriate research techniques and audience analysis will be discussed. A formal technical research report and presentation will be required. (Writing and Literature I & II) **Credit 4**

College of Liberal Arts

Programs

Master of Science

Advanced Certificate

Andrew M. T. Moore, Dean

The College of Liberal Arts offers master of science degrees in the following areas: school psychology, public policy and communication and media technologies.

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 courses in professional or applied technologies.

Graduates of the master of science degree in public policy will be well grounded in qualitative and quantitative theories and methodologies and in sound ethical principles. The curriculum is designed to provide the students with the skills to collect, organize, and analyze relevant science and technology policy data.

The (specialist level) master of science degree and advanced certificate in school psychology are 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 full-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 colleges at RIT.

Faculty

Members of the faculty are students' advisers, as well as teachers. Their backgrounds in the field and classroom and in research are the bases 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, 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 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 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
- Cumulative undergraduate grade point average of 3.0 or above (on a 4.0 scale)
- 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
- 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)

		Credits
0535-701	History of Media Technologies & Industries	4
0535-702	Communication Theory & Audiences	4
0535-703	Research Methods in Communication	4
0535-704	Communications Law & Ethics	4
0535-800	Project/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.

0535-705	Electronic Communication & Society	4
0535-706	Crafting the Message	4
0535-707	International Media	4
0535-708	Teaching & Training Technologies	4
0535-709	Online Advertising & Public Relations	4
0535-710	Visual Communication	4
0535-725	Special Topics in Communication	4

Applied professional or technical courses (12-16 credits)

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

2081-709	Trends in Printing Technology	4
2081-723	Contemporary Publishing	3
2081-742	Document Processing Languages	4

College of Computing and Information Sciences

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

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 Change in a Quality Organization	4
0102-742	Introduction to Technology Management	4
0102-762	Managing New Process & 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 Public Policy

James J. Winebrake, Department Chair
585-475-4648

The Rochester Institute of Technology (RIT) Public Policy Department offers an innovative, interdisciplinary Master of Science (M.S.) degree in 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 driving 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 industry; at federal, state, and local levels of government; and in the not-for-profit sector.

All students take a set of policy core courses that emphasize analysis, problem solving, and interdisciplinary approaches. Students choose from numerous electives to focus their policy studies in a particular policy 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 a master of science degree in public policy at RIT.

Students may enter the program from the public policy bachelor of science program and earn a combined BS/MS in five years. (For admission requirements to the BS program, consult the *Undergraduate Bulletin* or visit the RIT undergraduate Admissions Web site at www.rit.edu/~960www/admin.)

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 first two years of the BS curriculum
- A GPA of at least 3.0

During spring quarter of their third year, undergraduate students who have chosen the BS/MS combined degree program will be officially admitted into the MS program based on having met the requirements detailed above.

Students entering the master of science program from other RIT programs or from outside the Institute should meet the following requirements:

- Successful completion of the baccalaureate degree at an accredited college or university
- Minimum 3.0 grade point average (GPA) overall
- Two writing samples, including a statement of interest
- GRE scores unless a waiver request is approved
- Calculus and statistics recommended, but not required
- Two formal letters of reference
- Minimum TOEFL of 570 (230 for computer based exam) for students who do not speak English as their native language
- All applicable requirements listed in the Graduate Bulletin

Curriculum

A minimum of 48 quarter credit hours is required for completion of the master of science in public policy.

The BS/MS student may obtain 12 quarter credit hours of graduate work in the fourth year of the BS curriculum. These courses will be selected from the policy electives with the consent of the adviser and the instructor. 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 Institute 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 three-course sequence: Readings in Public Policy, Advanced Theory and Methods in Policy Analysis, and Evaluation Research. These required courses focus on developing a high level of quantitative and qualitative policy analysis skills. In addition, students will choose seven courses within their area of specialization from a wide selection of courses or work through independent study with appropriate faculty on specific topics. Students are also required to successfully complete a master's thesis.

Course sequence

This course sequence is for a student entering the program through the BS/MS program. Other students may be required to take 12 credits of Policy Analysis I-III, which typically adds another quarter for the MS degree.

Fall	Credits
Seminar: Readings in Public Policy	4
Elective Courses	12
Policy Colloquium	0
Total	16

Winter	
Seminar: Advanced Theory & Methods in Policy Analysis	4
Elective Courses	8
Thesis Research	4
Policy Colloquium	0
Total	16

Spring	
Seminar: Evaluation Research	4
Elective Courses	8
Thesis Research	4
Policy Colloquium	0
Total	16

(For course descriptions, consult the Undergraduate Bulletin or visit the public policy Web page at www.rit.edu/~ppolicy).

Public policy courses

The student may choose seven elective courses. Courses are chosen based on student interests, career goals, and offerings. Courses may be offered in various colleges throughout the Institute, including the Colleges of Business, Science, Engineering, and Applied Science and Technology. Course selection is done jointly with a faculty advisor and are typically aimed at developing a specialized area of interest for the student (e.g., biotechnology policy, environmental policy, energy policy, communications policy).

School Psychology Department

Master of Science in School Psychology

Scott P. Merydith, Program Chair,
585-475-6701

The College of Liberal Arts offers a nationally accredited graduate program leading to the master of science 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 they 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
- Evidence of professional commitment and potential for developing effective relationships with children, youth and adults:
  Letters of reference
  Student essay about goals and related experience
- 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)		Credits
0514-701	Advanced Developmental Psychology	4
0514-702	Psychology of Teaching/ Learning	4
0514-723	Developmental Psychopathology	4
0514-739	Children & 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 & Legal Issues	4
0514-731	Psychoeducational Assessment II	4
0514-732	Psychoeducational Assessment III	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 & VI	12
0514-777	Internship I, II & 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

Psychoeducational Assessment II
Advanced Consultation
Advanced Development Psychology
Practicum II

Spring Quarter

Psychoeducational Assessment III
Advanced Counseling
Developmental Psychopathology
Practicum III

Second year

Fall Quarter

Psychoeducational 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 & Legal Issues
Practicum VI
Project/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 is required for completion of the program. Before registering for the internship, 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 College 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 College at Oneonta; MA, State University of New York College at Brockport; Ph.D., Temple University—Associate 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. Collins, AB, Rutgers University; MA, Ph.D., University of Iowa—Professor, Fine Arts

Rebecca O. Edwards, BA, College of the Holy Cross; Ph.D., University of Rochester—Assistant Professor, History

Timothy H. Engstrom, BA, MA, Ph.D., University of Edinburgh, Scotland—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 Department

James J. Winebrake, BS, Lafayette College; MS, Massachusetts Institute of Technology; Ph.D., University of Pennsylvania—Department Chair; Associate Professor, Public Policy

Franz Foltz, BS, MS, Pennsylvania State University; Ph.D., Rensselaer Polytechnic Institute—Assistant Professor, Science, Technology, and Society

M. Ann Howard, BS, Cornell University; JD, Rutgers University—Associate Professor, Public Policy/ Science, Technology, and Society

Murli M. Sinha, AB, Bihar University, India; MA, Patna University, India; MA, City College of City University of New York; Ph.D., Cornell University—Professor, Sociology

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, SUNY 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

Paul McCabe, BA, University of Rochester; MA, Ph.D., Hofstra University—Assistant Professor, Psychology

Scott P. Merydith, BA, M.Ed., Ph.D., Kent State University—Associate Professor, Psychology

Murli M. Sinha, AB, Bihar University, India; MA, Patna University, India; 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 description.

Liberal Arts Elective Courses

0505-702 Film History & Criticism
This course examines the historical development of film as an art and the differing interpretations of its meaning, traced through major films by important directors. Emphasis will be placed on the varying critical methodologies by which films can be analyzed. **Class 4, Credit 4 (offered occasionally)**

0505-703 American Architecture
An examination of American architecture from the 17th century to the present designed for the graduate level of study. Emphasis will be placed on American building art in the late 19th and 20th centuries. **Class 4, Credit 4 (offered occasionally)**

0505-705 Theories of Aesthetics
A course for the art-oriented graduate student centering on the student's search for a supportable and reliable basis for making value judgments about works of art as well as introducing the student to major concepts in aesthetics. **Class 4 Credit 4 (offered occasionally)**

0505-707 Cubism to the Present
Cubism as a way of seeing and as an expression of 20th century thinking. Differences and similarities with art forms of earlier eras and other cultures will be discussed. **Class 4, Credit 4 (offered on sufficient demand)**

0505-711 20th Century American Art
An investigation of American art from the civil war to the present. Emphasis will be placed on the visual arts, but many references will be made to music and architecture. **Class 4, Credit 4 (offered occasionally)**

0505-712 Arts & Crafts in Tribal Society
A study of the function of primitive art and the techniques of its production, including the use of clay, stone, fibers, bark, wood, bronze, gold, etc. Hair styling, body painting and scarification will also be discussed. **Class 4, Credit 4 (offered occasionally)**

0505-713 Contemporary Issues in Art
This course offers the graduate art student the opportunity to investigate those aspects of 20th century art that question the very nature of art and the role of the artist in today's and tomorrow's society. **Class 4, Credit 4 (offered occasionally)**

0505-714 Art: Vision & Concept
Though the course will develop chronologically from the medieval period to the present, emphasis will be placed on a close analysis of (1) selected works of art, including paintings, sculpture and architecture, and (2) the development of the unique oeuvre of selected artists. Topics chosen for study will be limited in number but treated in depth. Topical choices will be based on richness and import of the formal and/or conceptual content embodied therein. Some background in the history of art is helpful but not necessary. **Class 4, Credit 4 (offered occasionally)**

0505-715 Picasso
The impact of Picasso and his circle on 20th century art. Their affinities with modern scientific philosophical attitudes also will be discussed. **Class 4, Credit 4 (offered occasionally)**

0505-716 Rembrandt
A detailed analysis of the art and times of the baroque master. Emphasis will be placed on the development of his style and technique, on his and other artists' relationship to their society and to the character of the baroque outlook. **Class 4, Credit 4 (offered occasionally)**

0505-717 Topics in Music History
This course is a study of various aspects of music in different historical environments with emphasis on analogies between music and the other fine arts. **Class 4, Credit 4 (offered occasionally)**

0505-721 Oriental Art: China & Japan
A seminar exploring the philosophical and cultural perspectives underlying traditional Asian art as a prelude to examining selected topics in Chinese and Japanese art. Emphasis will be placed on the application of research techniques and critical methods of an individual selected area of interest that may serve as a foundation for continuing study. **Class 4, Credit 4 (offered occasionally)**

0505-722 Oriental Art: India & Asia
A seminar exploring the philosophical and cultural perspectives underlying traditional Asian art as a prelude to examining selected topics in Indian and southeast Asian art. Emphasis will be placed on the application of research techniques and critical methods of an individually selected area of interest that may serve as a foundation for continuing study. **Class 4, Credit 4 (offered occasionally)**

0505-723 Art & Politics
The purpose of the course is to familiarize the student with the relationships that can exist between the art world and society. Fundamental questions concerning the social/political role of the artist (questions that are often overlooked in most curriculums) will be investigated. Questions dealing with public funding of the arts, the ideologic/political nature of art education, the function of art as a catalyst for political change, and other questions will be examined. **Class 4, Credit 4 (offered occasionally)**

0505-724 Women & Visual Arts
Examines the image of women in the visual arts and the role of women as image makers. Major topics include the variety of images of women, the evolution and change of these images over time, media images (as differentiated from fine art images) of women, images of women by women and by men, women's images and the issues of their relationship to the images made by men, the nude and pornography, history of women artists, selected women artists and their work, relation of their work to the art of the period, current issues and status of women artists. **Class 4, Credit 4**

0505-725 Special Topics in American Art
A critical examination of issues and/or artistic developments in American art. The topic may have been briefly covered in another concentration course. Provides a unique opportunity to expose the student to an in-depth analysis of one selected aspect of American art. Examples of likely topics are: American landscape painting; American portraiture; Pop art of the '70's; jazz; Robert Venturi and post-modern with American painting, sculpture, architecture, music and film. A research project is required. Prerequisites, if any, are determined by the instructor. **Class 4, Credit 4 (offered occasionally)**

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 educational history. **Class 4, Credit 4 (offered annually)**

0509-705 Philosophy of Art & 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
An investigation into concepts concerning mental experience. The basic question is "What is consciousness?" The question hides some presuppositions and raises many further questions. Can we be conscious of consciousness? What does it mean to be conscious? Is there a mind-brain identity? Can we describe mental experiences in non-mentalistic terms? Can computers think? It will be the business of this course to explore these and other related questions and to see what progress has been made in attempting to answer them. **Class 3, Credit 4 (offered annually)**

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 & 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 professor) **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 placement/internship. (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 placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2/qtr**

0514-715 Practicum IV
The practica serve as a bridge from theory and research to the professional practice of school psychology. They allow the student to become familiar with the organization and operation of schools. A weekly classroom seminar will be provided in addition to a placement in a school setting. The practica experiences are a major part of the preparation for the field placement/internship. (Matriculation in the school psychology program) **Class 2, Credit 2/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 placement/internship. (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 placement/internship. (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 & 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-based recommendations for intervention, and to provide written and oral reports. Assessment of persons who are culturally different or disabled is emphasized. (0514-726 and matriculation in school psychology program) **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 0514-726 and 0514-731 or permission of instructor) **Class 4, Credit 4**

0514-733 Applied Behavioral 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. An overview of relevant information on theory of exceptionality and current status of diagnosis and treatment of exceptional children and adolescents is provided. (0514-726, 0514-731, 0514-732 and matriculation in the school psychology program) **Class 4, Credit 4**

0514-742 Biological Basis of Behavior
This course is designed to review the neurophysiological and neuro-psychological 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 course focuses on the development of counseling skills used with children and adolescents in individual and group settings. Students are given the opportunity to integrate theory, research, and processes relative to individual and group work. Treatment plans are developed. Techniques for facilitating group counseling are emphasized. Crisis intervention is reviewed. (0514-724) **Class 4, Credit 4**

0514-745 **Alternative Assessment Techniques**
The prime focus of this course is on the assessment of academic problems in the classroom with special emphasis on the collection of data that allow the planning of interventions. Students will learn alternative direct methods of academic or behavioral assessment for both performance and skill deficits. Alternative assessment techniques include curriculum based assessment, curriculum based measurement, and analogue assessment. Emphasis will be on the integration of these assessment techniques, collaborative problem solving, systematic observation, the principles of applied behavior analysis and the psychology of learning for the purposes of intervention development. (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 0514-724 or permission from the instructor) **Class 4, Credit 4**

0514-752 **Children and Trauma**
This course examines the nature, incidence, demographic distribution, sequelae and appropriate treatment of trauma in children's lives. After defining trauma, it explores how experiences such as parental or sibling death, serious illness or injury, familial alcoholism, emotional, physical and sexual abuse, divorce or parental abandonment, community violence and natural disasters affect children. **Class 4, Credit 4**

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**

0515-701 **Cultural Diversity in Education**
The aim of the course is to understand the historical and structural origins of the present schooling system in the United States. The functions of schools, from an ideological as well as technical viewpoint, will be analyzed. In addition, different forms of school organizations will be compared, as in the public vs. private dimensions. The functionalist theoretical approach will be presented as well as the conflict perspective to frame the discussion and analysis of opposing sociological system 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 value constraints. (See requirements for admission for prerequisites or receive permission of instructor) **Class 4, Credit 4**

Advanced Graduate Certificate in School Psychology and Deafness

0514-764 **Developmental Issues & Deaf Learning**
This course examines the development of language, cognitive and psychosocial skills in deaf and hard-of-hearing children. Current research in these areas will be critically reviewed and analyzed. Careful attention will be given to understanding the social-cultural contexts of the child and the implications for psychosocial, language and cognitive development and educational planning. The cultural, deficit, compensation and ecological perspectives on deaf and hard-of-hearing children's development will be compared and contrasted. The role of the school psychologist as a consultant on psychosocial, language, and cognitive developmental issues will be discussed. (Matriculation in the school psychology and deafness program or permission of the instructor) **Class 4, Credit 4**

0514-777 **Internship School Psychology I, II, III**
Through direct, supervised 1,200-hour internship experience, the student will practice the various professional roles of a school psychologist in an educational setting. Competency in carrying out these tasks in an ethical and professional manner will be developed as preparation for employment. (Matriculation in the school psychology program plus satisfactory completion of 84 hours in graduate program and qualifying examination) **Class 3, Credit 3 per quarter**

0514-780 **Sign Language Development I**
During the fall and winter quarters in the second year of the program, students are required to participate in sign language development courses/activities that are recommended by the ASL curriculum advisor and written up as independent study contracts. These courses and activities are designed on an individual basis according to the students' particular skill development needs. Students' progress is monitored throughout the quarters with feedback shared during regular meetings with the ASL curriculum advisor. Two credits per quarter are given upon successful completion of the individualized skill development plan. **Class 4, Credit 2**

0514-781 **Sign Language Development II**
During the fall and winter quarters in the second year of the program, students are required to participate in sign language development courses/activities that are recommended by the ASL curriculum advisor and written up as independent study contracts. These courses and activities are designed on an individual basis according to the students' particular skill development needs. Students' progress is monitored throughout the quarters with feedback shared during regular meetings with the ASL curriculum advisor. **Class 4, Credit 2**

0514-782 Psychoeducational Assessment IV: Hearing and Deaf
This course will examine the assessment of the following areas of functioning for deaf and hard of hearing children and adolescents; communication, academic, cognitive, personality, and interpersonal assessment. Assessment and educational planning for a student will be viewed from an ecological perspective including the family, the school, the community, the support services and the legal systems. Attention will be given to preparing and communicating psychological report data and developing individual educational plans. **Class 4, Credit 4**

0514-799 Independent Study
A student may register for a graduate independent study project subject to the approval of the director of the student's graduate program, the faculty sponsor, the school psychology graduate committee and the dean of the College of Liberal Arts. Because of the length of the approval process, students who desire to take independent study should make arrangements several weeks before the quarter begins. An independent study project enables the interested student and his or her faculty sponsor to coordinate their efforts on subjects and topics that range beyond the normal sequence of the graduate course selection. **Credit variable.**

Public Policy

0521-700 Readings-Public Policy
An in depth inquiry into key contemporary public policy issues. 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 & Methods
This course will cover the major theoretical and applied analytical methods and techniques in both quantitative and qualitative analysis. An emphasis will be placed on integrating empirical and normative concerns. (Matriculation in the public policy master's program or permission of the instructor 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 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, satisfactory completion of Policy Analysis I–III, and satisfactory completion of a minimum of 16 graduate credits are required) **Class 4, Credit 8 (offered annually)**

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, bio- and information technologies. The course will then analyze how governments choose policies to spur innovation. (Graduate standing) **Class 4, Credit 4 (offered spring quarter)**

0521-709 Public Administration & Management
This course provides an introduction to the fields of public administration and public management. It is a survey course which covers topics such as bureaucratic behavior, program implementation, and recent innovations in management of public organizations. (Graduate standing) **Class 4, Credit 4 (offered spring quarter)**

0521-710 Information & Communication Policy
This course examines how federal and international policies are developed to influence innovation of information and computer technology. In particular the course will examine such topics as privacy, freedom of speech, intellectual property rights, access to information technology, and regulation of the Internet. (Graduate standing) **Class 4, Credit 4 (offered winter quarter)**

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. (Graduate standing) **Class 4, Credit 4 (offered occasionally)**

521-799 Public Policy Independent Study
A student may register for a graduate independent study project subject to the approval of the chair of the public policy program and the dean of the College of Liberal Arts. Because of the length of the approval process, students who desire to take independent study should make arrangements several weeks before the quarter begins. An independent study project enables the interested student and his or her faculty sponsor to coordinate their efforts on subjects and topics that range beyond the normal sequence of the graduate course selection. **Credit variable.**

Communication & Media Technologies

0535-700 Film & 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 & Audiences
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. Opportunity for application of theory in field research is available. **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 & Ethics
This course focuses on issues presented by communication technologies to the practice of law and study of standards of ethics. Legal challenges presented by communication technologies will be examined in the following contexts: intellectual property, technology rights, patents, privacy and information networks, access to information, defamation, indecency, obscenity, and pornography. Special attention will be paid to the difficulty of applying national laws to international media. (0535-701, 702) **Class 4, Credit 4**

0535-705 Electronic Communication in 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, and 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 **Teaching & Training in Technology**
The ways we teach, train, and learn are increasingly assisted and influenced by various communication technologies. This course focuses on education and training strategies using various communication technologies with particular emphasis on developing teaching and training materials from a learner perspective. (0535-701, 702) **Class 4, Credit 4**

0535-709 **Online Public Relation & 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, interstitials, the use of buttons, e-mail, sponsorships, interactive advertising and consumer tracking. (0535-701, 702) **Class 4, Credit 4**

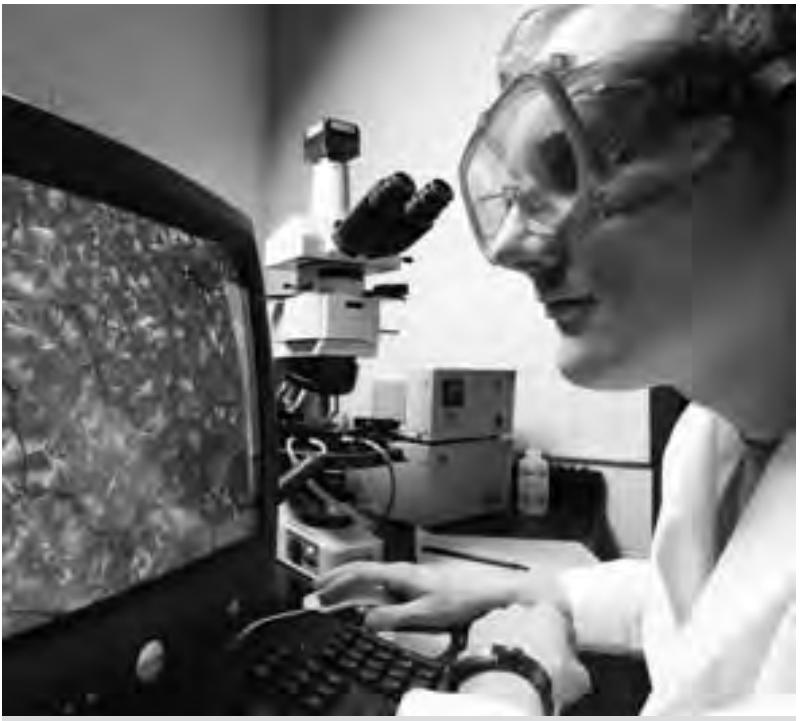
0535-710 **Visual Communication**
This course focuses on the use of still or moving images in mediated communication. Examples from print, television, internet, photography and film will be examined in light of traditional and emerging media. Rhetoric of image based technologies is examined. Graduate students will be required to complete advanced work beyond the undergraduate assignments. **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



Programs

Master of Science

Doctor of Philosophy

⇆ *Online learning option available*

Ian Gatley, Dean

The College of Science offers a unique complement of graduate programs with curricula designed with sufficient flexibility to prepare the graduate for direct entry into a career in the profession or for further study toward a more advanced graduate degree in a chosen discipline.

Whether the focus is on the foundations of matter, on applications of mathematics, on the role of the chemist in the health care environment, on the specialized properties of advanced materials or on the science and technology of advanced imaging systems, the College of Science graduate faculty join an out-standing group of students to furnish a valuable and integrated understanding of today's biological, environmental, clinical, industrial and research problems.

Department of Biological Sciences

G. Thomas Frederick, Interim Department Head,
Biological Sciences
585-475-2496, gtfsbi@rit.edu

Master of Science in Bioinformatics

Gary Skuse, Director
585-475-2532, grssbi@rit.edu

The master of science degree in bioinformatics is offered on either 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 will have 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 already rich with opportunities. Most of the individuals now employed in bioinformatics were not specifically trained in this field. Instead, they chose it because the relative 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 that 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 who bring with them 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 number of related fields. The MS program at RIT accommodates this diversity in two ways. First, there is a comprehensive bridge program for those 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, graduating students will be prepared to become professional bioinformaticists.

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.

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 to allow each student to pursue areas of personal or professional interest. In addition, every student will be required to complete a research project that will address a relevant and timely topic in bioinformatics and culminate in a thesis. Graduate electives may be chosen from any relevant RIT graduate courses.

Curriculum

Computational science degrees

		Credits
1001-700	Cell and Molecular Genetics	4
1001-701	Cell and Molecular Genetics II	4
1001-762	Introduction to Bioinformatics Computing	4
1001 763	Advanced Bioinformatics Computing	4
1001-722	Bioinformatics Seminar	2
1001-725	Ethics in Bioinformatics	3
1001-794	Molecular Modeling & Proteomics	4
1016-715	Statistical Models for Bioinformatics	4
	Graduate Electives	11
1001-890	Thesis	10
Total		50

Life science degrees

		Credits
4003-709	Programming Language Concepts	4
4002-720	Data Object Development	4
1001-762	Introduction to Bioinformatics Computing	4
1001-763	Advanced Bioinformatics Computing	4
1001-722	Bioinformatics Seminar	2
1001-725	Ethics in Bioinformatics	3
1001-794	Molecular Modeling & Proteomics	4
1016-715	Statistical Models for Bioinformatics	4
	Graduate Electives	11
1001-890	Thesis	10
Total		50

Master of Science in Environmental Science

John M. Waud, Director
585-475-2182, jmwscl@rit.edu

The master of science degree in environmental science is offered on either a part-time or full-time basis. The program options are designed to fill the needs of both the practicing environmental scientist in the greater Rochester community and the full-time graduate student.

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 objective of the curriculum is to prepare students for a career in environmental science by providing the background demanded in the marketplace and the knowledge that will enable them to contribute to the solution of environmental problems. To accomplish this, the program utilizes the strengths of the College of Science in providing a strong scientific and mathematical foundation complemented by a strong liberal arts component.

Admission requirements

Admission to the program will be granted to qualified graduates who are holders of a bachelor's degree in environmental science or a related field of study. Prerequisite courses for the program include one year of general chemistry, organic chemistry, and general biology; one course in statistics, ecology, microbiology, ethics, history, and economics; two courses in calculus and social sciences. In addition, preferred courses for applicants are physics, geology, environmental science, and communications.

The admission decision will be based on

- a minimum GPA of 3.0 (overall and in science/math);
- minimum TOEFL of 550;
- computer literacy;
- a brief statement outlining career goals and objectives;
- three letters of recommendation.

It is strongly recommended that students visit RIT to meet with the environmental science program director as a supplement to the normal application process.

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. Courses taken for credit can usually 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 may be limited. Please contact the program director for further information. Any applicant who wishes to register for a graduate course as a nonmatriculated student must obtain permission from the program director and the instructor.

All students who do not speak English as their primary language are required to submit TOEFL scores and must take the Michigan Test, given by RIT's 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 environmental science. This may mean that the student will need additional time and financial resources to complete the degree program.

Curriculum

The curriculum is designed to provide students with an understanding of the interdisciplinary nature of environmental issues and to teach them to work as team members in solving these problems.

The courses provide an integrated, interdisciplinary approach to the environment and include extended problem-solving exercises. The problems to be solved will be provided by members of the environmental community (government and private organizations and industry). Members of the environmental community also participate as mentors to the students in these problem solving exercises.

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 51 quarter credit hours beyond the bachelor's degree is required.

Required courses include:

1006-701, 702, 703	**Environmental Science Problem Solving I, II, III**
1009-702	**Biochemistry-Conformation**
1009-703	**Biochemistry-Metabolism**
1015-720	**Environmental Chemistry**
1016-352	**Probability and Statistics II**
0630-xxx	**Advanced Geology**
1001-475	**Applied Ecology**
1001-767	**Environmental Microbiology**
1006-870	**Environmental Science Graduate Seminar**
1006-877	**Environmental Science External Research**
	or
1006-879	**Environmental Science Research**
	Graduate Electives

Part-time study

The environmental science program encourages practicing environmental scientists in the greater Rochester area to pursue a program leading toward the master of science degree in environmental science without interrupting their employment. Consequently, most of the courses in the graduate program are scheduled in the late afternoon or early evening. Students employed full time normally take one course each quarter.

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 second year of study.

External research credit

Independent, creative research that is part of an applicant's employment history may be applied, to a maximum of 16 hours of research credit, towards the completion of the master of science degree.

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, UV-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 Spectrophoto-meters, Capillary Electrophoresis, DSC's, DMA, Asher, 300 MHz NMR, drying oven, leaf area index meter, digital clinometer, Wiley mill.

Facilities for Research

The RIT 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 the field research. This includes both wet laboratories and computer facilities. The latter facilities include traditional computational facilities and Geographic Information Systems (GIS).

Additional information

More information may be obtained by contacting the director of environmental science, 585-475-2182; the environmental science program office, 585-475-7577; or the Web site, www.rit.edu/~envsci/.

Department of Chemistry

Terence C. Morrill, Department Head
585-475-2497, tcmsch@rit.edu

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 either 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 the full-time graduate student.

The department of chemistry has research and teaching oriented faculty as well as excellent equipment and facilities to enable full-time graduate students to carry on a program of independent study that will develop ability to attack scientific problems at the research level. The research can result in either a thesis or a project report.

The objectives of the program are, through course work and research experience, to increase both the breadth and depth of the graduate student's background and to 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 are holders of a bachelor's degree in chemistry from an accredited college or university. An applicant with a bachelor's degree in another scientific discipline and the equivalent of a full year's course in each of analytical chemistry, organic chemistry, physical chemistry, physics and calculus will be considered for admission.

The admission decision will be based on:

1) college transcripts;
2) GRE scores (chemistry exam is recommended); and
3) letters of reference.

It is strongly recommended that students visit RIT as a supplement to the normal application process. 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. Courses taken for credit can usually 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 nine credits.

Any applicant who wishes to register for a graduate course as a nonmatriculated student must obtain permission from the chair of the graduate program plus the course instructor.

All students who do not speak English as their primary language are required to submit TOEFL scores. All foreign students must 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

Various program options are available to cover the diverse needs of graduate chemists. Program concentrations in such important areas as polymer chemistry, microelectronics, materials science, biochemistry, and environmental chemistry are possible.

Each student, together with an adviser, will arrange a program best suited to the student's 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 credits beyond the bachelor's degree. Courses in chemistry will be chosen from 700- and 800-level numbers and should include one or more representing each of the three fields: analytical, organic and physical. In addition, a course in inorganic or biochemistry is suggested. A maximum of nine quarter credits may be taken in undergraduate-level courses.

   Each student must select courses (subject to approval by the student's adviser and the graduate committee) that include the following core: 1008-621 and 1008-711; either 1013-737 or 1013-739; one of 1014-741, 1014-743, or 1014-744. The inorganic core course is 1012-764. For biochemistry it is 1009-702. The core requirement is one course each in organic, physical, and analytical chemistry and one course in inorganic chemistry if an appropriate undergraduate course was not taken. 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.
2. The thesis option requires a minimum of nine quarter credit hours in research and submission of a satisfactory thesis.
3. Pass an oral thesis defense.

Students enrolled in the program full time are expected to complete 45 credit hours of course work, including up to 21 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 for students working on a project report.

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.

Students employed full time normally take one course each quarter. Part-time students in the program are not required to complete a research thesis; the course work can be completed within four to five years.

Five-year combined BS/MS programs

The BS/MS program combines the BS chemistry, environmental chemistry option, biochemistry, and the BS polymer chemistry programs with the MS chemistry program and allows undergraduate chemistry majors to acquire an MS degree with only one extra year of study. Undergraduate majors are considered for entrance into the BS/MS combined program as early as their third year. Students in the combined program will be advised by the Chemistry Graduate Committee to take graduate-level electives so that they will receive both the BS and MS degrees after five years of full-time study.

Equipment

Research equipment for graduate students in chemistry labs in the College of Science program cannot be surpassed by any institutions in the nation that grant degrees no higher than the MS. We have state-of-the-art instrumentation in the areas of nuclear magnetic resonance as well as infrared and ultraviolet spectroscopy. Polymer characterization is made straight-forward in view of our thermal gravimetric analysis and differential scanning calorimetry units. We are excellently appointed in the areas of gas chromatography, gas chromatography-mass spectrometry, high-performance liquid chromatography, atomic absorption, fluorimetry, and capillary electrophoresis.

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. This experience may be applied, to a maximum of 16 hours of research credit, 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 (1010-999) 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, 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 Web site, www. rit.edu/chemistry.

Department of Medical Sciences

Richard L. Doolittle, Head

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 either full-time or part-time graduate study. Required courses are offered during the late afternoon or evening on a regular basis 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 that 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 which 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 & Dynamics**
1009-703	**Biochemistry: Metabolism**
1023-705	**Mechanisms of Disease**
1023-820, 821, 822	**Advanced Clinical Chemistry I, II, III**
0102-740	**Organizational Behavior & Leadership**
1016-715	**Statistical Models for Bioinformatics**
1023-877	**Clinical Chemistry Research**
	or
1023-879	

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 Web site, www.rit.edu/~676www/.

Department of Mathematics and Statistics

Sophia A. Maggelakis, Head

Master of Science in Industrial and Applied Mathematics

Hossein Shahmohamad, Graduate Program Director
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The ideas of applied mathematics pervade several areas of applications in a variety of businesses and industries and in 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 industrial and 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 the emphasis on developing computable, implementable solutions. Since this is an interdisciplinary program, students have the opportunity to choose from a wide variety of courses across campus.

Admission requirements

The applicant should have a baccalaureate degree with a cumulative grade-point average of 3.0 or above out of 4.0 (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 is also 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.

To indicate proficiency in the language needed to handle university-level work, every applicant for whom English is not the native language is required to take the TOEFL and achieve a minimum score of 550. 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 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 and select appropriate courses and to oversee the academic aspects of the student's program.

Curriculum

The master's degree program in industrial and applied mathematics consists of 48 quarter credit hours of study. There are four "core courses" for a total of sixteen quarter credit hours. These courses are usually taken by the student in the first two quarters of the program and provide the student with 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 and graph theory. 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 and 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 in enhancing their career options. All courses are scheduled in the late afternoon or early evening hours. 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 usually 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

K. S. V. Santhanam,
Director of the Center for 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 in recent times, the traditional practice of empiricism in the search for and selection of materials is rapidly becoming obsolete. The program offers, therefore, 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 non-matriculated 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 who do not speak English as their primary language are required to take both the TOEFL (Test of English as a Foreign Language) and the TWE (Test of Written English) examinations. Minimum scores of 575 on the TOEFL and 4.0 on the TWE are required. In addition, all such students, upon arrival at RIT, 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 center for further evaluation and assistance. These students are required to follow the center's recommendations regarding language course work; 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; and consequently, to provide 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, are required for the completion of the program.

The remaining 24 quarter credit hours are completed either as a combination of the research thesis and elective courses, or 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 credit 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.

Five-year combined BS/MS programs

Combined BS in chemistry and MS in materials science and engineering or BS in microelectronic engineering and MS in materials science and engineering degrees 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 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

Stefi Baum, Director

The Chester F. Carlson Center for Imaging Science was established in 1985 for the interdisciplinary study of all aspects of imaging. The center offers BS, MS and Ph.D. degrees in imaging science and an MS 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 include Canon, Eastman Kodak, Hallmark, Hewlett Packard, Microsoft, Pantone, Qualcomm, Ricoh Innovations and Xerox.

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 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 technology, instrument-based color matching, color appearance models, vision and psychophysics, color management and profile building, imaging systems optimization, and color image formation of printed documents. 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, applicants must satisfy the coordinator of the program that their previous education, ability and practical experience indicate a good chance of success. Scientific reasoning, technical writing and oral communication skills are particularly important.

- 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 of 3.0 or higher (if required)
- TOEFL score of at least 240 (computer-based) or 575 (paper-based) (international students)
- TSE-A score of at least 250 (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 250 (computer based) or 600 (paper based) and TSE-A scores above 250. Partial assistantships are also awarded. Applicants seeking financial assistance from the center must submit all application documents to the Admissions Office by February 15 for the next academic year.

Prerequisites: The foundation program

The color science major is designed for the candidate with an undergraduate degree in a scientific or nonscientific discipline. Candidates with adequate undergraduate work in related sciences will 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.

Calculus I, II, III
College Physics I, II, III
College Physics Lab I, II, III
C Programming
Matrix Algebra
Elementary Statistics
Introduction to 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. Candidates who wish to enter the program but lack adequate preparation may have to take as many as 36 credits of foundation courses in mathematics, statistics, computer science and general science before matriculating with graduate status. Foundation courses can be completed in three quarters.

Core courses

All graduate students in the MS program are required to complete the following core courses:

		Credits
1050-701	Vision & Psychophysics	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 electives 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:

		Credits
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 & 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		Credits
1050-701	Vision & Psychophysics	4
1050-721	Color Measurement I Lab	3
1050-801	Color Seminar	1
	Graduate Elective	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 9 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 the 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

Harvey E. Rhody, 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 the 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 at 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, electrophotography, electro-optical instrumentation, medical diagnostic imaging, chemical imaging, color imaging systems and astronomy. Interdisciplinary efforts are possible with the colleges of Engineering and Science.

The degree requirements can be completed on either a full- or a part-time basis. An online version of the MS program is available in the areas of color science, remote sensing, and digital image processing. Interested students should consult the Web site (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 the following courses in the major areas of study: mathematics through calculus, including differential equations; a full-year calculus-based physics course; a full-year college-level course, with laboratory, in chemistry. 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 an interview, the submission of a statement of purpose, presentation of undergraduate academic record, 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 Admissions Office 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 TOEFL score of 600 (paper based) or 250 (computer based) or higher. 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 are also required to take the TSE-A (test of spoken English), in order to be considered for financial assistantship.

Grades

The average of the grades for all courses taken at the Institute and credited toward a master's degree must be at least a "B" (3.0) grade point average. Research and thesis does not carry a letter grade and is not included in the average.

Curriculum

Imaging science studies are 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. Six tracks (concentrations) have been established: digital imaging processing, medical imaging, electro-optical imaging systems, remote sensing, color imaging and hard copy materials and processes. 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 program are required to complete the following core courses:

1051-711, 712 **Basic Principles of Imaging Science I, II**

1051-716, 717 **Linear Image Mathematics I, II**

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 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 Institute 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 Institute 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 MS 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

Harvey E. Rhody, Coordinator
585-475-6215, rhody@cis.rit.edu

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 Ph.D. degree must demonstrate proficiency by:

1. successfully completing course work, including a core curriculum, as defined by the student's plan of study;
2. passing a series of examinations;
3. 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 Ph.D. program in imaging science must have completed courses in the following areas:

- Calculus and differential equations
- Probability and statistics
- Chemistry (one year)
- University physics (one year)
- Modern physics
- Computer language

Admissions decisions are made by a committee of the 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, must demonstrate proficiency on the Graduate Record Examination (GRE) and must request letters of recommendation from two people well qualified to judge their abilities for graduate study.

Students for whom English is not the native language must also submit the results of the Test of English as a Foreign Language (TOEFL). Industrial and research experience are also considered in the decision to admit.

Graduate assistantships and tuition remission scholarships are available to qualified students. Applicants seeking financial assistance from the center must have all application documents to the Admissions Office by February 15 for the next academic year.

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 and computer engineering) may be granted up to 36 quarter credits toward the Ph.D. degree in imaging science based on their earlier studies and after successful completion of the breadth 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 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 must also complete 27 credits of research, 3 credits of which are associated with the graduate seminar course (1051-706, 707, 708) with a maximum of 9 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:

		Credits
1051-706, 707, 708	Imaging Science Seminar	1
1051-711, 712	Basic Principles of Imaging Science	4
1051-713	Noise & Random Processes	4
1051-714	Information Theory for Imaging Systems	4
1051-716, 717	Linear Image Mathematics I, II	4
1051-721, 722, 723	Imaging Lab I, II, III	1
1051-726	Computing for Imaging Science	4

Admission to candidacy

Admission to candidacy will proceed through the following steps.

- Adviser selection
- Submission and approval of preliminary study plan
- Breadth exam
- Study plan revision based on outcome of breadth exam and adviser recommendation
- Exam committee appointment
- Committee exam
- Faculty decision

The faculty decision for admission to candidacy will be based on the student's complete academic record, score on breadth exam and results of the committee exam. The recommendation of the adviser and exam committee will be carefully considered. If the faculty decision is not to permit the candidate to continue in the Ph.D. track then 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 Ph.D. track then the program continues with the following steps.

- Research committee appointment
- Submission of written research proposal
- Committee review of research proposal
- 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 member of the RIT faculty who is not a member of the faculty of the center. The research committee will supervise the student's research, including review of the research proposal, meeting with the student during the course of the research, and conducting 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. These areas include: remote sensing, digital image processing, color and visual perception, digital microlithography, astronomy, medical imaging, electro-optics and machine vision.

The student must make a formal proposal of the dissertation topic to the Research Committee for approval.

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 Ph.D. A full-time academic load 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 the Ph.D. 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 four years. A total of seven years is allowed to complete the requirements after admission to candidacy.

Final examination of the dissertation

The Research Committee must submit a letter to 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 result of the examination.

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(College of Engineering and College of Science)

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Mark D. Fairchild, BS, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Xerox Professor, Imaging Science and Color Science: color appearance perception and modeling; image quality metrics and models; image rendering; cross-media color reproduction

Richard Hailstone, BS, Northern Illinois University; MS, Indiana University—Associate Professor, Imaging Science: interaction between electromagnetic radiation and matter, photochemistry, computer simulation of imaging processes

Maria Helguera, BS, National Autonomous University of Mexico; MS, University of Rochester; Ph.D., Rochester Institute of Technology—Visiting Professor, Imaging Science: medical imaging, ultrasound tissue characterization, digital image processing

Joseph P. Hornak, BS, Utica College of Syracuse University; MS, Purdue University; Ph.D., University of Notre Dame—Professor, Joint Appointment with Department of Chemistry: physical chemistry, magnetic resonance spectroscopy and imaging

Joel Kastner, BS, University of Maryland; MS, Ph.D., University of California—Associate Professor, Imaging Science: astronomical imaging, including x-ray, infrared and radio spectroscopy; young stars and planet formation; evolved stars and planetary nebulae

John P. Kerekes, BS, MS, Ph.D., Purdue University—Associate Professor, Imaging Science: multispectral remote sensing systems, multidimensional imaging systems

Ethan D. Montag, BA, University of Pennsylvania; Ph.D., University of California, San Diego—Assistant Professor, Imaging Science: color science, color vision, psychophysics, color tolerance, image quality, the use of color in visualization

Zoran Ninkov, BSc, University of Western Australia; MS, Monash University; Ph.D., University of British Columbia—Professor, Imaging Science: detector array development and characterization, development of novel astronomical instrumentation, studies of young stellar clusters, planetary detection

Noboru Ohta, BS, MS, Ph.D., Tokyo University—Visiting Research Professor, Imaging Science: color science, digital color imaging, color reproduction

Jeff Pelz, BFA, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Associate Professor, Imaging Science: visual perception and cognition, understanding high-level visual processing by examining eye movements in the execution of complex tasks in natural environments

Navalgund Rao, MS, Banaras Hindu University; Ph.D., University of Minnesota—Associate Professor, Imaging Science: industrial and medical applications of ultrasound imaging, digital signal processing; modeling and analysis of medical imaging systems

Harvey E. Rhody, BSEE, University of Wisconsin; MSEE, University of Cincinnati; Ph.D., Syracuse University—Professor, Imaging Science: imaging algorithms

Carl Salvaggio, BS, MS, Rochester Institute of Technology; Ph.D., State University of New York College of Environmental Science and Forestry, Syracuse University—Associate Professor: novel spectral measurement techniques of material optical properties

John Schott, BS, Canisius College; MS, Ph.D., Syracuse University—Frederick and Anna B. Wiedman Professor, Imaging Science: quantitative radiometric remote sensing, synthetic image generation, spectroscopy, calibration and atmospheric correction of satellites imaging systems, remote assessment of the Great Lakes water resources

Anthony Vodacek, BS, University of Wisconsin; MS, Ph.D., Cornell University—Assistant Professor, Imaging Science: applications of passive hyperspectral and active laser remote sensing for environmental characterization and monitoring; in-water radiometric measurements for characterizing water quality parameters; non-thermal techniques for wildland fire detection, monitoring, and prediction; model-based algorithms for inverting remote sensing data

EXTENDED GRADUATE FACULTY

Peter G. Anderson, BS, Ph.D., Massachusetts Institute of Technology—Professor, School of Computer Science

David John Axon, BSc, Ph.D., University of Durham—Professor, Physics: astronomy, active galactic nuclei

Sohail A. Dianat, BS, Aria-Mehr University, Iran; MS, Ph.D., George Washington University—Professor, Control Systems, Signal Processing

Lynn F. Fuller, BS, MS, Ph.D., State University of New York at Buffalo (Electrical Engineering)—Professor, Microelectronic Engineering

Roger S. Gaborski, BS, MS, State University of New York at Buffalo; Ph.D., University of Maryland—Professor, Computer Science

Michael Kotlarchyk, BS, MS, Ph.D., Massachusetts Institute of Technology—Professor, Physics

Raghuveer Rao, BS, Mysore University, India; ME, Indian Institute of Science, Bangalore, India; Ph.D., University of Connecticut (Electrical Engineering)—Professor, Electrical Engineering

Ryne P. Raffaelle, BS, MS, Southern Illinois University; Ph.D., University of Missouri at Rolla—Professor, Physics: experimental solid state physics, chemically deposited thin film solar cells, thin film lithium batteries, EBIC, STOS, electrical and optical characterization of thin film semiconductors, semiconductor junctions and devices

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 Associates

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 & 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. (1001-250, 252, 1011-211-213, 1011-205-207, or **equivalent) Class 3, Credit 3 (F)**

1001-701 Cell & 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 *Bioinformatics, 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)**

1001-762 Introduction to Bioinformatics Computing
This course will provide a theoretical and practical (lab-based) study of computational genomics. Topics to be covered include web-based tools for data access, data structures encountered in biological database, database access and analysis, algorithms commonly used to analyze biological data and a comparison of those algorithms. (1016-265, 4003-231-233, or equivalent, and 1016-715) **Class 3, Lab 3, Credit 4 (W)**

1001-763 Advanced Bioinformatics Computing
This course will provide an in-depth exposure to advanced techniques in computational genomics. Topics to be covered include concepts of information theory as they apply to machine learning, algorithms for machine learning and mining of biomolecular data, data mining of micro-array data, molecular network analysis, probabilistic framework for modeling and inference, and the design and management of genomic databases. (1001-762) **Class 3, Lab 3, Credit 4 (S)**

1001-764 High Performance Computing for Bioinformatics
The purpose of this course is to introduce parallel and distributed computing so that students can understand the basics of this technology, determine the type of high-performance hardware and software systems that will be required in their work, effectively evaluate commercially available hardware and software systems, and be able to use and develop software that takes advantage of high-performance systems. An integral component of this course is a capstone oral presentation which will allow each student to describe for his or her peers an important aspect of this field and to demonstrate the integration of the principles of high performance computing into bioinformatics. (1001-763) **Class 3, Lab 3, Credit 4 (S)**

1001-767 Environmental Microbiology
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 & 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 micro-array 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. (1001-763) **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
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
Continuation of 1006-701. (1006-701 or permission of instructor) **Class 2, Lab 2, Credit 4 (W)**

1006-703 Environmental Science Problem Solving III
Continuation of 1006-702. (1006-702 or permission of instructor) **Class 2, Lab 2, Credit 4 (S)**

1006-870 Graduate Seminar
Students are required to participate in a weekly environmental science seminar. **Class 1, Credit 1 (F, S)**

1006-877 Environmental Science External Research
Students will be engaged in conducting environmental research 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)**

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

1008-621 Advanced Instrumental Analysis Lab
A capstone course requiring students to develop experimental protocols to accomplish assigned experiments involving advanced techniques in instrumental analysis. Library, literature and textbook research will be required. Upon agreement with instructor, two to four major experimental techniques will be required. (Corequisite 1008-511 or 711)(1014-441, 445) **Lab 6, Credit 2 (F-X*, W)**

1008-711 Advanced Instrumental Analysis
Theory, applications and limitations of selected instrumental methods in qualitative, quantitative and structural analysis. 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 & 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 neurotransmitters, neural network and directional selectivity using conducting polymers. (Nanoscale physics and chemistry or permission of instructor) **Class 4, Credit 4 (F, W)**

1008-785 Laboratory Techniques for Microsensors & 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. (Nanoscale physics and chemistry or permission of instructor) **Lab variable, Credit 2–4**

1009-702 Biochemistry: Biomolecular Conformation & Dynamics
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 principles, cellular localization and regulation mechanisms. Finally, the metabolic basis of several diseases is presented. Also offered in distance-learning format. (Baccalaureate degree or permission of instructor. **Class 3, Credit 3 (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 course 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 & 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. **Credit 1–16 (1010-879-99 Continuation of Thesis, Credit 0)**

1010-899 Independent Study: Chemistry
Credit variable

1011-707 Introduction to Intellectual Property
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 cannot 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
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. Oral presentation required. Literature project required for graduate credit. (1014-441) **Class 4, Credit 4 (offered every year) (S)**

1012-765 Preparative Inorganic Chemistry Laboratory
The chemistries of different areas of the periodic table are examined, advanced synthetic and characterization methods are utilized. (Inorganic chemistry or permission of instructor) **Class 1, Lab 7, Credit 3 (W)**

1013-730 Chemical Toxicology
Clinical and forensic aspects of abused drugs, including history, structure, classification, drug levels, metabolism and effects. Drug analysis methods: history, theory and practical applications of GLC, HPLC, GC/MS, UV spectrometry, TLC, IR, EIA, FPIA and stat tests. You are the drug chemist and the toxicologist in this multimedia experience. (College biology and chemistry, some biochemistry helpful or permission of instructor) **Class 4, Credit 4 (W-X*)**

1013-736 Spectrometric Identification of Organic Compounds
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, enolate chemistry, organometallic chemistry, synthetic free-radical chemistry, protecting groups and combinatorial chemistry topics are covered in depth. Several classics in total synthesis are included with a strong emphasis on syntheses published in the current chemical literature. (1013-433) **Class 4, Credit 4 (F-X*)**

1013-739 **Advanced Organic Chemistry**
Topics in physical organic chemistry including: techniques for elucidation of mechanism (kinetic, linear free, energy relationships, isotope effects), molecular orbital theory, electrocyclic reactions. (1013-433, 1014-44**3) Class 4, Credit 4 (offered alternate years) (S)**

1013-832 **Stereochemistry**
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**
A general treatment of heterocyclic chemistry. 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**
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**
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**
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**
A study of the fundamental principles of physical chemistry for clinical chemistry and biotechnology students. Kinetic-molecular theory, quantum mechanics, spectroscopy, thermodynamics and kinetics are presented in application to the life sciences. Not acceptable for BS in chemistry. **Class 3, Credit 3 (offered alternate years) (W-X*)**

1014-743 **Advanced Chemical Kinetics**
Methods of investigating the kinetics of chemical reactions and the theories used to interpret their results. Focus on homogeneous reactions in gas and liquid phases. Discussions of references from recent chemical literature. (1014-443) **Class 4, Credit 4 (offered alternate years) (W-X*)**

1014-744 **Advanced Quantum Mechanics**
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 alternate years) (S-X*)**

1014-747 **Principles of Magnetic Resonance**
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; 1014-648) **Class 4, Credit 4 (offered alternate years) (W-X*)**

1014-750 **Chemical Energetics**
This course is designed to explore the fundamental concepts of energy flow using a systems approach. Foundation will be offered with respect to how molecular systems communicate using the flow of energy. This foundation will then be expanded and applied to the understanding of how energy transfer may be harnessed to achieve device function. Molecular wires, optical and thermal switches and sensors will all be built from the understanding of function on the molecular level. Application will be the focus of the course. The course is designed for the individual with only a basic exposure to chemistry who desires to know how molecules can be exploited to provide work. (Nanoscale physics and 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; next offering 2000–01)(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 ad chain growth polymerization reactions are reviewed with specific attention being given to recent advances in block and graft copolymers, functional polymers and polymeric reagents. (1014-433) **Class 4, Credit 4 (F-X*)**

1029-702 **Polymer Chemistry: Chains & Solutions**
Although most polymeric materials find utility as solids, polymer fabrication and characterization techniques are generally liquid-phase processes. This course is concerned with the fundamental physical chemistry of polymers in liquid solutions. Topics to be addressed include: polymerization kinetics and chain structure, molecular weight distributions and determination, polymer solution thermodynamics and transport phenomena, and solution phase transitions. The study of polymeric solids is the focus of 1029-703. (Baccalaureate degree in science or engineering, or permission of instructor) **Class 4, Credit 4 (S-X*)**

1029-703 **Polymer Chemistry: Properties of Bulk Materials**
This course is designed to give the student with a chemistry or materials science background a thorough grounding in the main concepts which describe bulk polymer structure, behavior and properties and to give the student practical tools to predict them. Basic to the understanding of polymer behavior is the fact that it is time-dependent. To emphasize this idea, the course is designed to build up to a study of the thermo-mechanical behavior of viscoelastic materials. (Baccalaureate degree in a science or engineering, or permission of instructor) **Class 4, Credit 4 (F-X*)**

1029-704 **Polymer Characterization Laboratory**
Many students in the Chemistry and Materials Science and Engineering graduate programs are involved in polymer research. This course gives these students an opportunity to acquire proficiency in using the tools of polymer characterization. Techniques for studying 1) molecular weight distributions, 2) spectroscopic analysis of chemical structure, 3) thermal stability, 4) morphology and phase transitions, and 5) mechanical properties will be introduced and mastered. Techniques may concentrate on particular research topics. (Baccalaureate degree in a science or engineering discipline, or permission of instructor)(offered alternate years; next offering 2003-04) **Lab 6, Credit 2 (S)**

1029-705 **Preparative Polymer Chemistry Laboratory**
Students will carry out about eight experiments. They will conduct in about half of those experiments step-growth polymerizations, and in the other half chain-addition polymerizations. Among the polymers produced will be polyvinyl alcohol gel, Nylon 6-10, Nylon 11, polystyrene, high density polyethylene, linear low density polyethylene, copolymer of styrene and methyl methacrylate and polyurethane. The more specific types of polymerizations and reactions introduced will be crosslinking of polymer, interfacial and bulk step-growth polymerizations, cyclopolymerizations, 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 be primarily responsible to analyze the produced polymers and to use literature data to identify them. (1013-437) **Lab 6, Credit 2 (offered alternate years) (F)**

Industrial & 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**
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**
A rigorous study of theoretical concepts and computational issues in linear algebra. Topics include an analysis of gaussian elimination with pivoting, its error and its stability, iterative methods for solving linear systems, matrix factorizations, eigenvalues, singular value decomposition, Krylov subspace methods and application to least squares, systems of nonlinear equations and partial differential equations. This course requires independent study of certain topics that are not covered in the class lectures. Software packages like MATLAB will be utilized through several computing projects. (1016-331, 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**
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 & 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 (offered upon sufficient request)**

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, matchings, connectivity and coloring will be studied. Applications to areas such as optimal routing, transport networks, network design, tournaments and scheduling will be considered. The interplay between graph theory, counting techniques and algebra will also be studied. (1016-767) **Class 4, Credit 4 (S)**

1016-802 **Methods of Applied Mathematics I**
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**
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 & Applications**
A mathematical introduction to the theory and applications of orthogonal wavelets and their use in analyzing functions and function spaces. Topics include a brief survey of Fourier series representation of functions, Fourier transform and the Fast Fourier Transform (FFT) before proceeding to the Haar wavelet system, multiresolution analysis, decomposition and reconstruction of functions, Daubechies wavelet construction and other wavelet systems. Applications such as data compression, noise reduction and image processing will be studied. (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 to 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 or 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. **Class 4, Credit 4 (offered alternate years)**

1023-823 Advanced Clinical Chemistry IV
Introduces the student to the types of instrumentation and analytical methods commonly found in the clinical laboratory. Instrumentation and methods covered include UV-visible spectroscopy, immunoassay, GC-MS, TLC, fluorometry, atomic absorption spectroscopy, electrophoresis, osmometry, nephelometry and PCR techniques. The laboratory component serves to provide hands-on experience in these types of procedures and measurements. **Class 3, Lab 3, Credit 4 (offered alternate years)**

1023-870 Clinical Chemistry Seminar
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 svariable, 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 Grad Co-op
Cooperative work experience for MS clinical chemistry students. **Credit 0**

Materials Science & 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. (1028-701 or equivalent) **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. (1028-704 or equivalent) **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. (1028-701 and 702 or equivalents) **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 & 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 clean-room 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 Materials Properties & 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, mixing and shaping or molding of these materials. (1028-702 or equivalent) **Class 4, Credit 4**

1028-730 Optical Properties of Materials
Fundamentals of geometrical and physical optics, interaction of radiation with matter, dielectrics and thin films, introduction to electro-optic and acousto-optic effects. (1028-704 or equivalent) **Class 4, Credit 4**

1028-733 Magnetic Properties of Materials
Magnetostatics, creation and measurement of magnetic fields, galvano-magnetic and magneto-optic effects, magnetic materials, applications. (1028-701 and 704 or equivalents) **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 & 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 & 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 & 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**

1028-800 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 & 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**

Color Science

1050-701 Vision & 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. **Class 4, Credit 4 (F)**

1050-702 Applied Colorimetry
This course covers the principles of color science including theory and application. Topics include CIE colorimetry, the use of linear algebra for color transformations, the Munsell color order system, metamerism, color inconstancy, history and theory of color tolerance equations and spaces, and an overview of color management. **Class 4, Credit 4 (W)**

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 adaption and color appearance modeling. (1050-702) **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 ference materials for calibration, and evaluation of instrumentation and psychophysical experimentation. (Corequisite: 1050-701) **Class 1, Lab 3, Credit 3 (F)**

1050-722 Color Measurement Laboratory II
This course is the second part of a two-course sequence in which students develop the background and skills required for successful laboratory practice for color science research including data management and analysis, technical writing,and basic programming. Topics include the precision and accuracy analysis of color measuring instrumentation, color tolerance psychophysics, and building an imaging colorimeter. (1050-701, 1050-721, corequisite 1050-702) **Class 1, Lab 3, Credit 3 (W)**

1050-751, 752, 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. **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-controller 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. (1050-702) **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 & 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 9 (minimum for MS)**

1050-999 Color Science Co-op
Cooperative work experience for graduate color science students. **Credit 0**

Imaging Science

1051-706, 707, 708 Introduction to Imaging Science
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, W, S)**

1051-711 Basic Principles of Imaging Science I
This course, the first in a two-quarter sequence, provides the student with a basic understanding of the scientific principles associated with electromagnetic radiation propagation, image capture and formation, and image processing used to reproduce or display images. The first part of the course focuses on the image capture phase of the imaging chain. The fundamentals of the interaction between light and matter are covered. These concepts are then used to understand the operation and limitation of detectors, including charge-coupled devices and conventional film. The latter part of the course focuses on the image display stage of the image chain. Both mean level and spatial properties are discussed. The final part of the course ties together the basic principles covered and uses these to understand system design optimization. Also offered online (Credit or coregistration in 1051-716) **Class 4, Credit 4 (F)**

1051-712 Basic Principles of Imaging Science II
This is the second in a two-quarter sequence that completes a detailed description of the elements of the imaging chain and their interrelationships. In the first module of the course, a basic description of optics is provided starting from electromagnetic principles. In the second module, fundamental techniques for image processing are described, tying in elements from optics, detector physics, and image display. In the final module, the human vision system and color perception are discussed. Also offered online. (Credit or coregistration in 1051-717) **Class 4, Credit 4 (W)**

1051-713 Noise & 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. (1051-711, 712, 716, 717 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. (1051-711, 712, 716, 717 or consent of instructor)(offered alternate years, offered 2004-05) **Class 4, Credit 4 (S)**

1051-716 Linear Image Mathematics I
This course develops the mathematical methods required to describe continuous and discrete linear systems, with special emphasis on tasks required in the analysis or synthesis of imaging systems. The classification of systems as linear/nonlinear and shift variant/ invariant is discussed first, followed by development and use of the convolution integral. This is followed 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. Image sampling and quantization is introduced and discrete convolution and Fourier transform is considered. 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. **Class 4, Credit 4 (F)**

1051-717 Linear Image Mathematics II
This course continues the development of mathematical methods required to describe continuous and discrete linear systems that was begun in 1051-716, with emphasis placed on the use of discrete models of imaging systems. The various types and effects of quantization are considered first, followed by discussions of common means to process sampled and quantized images. The use of linear models of imaging systems is considered, including he discussion of the valid limiting cases of optical imaging in coherent and incoherent light. The course concludes with discussions of various applications of the mathematical models. Also offered online. (1051-716) **Class 4, Credit 4 (W)**

1051-721, 722, 723 Imaging Laboratory I, II, III
This three quarter laboratory is designed to parallel the Basic Principles of Imaging Science I, II, and Noise and Random Processes core requirements. It provides hands-on experience with imaging materials and devices, digital imaging techniques, electro-optical devices, and other imaging modalities. It is intended to reinforce course work and provide the student exposure to, and facility with, a broad variety of instrumentation and analytical methods. In addition, statistical methods of data analysis will be introduced and utilized. **Class 1, Lab 3, Credit 1 (F, W, S)**

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 & Fabrication of Solid State Cameras
The purpose of this course is to provide the student with hands-on experience in building a CCD camera. The course provides the basics of CCD operation including an overview, CCD clocking, analog output circuitry, cooling, and evaluation criteria. **Class 1.5, Lab 7.5, Credit 4 (W)**

1051-736 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, geometrical optics of gaussian beams. Also offered online. **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 (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. (F)**

1051-751, 752, 753 Special Topics: Imaging Science
Advanced topics of current interest, varying from quarter to quarter, selected from the field of imaging science. Specific topics announced in advance. (Not offered every quarter. Consult the imaging science graduate program coordinator.) **Credit variable**

1051-761 Principles of Remote Sensing & Image Analysis
An introduction to radiometric concepts as they relate to remote sensing. The emphasis is on aerial and satellite imaging systems operating from 0.4 - 20 um. After a brief review of the field, the basic radiometry concepts needed for remote sensing are introduced and a governing equation for radiance reaching the sensor is carefully derived. Also offered online. **Class 4, Credit 4 (F)**

1051-762 Remote Sensing & Image Analysis II
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. (1051-761) Also offered online. **Class 4, Credit 4 (W)**

1051-763 Remote Sensing & 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 & 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, sensor response functions, neural networks, and an introduction to electro-optical and computational analogs. Also offered online. **Class 4, Credit 4 (F)**

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 Munsell 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 pain, 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 & 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 Introduction to Digital Image Processing
After a brief review of 2-dimensional signal processing, the course discusses the processing of images on a computer. It includes methods of contrast manipulation, image smoothing, and image sharpening using a variety of linear and non-linear methods. Also discussed are methods of edge and line enhancement and detection, followed by techniques of image segmentation. The course concludes with a discussion of image degradation models and image restoration. Also offered online. **Class 4, Credit 4 (F)**

1051-784 DIP: Spatial Pattern Recognition
This course develops a fundamental understanding of adaptive pattern recognition and a basic working knowledge of techniques that can be used 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 that are developed and analyzed include statistical PR, clustering systems, fuzzy clustering systems, multilayered 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. **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 prototyping, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration. (1051-726, 1051-782 or permission of instructor) **Class 4, Credit 4 (offered alternate years, offered 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 Computer 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 back-projection 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. C**lass 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. **Class 4, Credit 4 (W in class, S online)**

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 & 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 advisor. **Credit variable**

1051-999 **Imaging Science Grad Co-op**
Cooperative work experience for graduate imaging science students. **Credit 0**

National Technical Institute for the Deaf

Programs

Master of Science

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. Within NTID, students can choose from more than 23 fields of study to earn associate degrees. Hearing students may pursue an associate or bachelor's degree in ASL-English interpretation from NTID. Or students may choose from more than 200 technical and professional courses of study to pursue bachelor's or master's degrees through RIT's other seven colleges.

Master of Science in Secondary Education of Students Who Are Deaf or Hard of Hearing

Gerald C. Bateman, Director,
585-475-6480 (voice/TTY)

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 score of 550 or better (213 on computer-based test) on the Test of English as a Foreign Language (TOEFL)

- 30 semester credit hours in a content area are required by New York State 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:** Major in social studies includes economics and government, and at least 21 semester hours in the history and geography of the United States and world.
- Applicants must demonstrate a basic knowledge of sign language as measured by a departmental skill assessment or be willing to take ASL I course at NTID or its equivalent at 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 2004–2005 tuition for students pursuing a master of science degree in secondary education of students who are deaf or hard of hearing is:

Domestic

- Full time (12–18 credit hours)—$2,739 per quarter
- Part time (11 credit hours or less)—$304 per credit hour

International

- Full time (12–18 credit hours)—$5,478 per quarter
- Part time (11 credit hours or less)—$609 per credit hour

		Credits
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 & 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 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 & Sociology of Adolescence
0835-706 Educational Technology & Teaching
0835-721 Structure of American Sign Language
0886-xxx ASL course

Winter Quarter

0835-722 Audition & Spoken Language: Application in Education
0835-712 Curriculum Content & Methods of Instruction
0835-723 Language Acquisition & Variation
0507-701 History of American Educational Thoughts & Practice
0886-xxx ASL course

Spring Quarter

0835-860 Student Teaching I *
0835-820 Perspectives in Teaching Deaf & 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 & 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

* *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,
585-475-2087 (voice/TTY)

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 the above-mentioned programs and who are chosen for the fellowship will receive:

- Full tuition waiver for a 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 hall†

The only expenses remaining for the recipient are food, health insurance, books, and supplies.

Recipients must complete course work within two to 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 baccaluareate degree from an accredited college or university
- United States citizenship
- A 70-decibel or greater hearing loss in the better ear, unaided
- G.P.A. of at least 3.0
- Acceptance into a program of graduate study at RIT

Application materials should be submitted by February 1 for admission the following fall. Applicants will be notified after May 1. For application materials and more information, contact:

NTID Office of Outreach and Transition Services
585-475-2087 (voice/TTY)
www.ambnes@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

National Technical Institute for the Deaf

John A. Albertini, BA, Drew University; MS, Ph.D., Georgetown University—Professor

Gerald C. Bateman, BS, MS, State University of New York College at Geneseo; Ed.D., University of Rochester—Professor; Director, MSSE

Gerald P. Berent, BA, University of Virginia; Ph.D., University of North Carolina–Chapel Hill—Professor

Joseph Bochner, BA, City University of New York-Queens College; MA, Ph.D., University of Wisconsin—Associate Professor

Paula Brown, BA, University of Missouri, Columbia; MA, Kent State University; MS, Ph.D., University of Rochester—Associate Professor

Karen Christie, BS, M.Ed., Lewis and Clark College; Ph.D., University of Pittsburgh—Assistant Professor

Patricia A. DeCaro, BA, Earlham College; MS, State University of New York College at Brockport

Carol Lee De Filippo, BA, Newark State College; MS, Purdue University; MS, Ph.D., Washington University—Associate Professor

Judy C. Egelston-Dodd, BS, MS, State University of New York at Albany; Ed.D., State University of New York at Buffalo—Professor

Susan Fischer, AB, Radcliffe College; Ph.D., Massachusetts Institute of Technology—Professor

Susan Foster, BA, Northwestern University; BS, University of Maine; M.Ed., Bridgewater State College; Ph.D., Syracuse University—Professor

Ronald Kelly, BS, M.Ed., Ph.D., University of Nebraska at Lincoln—Professor

Baldev Kaur Khalsa, BA, M.Ed., Western Maryland College—Assistant Professor

Peter A. Lalley, BS, Siena College; MS, Catholic University of America; Ph.D., State University of New York at Buffalo—Professor

Harry G. Lang, BS, Bethany College; MS, Rochester Institute of Technology; Ed.D., University of Rochester—Professor

Barbara G. McKee, BA, MA, Michigan State University; Ph.D., Syracuse University—Associate Professor

Jeffrey E. Porter, B.Ed., M.Ed., University of Virginia; Ph.D., Washington University—Associate Professor

Sara Schley, BA, Reed College; MA, Northeastern University; Ed.D., Harvard University—Assistant Professor

J. Matt Searls, BA, MA, Gallaudet University; Ph.D., American University—Assistant Professor

Nora Shannon, BS, Nazareth College; MS, Canisius College—Assistant Professor; Coordinator of Student Teaching, MSSE

Donald G. Sims, BA, University of Colorado; MS, Ph.D., University of Pittsburgh—Associate Professor

Michael S. Stinson, BA, University of California at Berkeley; MA, Ph.D., University of Michigan—Professor

National Technical Institute for the Deaf

Secondary Education of Students Who Are Deaf or Hard of Hearing

0835-701 Psychology & Sociology of Adolescence
The purpose of this course is to examine the psychological and social development of adolescents. The ways that family, school and community affect the adolescent's development, including effects on cognitive processes, identity formation and peer relationships, are considered. Psychological and sociological perspectives on the adolescent experience in general are used to provide a framework for understanding the development of deaf adolescents. Educational implications of the theories and research presented are discussed. **Credit 4**

0835-702 Deaf Students: Educational & 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. **Credit 4**

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 interaction, and human ecology. **Credit 4**

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. **Credit 4**

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. **Credit 4**

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. **Credit 2**

0835-712 Curriculum Content & Methods of Instruction
Note: There are five discipline-specific courses here, designated by section: 01 English, 02 Mathematics, 03 Science, 04 Social Studies and 05 American Sign Language. Students will take only the section focusing on the content area in which they will be certified. Descriptions of all five sections follow.

Section 01 English
This course examines issues and methods related to teaching English at 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. **Credit 4**

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. **Credit 4**

Section 03 Science
This course examines issues and methods in teaching secondary level science to deaf and hard-of-hearing students, including the selection, modification, and use of curriculum materials in science. Discussions will be concerned with instructional strategies, classroom management, 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. **Credit 4**

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. **Credit 4**

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. **Credit 4**

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. **Credit 4**

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. **Credit 4**

0835-722 Audiology & 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. **Credit 4**

0835-723 Language Acquisition & 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. **Credit 4**

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. **Credit 4**

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. **Credit 4**

0835-820 Perspectives on Teaching Deaf & 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) **Credit 2**

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**

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**

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) **Credit 2**

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 on 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. **Credit 4**

0886-200 American Sign Language II
This course focuses on continued development of conversational fluency in ASL. Students learn to accurately recognize and produce ASL with appropriate nonmanual behaviors and grammatical features. (American Sign Language I, 0886-199) **Credit 4**

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. (American Sign Language II, 0886-200) **Credit 4**

0507-701 History of American Educational Thought & 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 1920s and '30s and post-World War II changes. Course structure: lectures, seminars, readings from multiple paperbacks and class handouts, essay exams and critique. **Credit 4**

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 myCourses. Last year, myCourses was used by more than 10,000 students at RIT. Online Learning also reviews emerging technologies that support the critical mission of constantly improving teaching and learning.

RIT offers 38 degree and certificate programs, 10 MS, 5 undergraduate degrees, 6 graduate certificates, 17 undergrad 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 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 will take advantage of toll-free phone conferences; while others use text-based chat; others utilize CD-ROMs; some have Web-based simulations, and some require additional software to complete course requirements. All courses use asynchronous Internet/Web-based tools for the fundamental class structure.

Distance students have full access to customer and technical support through toll-free phone numbers and e-mail. Online learners also have full access to the library and library services. Other online services include registration, access to student records, bookstore ordering, and academic advising. Registration can also be accomplished through touchtone phone and fax. Upcoming quarterly schedules can be found at http://online.rit.edu. Once registered, students receive orientation information, including access to registered student pages at http://online.rit.edu. 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 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 like they would face-to-face.

RIT online learning serves students throughout the United States and in some 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, contact:

RIT Online Learning
91 Lomb Memorial Drive
Rochester, NY 14623-5603
http://online.rit.edu/
585-475-5089/5896 (TTY)
1-800-CALL-RIT (V/TTY)

ONLINE GRADUATE PROGRAMS:

Master's Degrees

- Applied Statistics (page 76)
- Cross-Disciplinary Professional Studies (page 18)
- Environmental, Health and Safety Management (page 7)
- Health Systems Administration (page 16)
- Imaging Science (page 142)
- Information Technology (page 51)
- Microelectronics Manufacturing Engineering (page 72)
- Print Media (page 105)
- Software Development and Management (page 50)
- Telecommunications Engineering Technology (page 10)

Advanced Certificates

- Health Information Resources (page 18)
- Health Systems Finance (page 17)
- Human Resource Development (page 15)
- Interactive Multimedia Development (page 54)
- Statistical Methods for Product and Process Improvement (page 77)
- Statistical Quality (page 76)
- Technical Information Design (page 76)

EXECUTIVE EDUCATION

RIT offers programs designed specifically for working professionals looking for a flexible option to complete a graduate degree. These programs are targeted to working professionals and offer non-traditional and time-shortened options for degree completion.

The College of Applied Science and Technology offers five Executive Leader graduate programs that allow career professionals to pursue a master's degree with minimal interruption. By combining summer sessions, distance learning, independent study, and credit for selected work experience and significant professional accomplishments. Executive Leader programs allow students to earn a degree in about 15 months. These accelerated MS degree programs are developed for practicing mid-level managers and for executives who hold a bachelor's degree and a minimum of five years' experience in the field. Programs include:

- (MS) Hospitality-Tourism Management (page 11)
- (MS) Human Resource Development (page 15)
- (MS) Training and Instructional Design (page 15)
- (MS) Packaging Science (page 9)
- (MS) Service Management (page 12)

College of Business Executive Programs are designed emerging executives—especially technical and functional specialists interested in improving their organization's customer satisfaction, product quality, and organizational productivity.

- **(EMBA) Executive Master of Business Administration**
  A general management program for executives with extensive work experience. This program can be completed on alternating weekends in a two-year time frame (see page 38).
- **(MS) Master of Science in Manufacturing Management & Leadership**
  A joint program with the College of Engineering that focuses on the cross-functionality of business and manufacturing in the manufacturing environment. Students attend part time and complete the program in two years (see page 79).
- **(MS) Master of Science in Product Development**
  A joint program with the College of Engineering that focuses on the management processes of bringing new products to market. Classes are held one day per week over a two-year time frame (see page 77).

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, 58 Lomb Memorial Drive, Rochester, New York, 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 or 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 four year 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 higher. Upon arrival at RIT, students with English as a second language may be required to take the Michigan Test. 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 on, 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 with in 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 do 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 students' appropriate status rests with the student's academic department in consultation with the Office of Graduate Enrollment Services and the Registrar.
10. Evaluation of transfer credit (see p. 170) is made by the academic school or department in question.
11. 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 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 program deficiencies may need to be made up.
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 and/or transfer credit may be lost and program deficiencies may need to be made up.

Expenses and Financial Aid

COSTS AND PAYMENT PROCEDURES

The Institute reserves the right to change its tuition and fees without prior notice. Nonmatriculated students are charged graduate rates for graduate courses.

Graduate costs are listed in the table on this page. In addition, any graduate student carrying more than 18 credit hours of study will be charged the full-time tuition rate plus $676/credit hour for each hour of study exceeding 18.

Room and board for full-time students for 2004–2005 will be $1,161 per quarter for a standard meal plan and $1,551 for a double occupancy room in the RIT Inn and Conference Center. 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 course 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; bills are mailed approximately four weeks prior to the beginning of each quarter. A convenient electronic billing option is also available. Payments sent by mail should be made by check, payable to Rochester Institute of Technology. Payments can also be made online at http://ipay.rit.edu. Due dates for the 2004–2005 school year are as follows:

Fall Quarter—Aug. 25, 2004
Winter Quarter—Nov. 23, 2004
Spring Quarter—March 2, 2005
Summer Quarter—June 1, 2005

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.

If you have questions concerning payment options, please contact Ms. Kathy Cole, RIT Bursar's Office, 585-475-2756.

ONLINE PAYMENT CENTER

The Bursar's Office offers a Web-based payment application that accepts and updates payments on student accounts in real time and payments to food and flex accounts within one business day. Students/parents can conveniently make payments by supplying the student's RIT identification number and date of birth. Payments via Visa or MasterCard are accepted through a secure SSL Web site and updated accordingly. The URL for this e-commerce application is http://ipay.rit.edu/ and there are links for both the Bursar's Office's Web page and the Info-Center/SIS that can be accessed directly from the RIT home page.

GRADUATE COSTS

Tuition	Per Quarter	Per Year—3 Quarters
Full-time (12–18 Credit hours)	$8,030	$24,090
Part-time (11 Credit hours or less)	$676/credit hour	$676/credit hour
Student Activities Fee	$58	$174

ELECTRONIC BILLING AND PAYMENT PRESENTATION (EBPP)

The Bursar's Office offers an electronic billing option for both our quarterly and monthly billing statements. This option enables students and parents to access their billing statements through a secure SSL Web site and link to the Online Payment Center to conveniently make their payment. At the time of each billing, an e-mail is generated to those who select this option.

You may simply click on the URL and link to a PIN number protected site to access the bill. The Bursar's Office Web site at http://finweb.rit.edu/Bursar/ offers directions if you are interested in our EBPP application.

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 here 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 can apply for these awards before matriculation, they can be awarded only to matriculated students. These awards are generally given to full-time students, but exceptions are made for qualified part-time students.

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 Student Financial Assistance Summary on page 169 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 per 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 with 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, 585-475-2186. 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 normally 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 here.

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 Bursar's Office for a 100% 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 Bursar.

Any student who intentionally defrauds or attempts to defraud the Institute of tuition, fees, or other charges or who gives false information in order to obtain financial aid is subject to legal liability, prosecution, and Institute disciplinary action.

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 Bursar 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 your quarterly plan charge and will be deducted from your 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
   Fifth and 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

Standard of Satisfactory Progress for the Purpose of Determining Eligibility for State Student Aid

Graduate Degree—Quarter System

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

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 Bursar's Office 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.

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 Richard B. Schonblom, Bursar.

FINANCIAL AID REFUND POLICY

Return of federal funds

In accordance with federal regulations, the Office of Financial Aid 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 institution. 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
D = Remaining credit balance

$$\frac{A}{B} = C \times D$$

GRADUATE STUDENT FINANCIAL ASSISTANCE SUMMARY, 2004–2005*

PROGRAM	ELIGIBILITY	AMOUNT	HOW TO APPLY
Grants/Scholarships			
Graduate Assistantships	Varies according to need and program of study	Varies	Contact academic department
Institute Graduate Scholarships	Graduate student matriculated into an RIT graduate degree program	Varies	Complete Graduate Admissions Application and check appropriate box to be considered for graduate scholarship
Tuition Assistance Program (TAP)	New York State resident, matriculated and enrolled full time (minimum of 12 credit hours per quarter	Varies	File FAFSA and Express TAP Application (ETA) if sent one after filing FAFSA
Bureau of Indian Affairs Higher Education Program Fellowships	Enrolled full time and recognized by Secretary of the Interior as member of an Indian tribe and demonstrating financial need and academic achievement	Up to $1,500 per academic year	Contact American Indian Graduate Center, 4520 Montgomery Blvd. NE, Albuquerque, NM 87109
AALANA Graduate Scholarship	Awarded to African American, Latino American, and Native American full-time matriculated graduate students demonstrating financial need and academic achievement	Up to $1500 per academic year	File FAFSA by March 15.
NTID Professional Fellowship* Program**	Matriculated graduate students in selected programs of study	Full tuition and stipend	NTID Office of Outreach and Transition Services
Loans			
Federal Direct Subsidized Loan	Students attending at least half time (6 credit hours) and who meet the financial eligibility requirements established by the federal government	Maximum loan is $8,500 per year. Aggregate total cannot exceed $65,500 for undergraduate and graduate work.	Applicants must file the Free Application for Federal Student Aid (FAFSA).
Federal Direct Unsubsidized Loan	All graduate students attending at least half time. Loans cannot exceed cost of education minus other financial aid.	Maximum loan is $10,000 per year. Aggregate limit is $73,000, including undergraduate loans.	Applicants must file the FAFSA.
Federal Perkins Loan	Full-time students who meet financial need requirements established by the federal government	Typically $1,000–$2,200 Limited funding is available for this program. Aggregate limit is $30,000, including undergraduate loans.	File FAFSA by March 15.
Private Lender Loans	Students may apply; subject to normal credit review guidelines. Variable interest rates	Up to the cost of education less other financial aid; subject to lender review	Information and applications are available from the Office of Financial Aid, 56 Lomb Memorial Drive, Rochester, N.Y. 14623-5604.
Work			
Federal College Work-Study Program	Students who meet financial need requirements as established by the federal government	Varies depending on hours and wage rate	File FAFSA by March 15.
Institutional Employment	Full-time students	Varies depending on hours and wage rate	Student Employment Office at RIT

* *Information is accurate as of March 2004. Additional information covering federal financial aid programs is provided in U.S. Department of Education Student Guide. Contact RIT Financial Aid Office to request a copy.*

** *TAP award amounts are dependent upon action in the New York State budget.*

*** *See page 166 for details.*

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. Degrees for fall graduates are mailed early 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 advise the Registrar of any change of address.
3. RIT identification 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. (In the case of nonregistration, the department should inform the Registrar as to whether the student should be put on nonmatriculated status or withdrawn from the program.)
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 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 the 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 always apply to RIT graduate programs. In certain cases, where educationally sound programs will result, appropriate undergraduate courses as approved by the faculty adviser and by 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 (700 and above).

DEGREE REQUIREMENTS

Credit requirements

The minimum credit requirement for a master's degree is 45 quarter (or 30 semester) 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 in 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.

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 the usual 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 should 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.

* *The dissertation is required only of Ph.D. students.*

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.

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.

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 time used for the first degree and 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 Bursar's 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 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 4 quality points
B 3 quality points
C 2 quality points
D 1 quality point

F grades count as 0 in computing the grade point average (GPA). The GPA is computed by the following formula:

$$\text{GPA} = \frac{\text{total quality points earned}}{\text{total quality hours}}$$

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 (I)—this notation is given when the professor observes conditions beyond the control of the student such that the student is not able to complete course requirements in the given quarter. This is a temporary grade that reverts to an F if the registrar has not received a change of grade directive from the professor by the end of the second succeeding quarter (including summer terms). Full tuition is charged.

Withdrawn (W)—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. The student need not take exams, and full 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. Wallace Library is a high-technology multimedia resource center, and serves as the main library on campus. Its vast information resources are conveniently available to all students 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.

Videotapes (VHS) and DVDs can be checked out at the Circulation Desk. Audio Books and wireless laptop computers (Mac and PC) are also available. The IDS (Information Delivery Services) Department on the first floor manages interlibrary loans, and patrons can request materials online through IDS Express. ConnectNY is a service which makes available the combined resources of (currently) five 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 at Geneseo and Brockport.

The Idea Factory is a multi-purpose room on the first floor, featuring The Soap Box (for both impromptu and scheduled use), a living coral reef aquarium, its own 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. Live performers are periodically scheduled here, too. Also on the first floor, Wally's Book Nook features a constantly changing array of available books on a particular topic 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 RIT Library, it is housed in an environment that is temperature and humidity controlled for the preservation of paper and photographs. It forms the primary source for the study of the history and development of the Institute.

The Library is open more than 100 hours per week, with extended hours before and during Finals. For library hours, call 475-2046 (voice); for the RE:SEARCH ZONE, call 475-2563 (voice/TTY) or 475-2564 (voice). You can e-mail the Library at 610wmlref@rit.edu. The Circulation Desk can be reached at 475-2562 (voice) and 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 broadband capabilities for better access to digital libraries, scientific instruments, and other research applications. Many faculty 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 in residential housing at RIT. This team can assist students with getting their computers onto the RIT network, accessing their RIT e-mail account, and trouble-shooting technical problems that may arise. Call ResNet at 585-475-2600 (voice), 585-475-4927 (TTY); e-mail them at resnet@rit.edu, or visit resnet.rit.edu.

Modem access to the campus computer network

Both asynchronous and DialIP 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 and job search seminars and presentations. It also provides on-line 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 Web site 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 475-2301.

Educational Technology Center

The Educational Technology Center 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/Web, 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.

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. Media 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.

A satellite downlink service is also available for those who would like to view a live teleconference broadcast or have it recorded.

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 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 in the Hale-Andrews Student Life 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 4:30 p.m., Mon. through Fri. For more information about counseling services, call 475-2261 (voice/TTY) or 475-6897 (TTY). Check out our Web site at www.rit.edu/~361www/.

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 Web page at www.rit.edu/~320www/ or call 585-475-2135 for more information.

Learning Development Center

The Learning Development Center provides instruction in reading, study skills, mathematics, and writing. These services are available at no additional charge during regular LDC 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 Learning Development Center services, call 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, 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 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); 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) and 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 30 years of age, who live in campus housing, and are enrolled for at least four credit hours, to be immunized against meningitis (meningococcal disease). Additional information concerning the necessary documentation and where it must be sent is included with the Admissions Office acceptance packet or available from the Student Health Center office.

Emergencies, Escort Service

In case of emergency, call the Institute's 24-hour emergency number, 475-3333 (V/TTY). For routine security services, call 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 3:45 a.m., on a timed basis. Call 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 585-475-6620. Our services are also explained on our Web site: 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, 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. For current information about hours and special sales, call 585-475-6033. You can also visit the Campus Connections Web site at http://bookstore.rit.edu.

Campus Connections accepts cash, checks, MasterCard, VISA, and RIT flexible debit cards 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. The Candy Counter accepts cash, checks, MasterCard, VISA, and RIT flexible debit and food debit cards.

Housing Operations

Serving approximately 6,700 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, a fitness center, and a laundry room. Full shuttle service to campus is also available to students. Students with cars will 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

Five apartment complexes and nearly 1,000 apartment and townhouse units distinguish RIT's apartment community as one of the largest university-operated apartment programs in the country. 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 Operations, Rochester Institute of Technology, 63 Lomb Memorial Drive, Rochester, NY 14623-5603 or call 475-2572 (voice) or 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, Grace Watson Hall, the 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, stop in or call 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 is located in the Center for Student Transition and Support and 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. In addition, the office coordinates off-campus programs through the Rochester International Council.

International student clubs on campus 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 PAL (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 on the upper level of the Student Alumni Union. For more information, call 585-475-6943 (voice/TTY). More information is available at www.rit.edu/internationalservices.

The English Language Center

Students whose native language is not English can find assistance at the English Language Center. Writing, grammar, vocabulary, conversation and reading courses are offered at several levels each quarter. Courses are also available in Presentation Skills, Research Paper, Pronunciation, Business Communication and TOEFL Preparation, among others.

Students also may enroll in a full-time intensive English to Speakers of Other Languages (ESOL) program. In addition, students 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 English Language Center, where they can teach their native language and culture or do translations.

The office is located on the first floor (north end) of the George Eastman Building, room 1301. For more information, call 585-475-6684 or visit the Web site at www.rit.edu/~370www or e-mail jbcelc@rit.edu.

English Language Testing

The minimum TOEFL requirement for most graduate programs at RIT is 213/550. Upon arrival at RIT, 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 additional cost.

The tests are given at the English Language Center in the George Eastman Building before registration each quarter or at another time 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 NYS 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. It is open to children of RIT students, faculty, and staff and 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: three- and four-year olds
- Full-day kindergarten/after-school programs: five- to eight-year-olds
- "Lil" Kids on Campus: for youngsters 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. Programs are characterized by a dynamic, project-oriented approach to learning.

- Kids on Campus: for youngsters entering grades 5 through 10
  Full-day program offered during July

Kids on Campus programs are offered to all Rochester-area students. Call for information and registration material. Contact Susan Kurtz at 585-475-5987 or sfkldc@rit.edu.

Veteran Services

Courses and programs at the Institute 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.

To ensure a smooth transition and successful academic program completion, start your benefits paperwork early. For benefits assistance or information, call 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,
- to develop and implement programs that promote commitment to equality and justice in campus-wide activities and
- to develop and nurture a support system that increases participation by all members of the RIT community.

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* 0104 Finance
* 0105 Marketing
* 0106 Decision Sciences/ Production & Operations Management
* 0112 Management Information Systems

COLLEGE OF ENGINEERING

* 0301 Electrical Engineering
0302 General Engineering
* 0303 Industrial & Systems Engineering
* 0304 Mechanical Engineering
* 0305 Microelectronic Engineering
* 0306 Computer Engineering
* 0307 Quality & Applied Statistics
0308 Microsystems Engineering

COLLEGE OF LIBERAL ARTS

0501 Criminal Justice
0502 Language
0503 Foreign Languages
0504 Literature
* 0505 Fine Arts
0507 History
0508 Science, Technology & Society
* 0509 Philosophy
0510 Anthropology
0511 Economics
0513 Political Science
* 0514 Psychology
* 0515 Sociology
0516 Social Work
0520 Interdisciplinary—Liberal Arts
* 0521 Public Policy
0522 Women's Studies
0523 American Studies
* 0535 Professional & Technical Communication

COLLEGE OF APPLIED SCIENCE AND TECHNOLOGY

0606 Electrical/Mechanical Engineering Technology
* 0607 Packaging Science
0608 Civil Engineering Technology
0609 Electrical Engineering Technology
* 0610 Mechanical Engineering Technology
* 0614 Telecommunications Engineering Technology
* 0617 Manufacturing Engineering Technology
0618 Computer Engineering Technology
0619 Hospitality Service Management
0620 Nutrition Management
0621 Food Management
0622 Hotel & Resort Management
0623 Travel Management
* 0624 Hospitality/Tourism Management
* 0625 Service Management
* 0626 Human Resource Development
* 0627 Instructional Technology
* 0630 Environmental Management Technology
* 0633 Safety Technology
0634 Emergency Management
* 0635 Health Systems Administration
0640 Reserve Officer Training Corps—Air Force
0650 Reserve Officer Training Corps—Army
0680 Accounting & Business Systems
0681 Business & Management
0682 International Business
0684 Quality Management
0686 Humanities & Social Science
* 0688 Technical Communication
0692 Math & Science
0694 Emergency Management
* 0699 Cross-Disciplinary Professional Studies

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0801 Accounting Technology
0804 Business Technology/ Administrative Support Technology
0805 Applied Computer Technology
0806 Interdisciplinary Studies
0812 Computer Integrated Machining Technology
0813 Computer Integrated Machining Technology
0820 Healthcare Billing & Coding Technology
0825 Art & Computer Design
0827 Applied Optical Technology
* 0835 Graduate Secondary Education
0853 Prebaccalaureate Studies
0860 Speech & Language
0875 ASL/English Interpretation
0876 Deaf Studies Certificate
0878 Digital Imaging & Publishing Technology
0879 Laboratory Science Technology
0880 Communication Studies
0880 Humanities
0881 Performing Arts
0882 Social Science
0883 English
0884 Mathematics
0885 Science
0886 American Sign Language
0890 Computer Aided Drafting Technology
0891 Automation Technologies

COLLEGE OF SCIENCE

1001 Biology
1004 General Biology
1005 Field Biology
* 1006 Environmental Science
* 1008 Analytical Chemistry
* 1009 Biochemistry
* 1010 Chemistry
1011 General Chemistry
* 1012 Inorganic Chemistry
* 1013 Organic Chemistry
* 1014 Physical Chemistry
* 1015 Environmental Chemistry
* 1016 Mathematics & Statistics
1017 Physics
1018 Contemporary Science—General
1024 Medical Lab Technology
1025 Nuclear Medicine Technology
1026 Clinical Science—General
1027 Biomedical Computing
1028 Materials Science & Engineering
* 1029 Polymer Chemistry
1030 Diagnostic Medical Sonography
1032 Physician Assistant
1050 Color Science
* 1051 Imaging Science
1055 Honors Courses

COLLEGE OF IMAGING ARTS AND SCIENCES

* 2001 Interdisciplinary Imaging Arts
2009 New Media Design
* 2010 Graphic Design
2011 Art Education
2012 Art & Design Extended Studies
2013 Foundation Courses
2015 Interior Design
* 2019 Illustration
* 2020 Medical Illustration
* 2021 Fine Arts Studio
* 2035 Industrial Design
2039 Art History
* 2040 Ceramics
* 2041 Glass
* 2042 Metals
* 2043 Textiles
* 2044 Wood
2045 General Crafts Studies
2046 Crafts Extended Studies
2060 Fine Art Photography
2061 Biomedical Photo
* 2065 Film & Animation
2067 Photographic Arts
2068 Imaging Systems Management
2076 Imaging & Photo Technology
* 2080 Printing Management
* 2081 Printing Technology
2082 Graphic Media
2083 New Media Publishing

COLLEGE OF COMPUTING AND INFORMATION SCIENCES

* 4002 Information Technology
4003 Computer Science
4004 Information Technology Graduate Web and Multimedia
4005 Computer Science
4010 Software Engineering

** Online option*