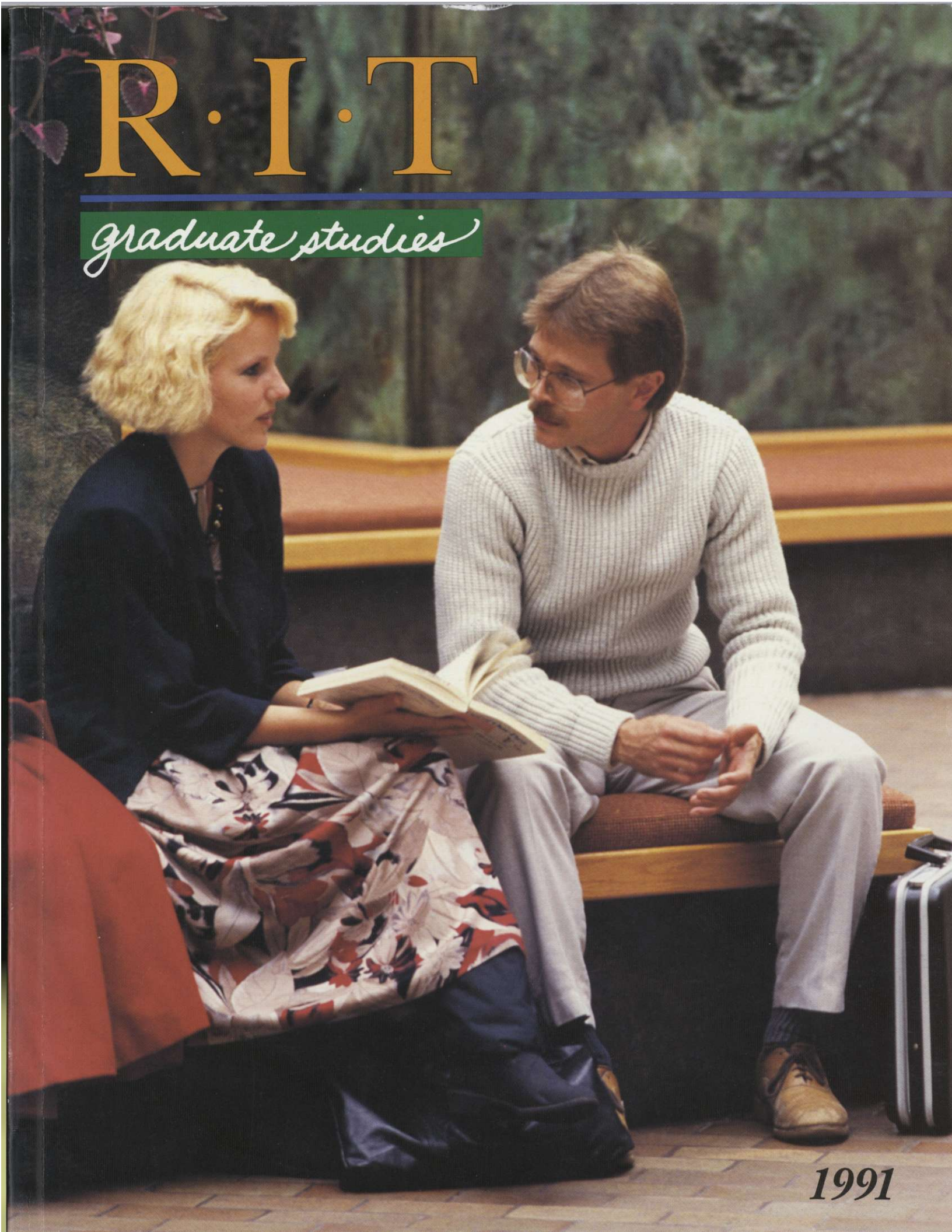
R·I·T

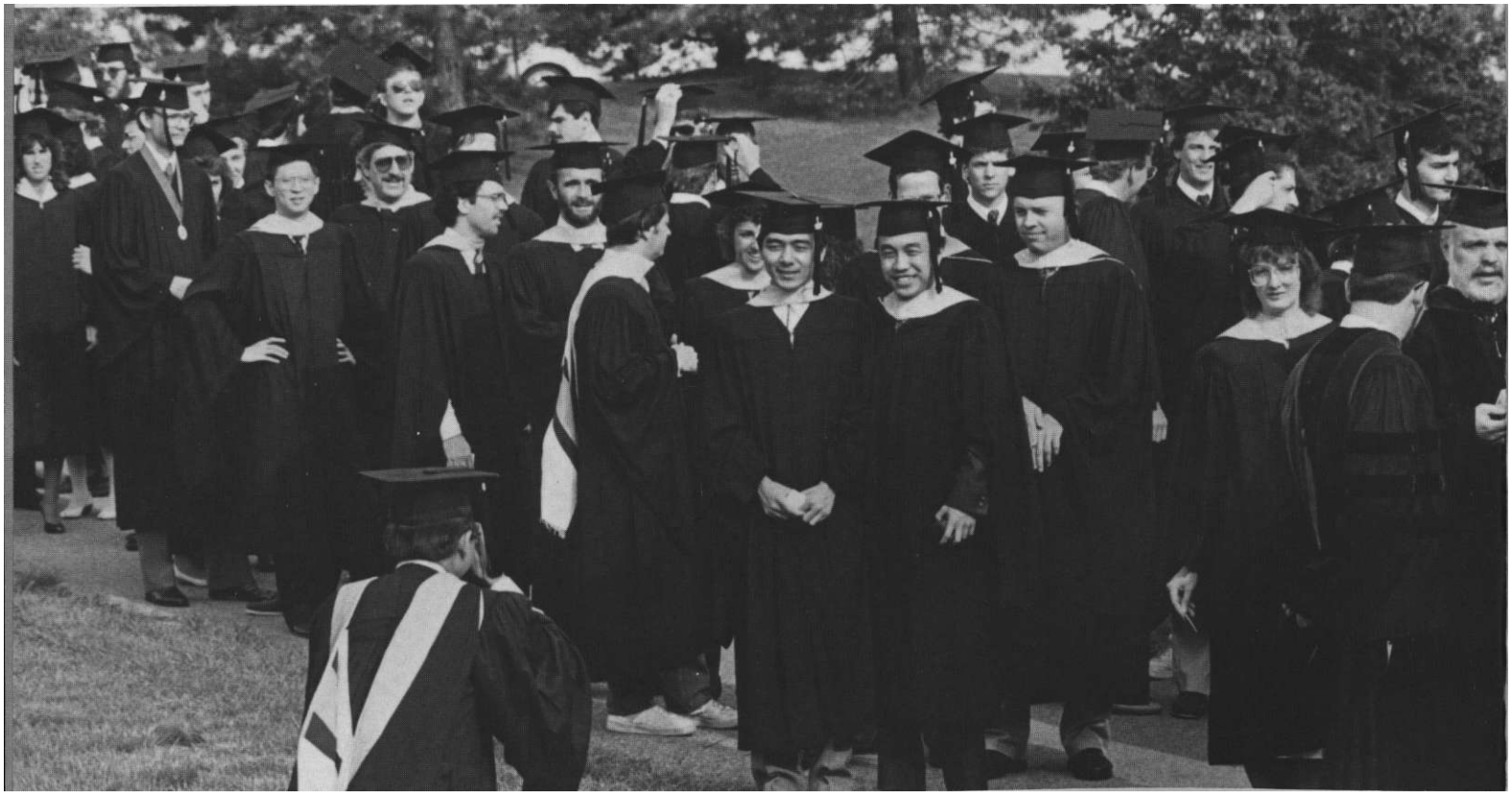
graduate studies



1991

Rochester Institute of Technology Calendar 1991-92

	No Classes	Classes Begin Day Colleges	Exam Week	Last Day of Quarter
Fall Quarter	Nov. 20-Dec. 1	Sept. 5	Nov. 15-19	Nov. 19
Winter Quarter	Dec. 22-Jan. 6 Mar. 1-5	Dec. 3	Feb.26-29	Feb. 29
Spring Quarter	May 24-31	March 9	May 19-22	May 22
Summer Quarter	July 3,4	June 1	Aug. 11-13	Aug. 15



About this bulletin—
This Graduate Bulletin does not constitute a contract between the Institute and its students on either a collective or individual basis. It represents RIT's best academic, social, and financial planning at the time the Graduate Bulletin was published. Course and curriculum changes, modifications of tuition, fee, dormitory, meal and other charges, plus unforeseen changes in other aspects of RIT life sometimes occur after the Graduate Bulletin has been printed but before the changes can be incorporated in a later edition of the same publication. Because of this, Rochester Institute of Technology does not assume a contractual obligation with its students for the contents of this Graduate Bulletin.

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

Graduate Study 1991-92
Produced by RIT Communications and the Graduate Council

Write or phone:
Rochester Institute of Technology
Graduate Studies Office
P.O. Box 9887
Rochester, NY 14623-0887
(716) 475-6768

Contents

RIT

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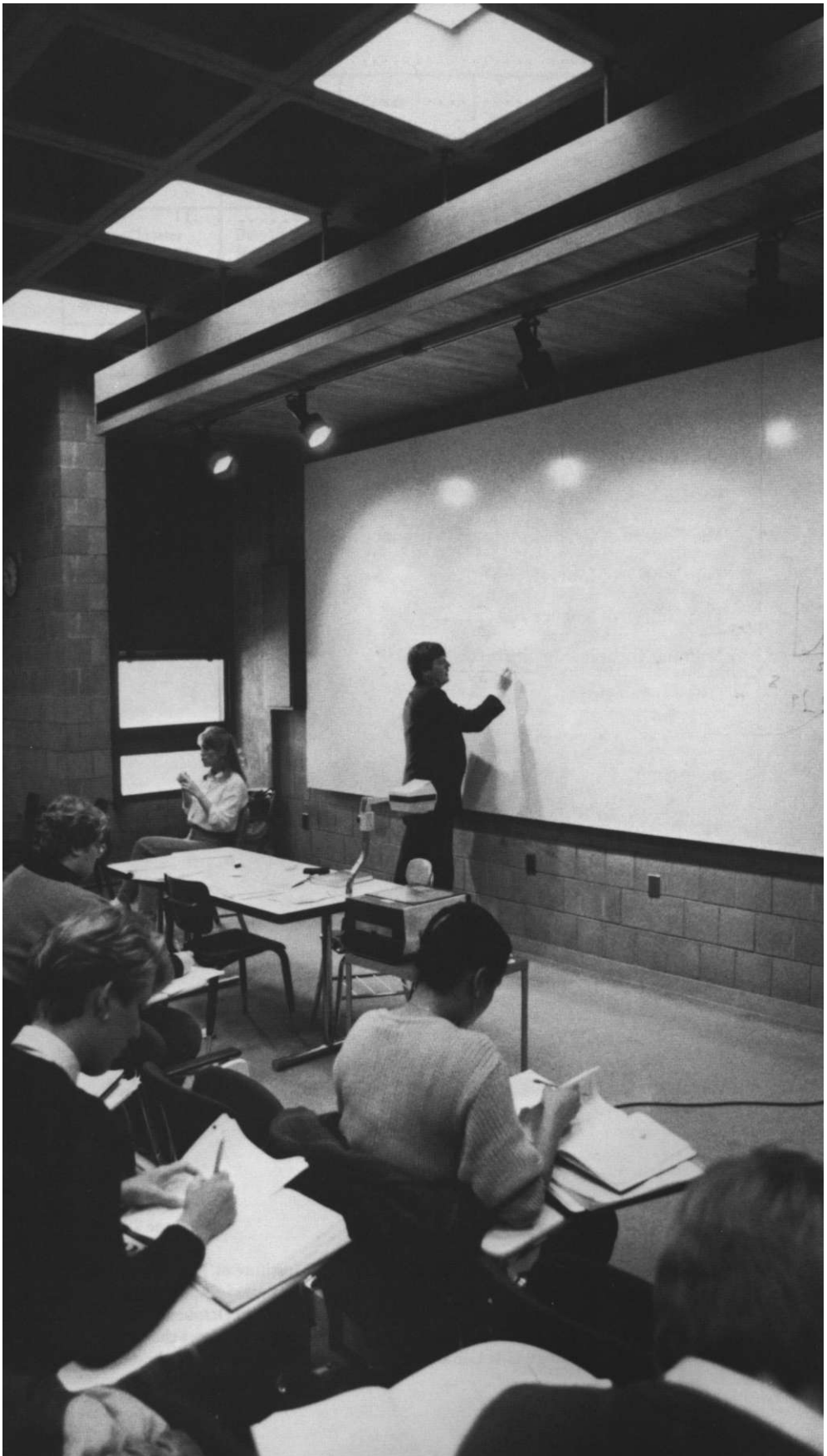
About RIT



Founded in 1829, Rochester Institute of Technology has been a pioneer in career-oriented and cooperative work-study higher education. RIT includes a modern 1,300-acre campus and the RIT City Center in downtown Rochester. The nonsectarian, coeducational, independent Institute prepares students for technical and professional careers in a changing world.

RIT consists of nine colleges: Applied Science and Technology, Business, Continuing Education, Engineering, Fine and Applied Arts, Graphic Arts and Photography, Liberal Arts, Science, and the federally funded National Technical Institute for the Deaf.

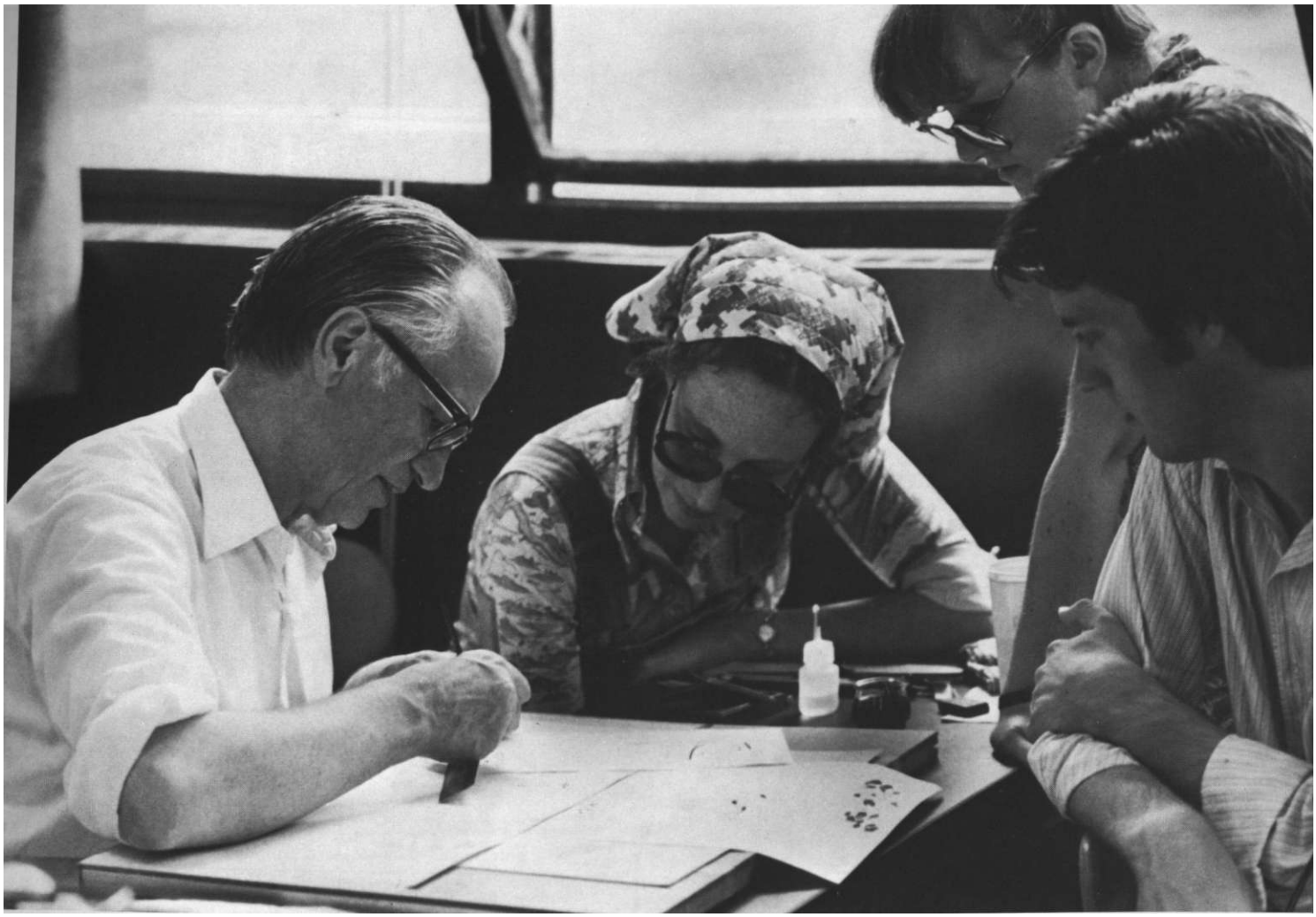
Graduate Education at RIT

About 30 years ago, Rochester Institute of Technology expanded its educational responsibilities to include graduate curricula, the first being in the area of fine arts. Encouragement from a variety of professional sources plus student demand caused the Institute to initiate programs in the arts and crafts leading to the master of fine arts degree. Shortly thereafter, RIT appointed a Graduate Council and petitioned for a charter to give the Institute authority to grant the master of science degree.

In early 1990, the Institute's first doctoral program in imaging science was registered with the State Education Department.

The function of the Council on Graduate Studies was "to define the essential character of a graduate study at the Institute, to establish policies and procedures for the administration of graduate study, and to provide for a continuous review of graduate programs."

By 1963 student interest and industrial and business requirements caused the College of Science to develop a master's program in chemistry. This program was designed to provide opportunities for significant research, additional acquisition of knowledge in appropriate areas of chemistry, and study in allied areas such as physics and mathematics.



Within a year, the Institute received requests from the armed forces and many industrial employers for a graduate program in photographic science. The new curriculum, in contrast to offerings at European universities, was concerned principally with the application of photography to problems of science and engineering.

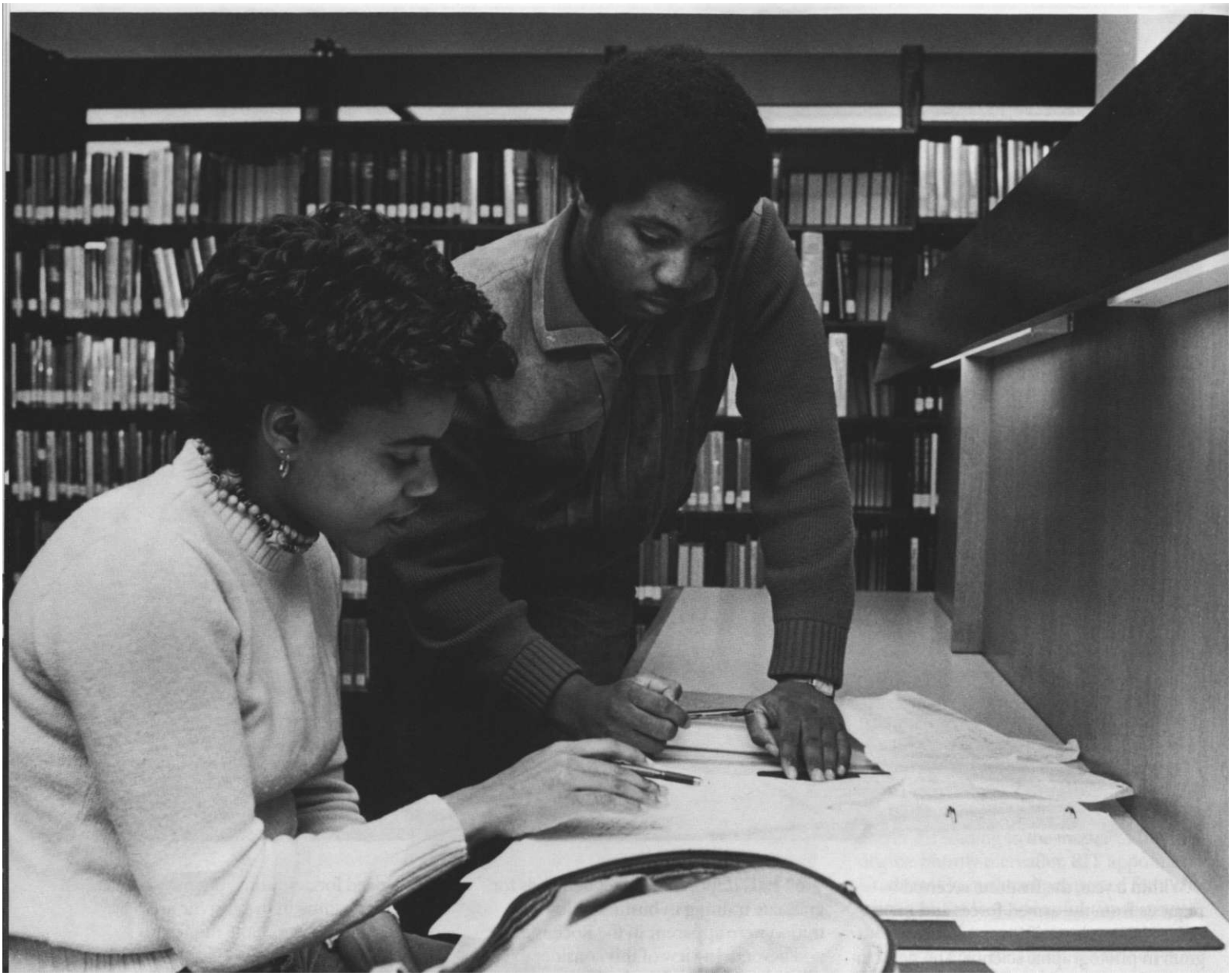
By 1965 national and local surveys suggested another area of responsibility for RIT. Considerable need was indicated for sophisticated statisticians, particularly individuals who could undertake the complex task of collecting, analyzing, and interpreting data necessary for industrial planning. Accordingly, the College of Continuing Education created a Department of Statistics and began to offer work leading to a master of science degree in applied and mathematical statistics.

By 1968 important unmet demands for graduate training in business administration were apparent in the Rochester area and beyond. In view of this considerable need, the College of Business developed a master of business administration program which encompassed all of the management and business areas common to middle and upper-middle management. The new curriculum was also designed to provide a balance between the behavioral and quantitative aspects of business management.

Later in 1968, in addition to the two-year MFA program, the College of Fine and Applied Arts developed a program in art education leading to the master of science in teaching degree. The program was specifically designed for secondary school teachers of fine and applied arts who wished to improve their understanding and skills and earn certification.

The need for additional people with technological training in the graphic arts became apparent from the numerous requests RIT received for a graduate program in printing. As a result, the School of Printing Management and Sciences introduced a graduate program in January 1969, leading to the MS degree.

Recent additions to the list of graduate degree programs now available include the MS in school psychology, the MS in hospitality-tourism, the MS in both graphic arts publishing and graphic arts systems, and the Ph.D. in imaging science.



The Department of Instructional Technology has developed an MS degree program for those engaged in teaching or directing multi-media communications. This combines and builds upon the several communication/graphics/visual disciplines long associated with RIT. In addition, the College of Applied Science and Technology now offers an MS in computer science through its School of Computer Science and Information Technology. The Department of Packaging Science also started its master of science degree program in the spring of 1983 in response to demand from industry for people with graduate education in packaging. RIT is one of only four schools in the country to offer an MS degree in packaging.

RIT has also initiated an MS interdisciplinary program involving science and engineering in the area of materials science. In addition, our College of Fine and Applied Arts began an MS offering in medical illustration in 1981-82 and inaugurated its MFA program in computer graphics design in the fall of 1984. Beyond this, the new manufacturing engineering option within the ME was approved for the fall of 1985. More recendy, RIT has added new programs in software development, computer engineering, microelectronic engineering, and computer integrated manufacturing. The Institute also began its first Ph.D. program, in the area of imaging science, in September 1990.

Through these programs, the Institute has exhibited a continuous concern for the emerging needs of the business, industrial and scholarly communities. It will consider additional graduate programs as these requirements become evident.

Accreditation

The Institute is chartered by the legislature of the State of New York and accredited by the Middle States Association of Colleges and Secondary Schools. In addition to institutional accreditation, curricula in some of the colleges are accredited by appropriate professional accreditation bodies. Specific mention of these is included in the college descriptions, where applicable.

Graduate Programs of Study

	Graduate Degrees Offered	Programs Available in	HEGIS* Code	For More Information See Page
College of Applied Science and Technology	Master of Science	Computer Science	0701	19
		Software Development and Management	0799	
		Computer Integrated Manufacturing	0913	
		Instructional Technology	0699	
		Hospitality-Tourism	0510.10	
		Packaging Science	4999	
		Computer Integrated Manufacturing	0913	
	Advanced Certificate	Applied Computer Studies	0701	
	Advanced Certificate	Interactive Media Design	0699	
College of Business	Master of Business Administration	Business Options Listed on pages 45-46	0506	42
College of Continuing Education	Master of Science	Career and Human Resource Development	0826	54
College of Engineering	Master of Science	Applied and Mathematical Statistics	1702	58
		Cooperative Program		
		Summer Program		
		Computer Engineering	0999	
		Electrical Engineering	0909	
		Mechanical Engineering	0910	
		Materials Science and Engineering**	0915	
		Computer Engineering	0999	
	Master of Engineering	Engineering (CE, EE, ME, IE, Micro E)	0901	
College of Fine and Applied Arts	Master of Fine Arts or Master of Science for Teachers	Ceramics and Ceramic Sculpture	1009	82
		Graphic Design	1009	
		Industrial & Interior Design	1009	
		Glass	1009	
		Metalcrafts andjewelry	1009	
		Painting	1002	
		Printmaking	1002	
		Weaving and Textile Design	1009	
		Woodworking and Furniture Design	1009	
	Master of Fine Arts	Medical Illustration	1299	
		Computer Graphics Design	1009	
	Master of Science for Teachers	Art Education	0831	
College of Graphic Arts and Photography	Master of Science	Printing Technology	0699	92
		Graphic Arts Publishing	0699	
		Graphic Arts Systems	0699	
		Color Science	1099	
		Imaging Science	1011	
	Master of Fine Arts	Imaging Arts	1011	
	Doctor of Philosophy	Imaging Science	1011	
College of Liberal Arts	Master of Science	School Psychology	0826.02	119
College of Science	Master of Science	Chemistry	1905	125
		Clinical Chemistry	1223	
		Materials Science and Engineering**	0195	
National Technical Institute for the Deaf	None. M.S. in Education offered jointly with University of Rochester	Educational Specialists for the Deaf	0812	136

Enrollment in other than registered or otherwise approved programs may jeopardize a student's eligibility for certain student aid awards. All the above programs are registered according to the indicated HEGIS* code.

**Higher Education General Information Survey*
***Joint program of Colleges of Engineering and Science*

Philosophy of Graduate Education at RTT

Graduate education has been part of the mission of the Rochester Institute of Technology since the first graduate program in Fine and Applied Arts was begun in 1958. During the ensuing years, student demand has led to the emergence of more than 35 graduate programs in such diverse areas as fine arts, business, engineering and imaging science and photography. These offerings have drawn on the total resources of the Institute and have received wide acceptance.

From its beginnings as the Mechanics Institute, RIT has stressed both "earning a living and living a life." Its offerings have also emphasized the amalgam of formal education and experience, and have included a definitive commitment to career development in a context of social responsibility. In particular, RIT's graduate thrust has been oriented in the direction of technology and business, as well as the aesthetic content of the fine arts, photography, and printing.

RIT's graduate programs stress the applications of specialized knowledge that enable students to use their professional knowledge and skills to attain personal and career goals. Further, their graduate accomplishments at the Institute are basic to continuing lifelong learning, career development and personal satisfaction. In certain areas, the MS or MFA is the terminal degree in the field, while in others it provides the base for work at a higher level.

Another fundamental objective of graduate education at RIT is that it be characterized both by effective teaching and quality scholarship. Out of these concerns have risen selective research projects that aid the education of students and provide continuing opportunities for professional growth. At RIT many of our research projects—including projects in engineering, graphic arts, and imaging science—are under the umbrella of the RIT Research Corporation. These projects bring industry experts to campus to interact with faculty and graduate students, give graduate students the opportunity to assist with research projects and keep faculty members up to date on current industry practices. In addition, through the Research Corporation, graduate students utilize special libraries and research facilities as they study in their fields.

Graduate programs at RIT help students understand the conceptual structure and organization of knowledge of their chosen programs. Such an understanding is a necessity if our graduates are to cope with the accumulation of knowledge and technological change in the professions. These programs provide the educational base for additional learning, and offer access into and mobility within one or more professional areas. Through their education, RIT's graduate learners become equipped with the knowledge, skills, and attitudes to stay abreast in their professional fields.

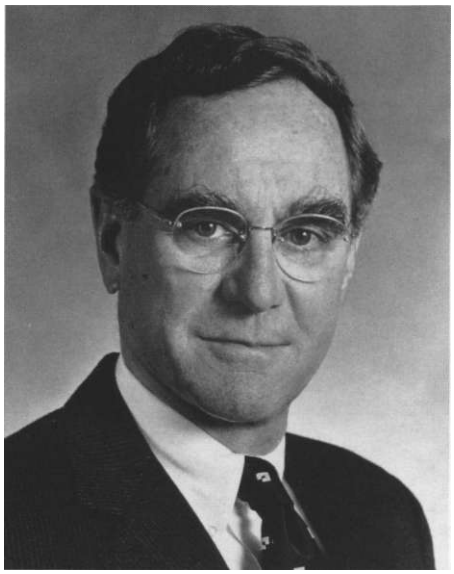
Graduate study should help students to mature as perceptive problem-solvers who will emerge as professional and community leaders. It also should provide a strong base for independent study and experimental learning. Above all, graduate education should help students become skillful and incisive professionals who perceive the human purposes that underscore all learning.

Graduate programs specialized and diverse

In this final decade of the century, it is with a sense of great excitement that I look to RIT's leadership role in higher education.

The Institute continues to receive international recognition for the quality of its programs and faculty from such publications as *U.S. News & World Report, Datamation, Forbes,* and others. RIT's reputation as seen in such programs as imaging science, graphic arts, microelectronic engineering, and the fine and applied arts constantly grows stronger.

This year we enrolled candidates in the nation's first and only doctoral program in imaging science. The master's and Ph.D. programs reinforce RIT's position as the nation's undisputed leader in imaging science.



RIT President M. Richard Rose

At the same time we are exploring programs abroad that further strengthen the international business component within the College of Business.

Graduate students bring increasingly higher credentials to their programs and find RIT to be challenging, professional, energetic, and relevant. Their comments echo our own evaluation of RIT as a dynamic and progressive university that has always been willing to take those extra steps necessary to keep our programs ahead of tomorrow's requirements.

In many ways, RIT also symbolizes much of what we find so desirable about our community, particularly through its attractive blend of tradition, culture, innovation, business, and education.

Dr. Paul Bernstein

"RIT is a highly specialized institution, and our graduate program is a reflection of that," says Dr. Paul Bernstein.

"The hallmark of our overall graduate program is the diversity and quality of the individual programs," he says.

Bernstein is dean of Graduate Studies. He received his bachelor's and master's degrees in education from Temple University, and his Ph.D. in history from the University of Pennsylvania. He has been at RIT since 1966.

"Each of our graduate programs is built as a freestanding unit," he says. "As such, they are designed to fill a specific need in a given field of study.

"As a need developed in a specialized field and RIT felt it could satisfy that need, a program followed," he says.

"Good examples of that are the Hospitality-Tourism, MBA and Imaging Science programs. We perceived an important demand for people in these areas from our discussions with business and industrial leaders, and then proceeded to develop these offerings with their encouragement."

Admission

Decisions on graduate selection rest within the college offering the program. Correspondence between the student and the Institute will be conducted through the Admissions Office, according to the following policies and procedures:

1. Inquiries about, and applications for, graduate study are directed to the Director of Admissions, Rochester Institute of Technology, Bausch & Lomb Center, P.O. Box 9887, Rochester, New York, 14623-0887.

2. The Admissions Office 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 Admissions Office will prepare an applicant file for him or her. All correspondence and admission data will be collected by the Admissions Office, and placed in the applicant's file. The applicant's file will include an RIT application, previous college or secondary school records, applicable test scores, two 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 Admissions Office.

6. The Admissions Office will notify the student of the admission decision.

7. Academic departments may informally advise non-matriculated 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 baccalaureate degree and whatever other evidence of the applicant's potential to successfully complete graduate studies may be required by the particular college. Rare exception 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 are required.

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 their final year of undergraduate study. The student must present a final transcript within one quarter after first registering for a graduate program.

Graduate applicants who do not fully satisfy all admission criteria as to grades, test scores or other 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 student's appropriate status rests with the department in consultation with the Admissions Office and the Registrar.

10. Evaluation of transfer credit (see p. 13) is made by the academic school or department in question and the College of Liberal Arts. For students applying to the College of Continuing Education, transfer credit will be evaluated within that college.

11. RIT will admit and hire men and women, veterans, and persons with disabilities, individuals of any race, creed, religion, color, national or ethnic origin, sexual orientation, age, or marital status, in compliance with all appropriate legislation.

Readmission

If a student has become inactive (has not completed a course in four quarters) or has withdrawn from RIT, Institute policy requires the student reapply for admission. Readmission applications are handled according to the following policy:

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.

4. In addition, each college will have the responsibility, upon readmission, of determining which previous courses, if any, will be applicable toward the degree.

5. In all cases, students must complete the program within seven years of the date of the oldest course counted toward their program. This does not apply to prerequisites, Bridge Program courses in computer science, Foundation courses or similar requirements in other departments. This policy took effect on September 1,1984.

Financial Aid

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 dean, or call Dian Miller in the Graduate Studies Office at (716) 475-2337.

While students can apply for the above 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 (TAP) and various work-study and student loan programs. Please refer to the accompanying summary chart for details.

Graduate Student Financial Assistance Summary, 1991-92

Program	Eligibility	Amount	Where To Apply
Grants/Scholarships Graduate Assistantships	Varies based on academic excellence	Varies up to full tuition	Contact your academic department at RIT for additional information.
Graduate Scholarships	Varies based on academic excellence	Varies up to full tuition	Dr. Paul Bernstein Dean of Graduate Studies RIT P.O. Box 9887 Rochester, NY 14623-0887 (Also see Graduate Scholarship Application Form included in Graduate Admissions Application Packet.)
Outside Scholarships (foundations, corporations, etc.)	Varies	Varies	Consult with principal investigator of research grants in your department.
Tuition Assistance Program (TAP)	Graduate students attending full-time who meet New York State residency requirements and are matriculated at RIT	Maximum award is $ 1200 and is reduced according to family income.	Financial Aid Office at RIT
Loans Guaranteed Student Loan (GSL)	Students attending at least half-time (6 credit hours) and who meet the financial eligibility requirements established by the federal government	Maximum loan is $7,500 per year. Aggregate total cannot exceed $54,750 for undergrad and graduate work.	Applications are available from local lenders. Applicants must also file the Financial Aid Form (FAF) by March 15.
Supplemental Loan	All graduate students	Maximum loan is $4,000 per year. Aggregate limit is $20,000.	Local bank
Plato Loan Universal Education Loan	Students or parents; subject to normal credit review guidelines. Variable interest rates	Up to the cost of education less other financial aid; subject to lender review	RIT Financial Aid Office will mail applications for lender review.
Work College Work-Study Program	Students who meet financial need requirements as established by the federal government	Varies depending on hours and wage rate	File Financial Aid Form (FAF) by March 15. Applications available from RIT Financial Aid Office.
Institutional Employment	Full time student	Varies depending on hours and wage rate	Student Employment Office at RIT

Costs

On the date of publication, the 1991-92 tuition for graduate students pursuing a master's degree is:
Full time (1218 credit hours)—$4,219/quarter
Part-time (11 credit hours or less)—$359/credit hour
Master of Science (CCE)—$359/credit hour
Internship*—$236/credit hour

In addition, any graduate student carrying over 18 credit hours of study will be charged the full-time tuition rate plus $359/credit hour for each hour of study exceeding 18.

Room and board for full-time students for 1991-92 will be $1,678 per quarter. An estimated cost for books and supplies ranges from approximately $700-$1,200 per year per student. For part-time students, books and supplies will depend on the number of courses taken and may cost approximately $300-$450.

All full-time graduate students are required to pay a Student Activities Fee of $30 per quarter.

Tuition and fee payments are due on the following dates:
Fall Quarter, August 21,1991;
Winter Quarter, November 21,1991;
Spring Quarter, February 27,1992;
Summer Quarter, May 20,1992.
These due dates are firm. If payment is not received by the date stated, the student must appear at the registration day for the quarter desired. (See calendar on page 2.) A late payment fee will be charged to all student accounts that become past due.

The Institute reserves the right to change its prices without prior notice. Nonmatriculated students are charged graduate rates for graduate courses.

**Applied only to the internship portion of the master of engineering degree in the College of Engineering, the industrial research option of the MS degree in the Department of Chemistry and the External Research Option in the MS in Clinical Chemistry in the Department of Clinical Sciences. It also applies to the MS degree in career and human resource development in the College of Applied Science and Technology, and to the MS degree in school psychology in the College of Liberal Arts.*

Note: Matriculated graduate students enrolled in CCE or Day College undergraduate courses will be charged the Day College graduate tuition rate.

12-Month Payment Plan

For the 1991-92 academic year RIT offers a 12-month payment plan, which combines the elements of a prepayment/deferred payment plan. For further information about the plan, contact the Bursar's Office at (716) 475-6059.

Refund Policies

Advance deposits are non-refundable. The acceptable reasons for the 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 may elect to complete the course by making special arrangements with both his instructor and department, or to withdraw and receive a full tuition refund. If he withdraws, he 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.

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 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 advisor or department representative, the Institute Coordinator for Academic Advising and the Bursar

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

Fifth and subsequent weeks—No tuition reduction

Note: Non-attendance 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 differential 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 board

To complete a withdrawal from RIT, a resident student or a non-resident student on a meal plan must check out with Housing and/or Food Service. Refunds, when granted, are from the date of official check-out.

Partial refund schedule:

1. Room
   a. During the first week of classes 90% of unused room charge
   b. During the second week of classes 75% of unused room charge
   c. During the third week of classes 60% of unused room charge
   d. During the fourth week of classes 50% of unused room charge
   e. Fifth and subsequent weeks—No refund
2. Board
   a. During the first four weeks, 75% of unused board charge
   b. After the first four weeks, 50% of the unused board charge
   c. During the last two weeks of classes, no refund

Fees

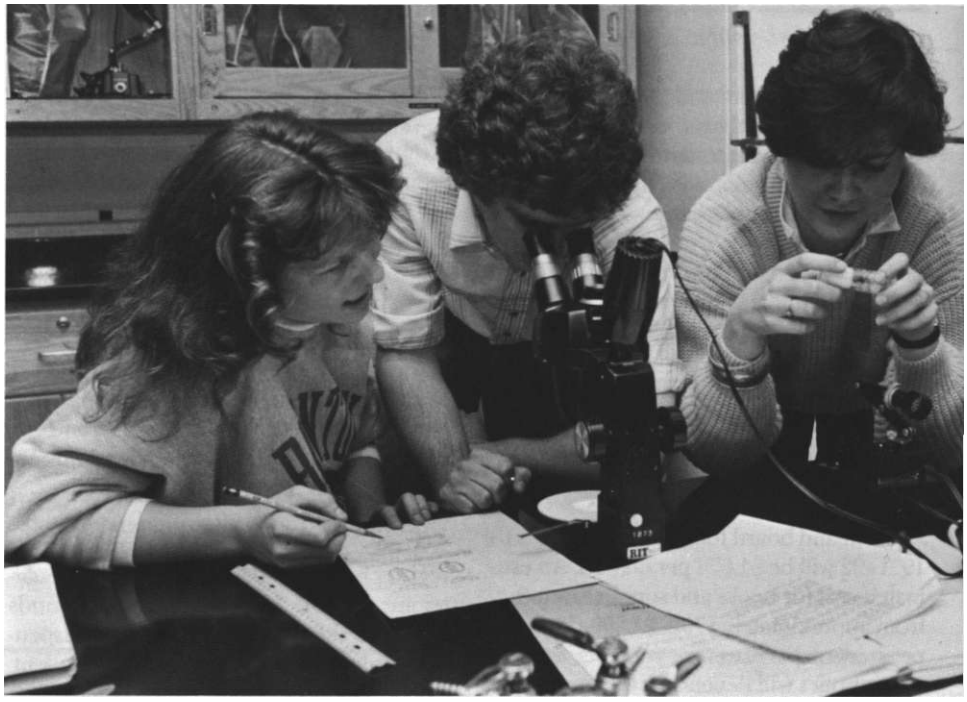
Fees are not refundable.

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. Unresolved matters will be referred for further action to William J. Welch, Controller.

Registration Procedures

1. The 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. Once the student has completed the registration procedure, his/her ID card will be validated. The validated ID card will allow the student to use Institute facilities.
4. If the student fails to register, it is assumed that the student has left the program and that readmission policies will apply if the student wishes to be readmitted to the program. (In the case of non-registration, the department should inform the Registrar as to whether the student should be put on non-matriculated status or withdrawn from the program.)



The Steps Toward Earning Your Degree

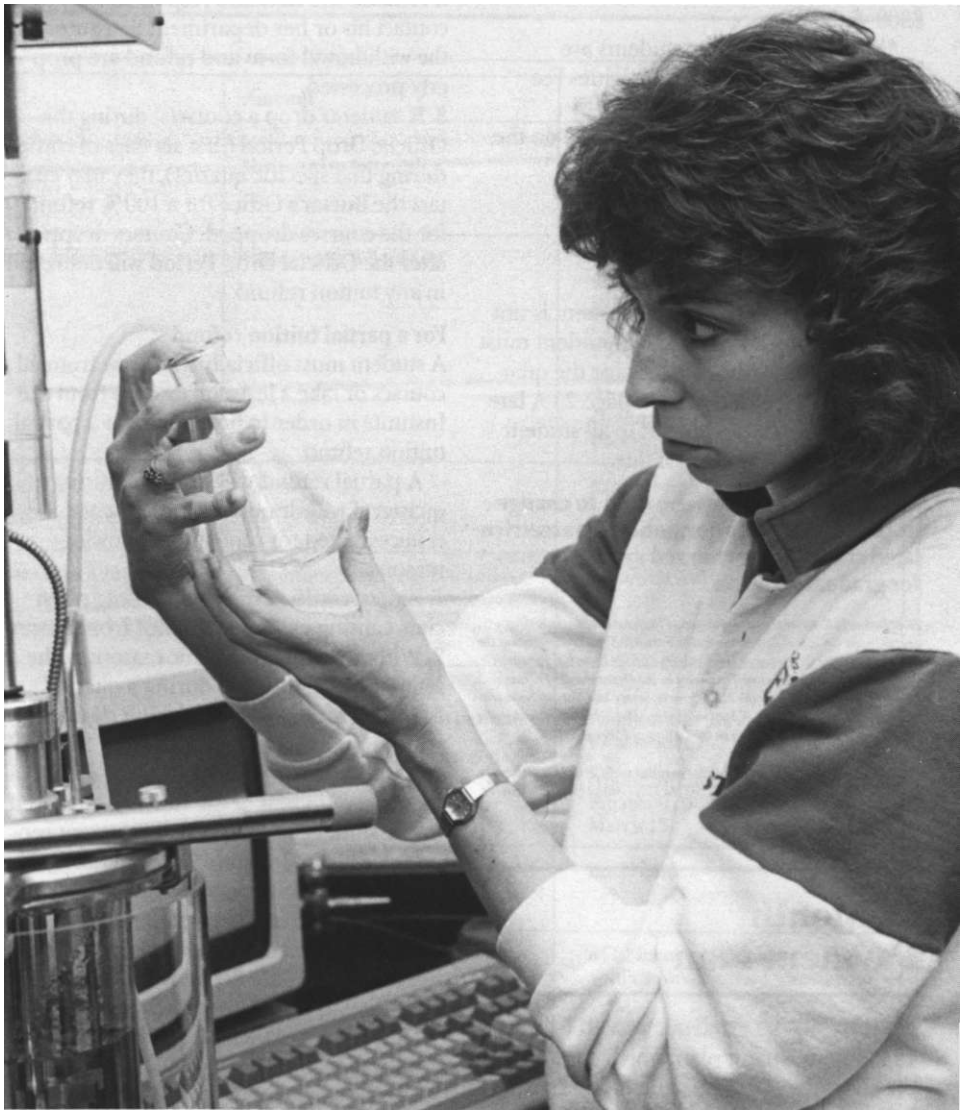
Graduate degree programs

A master's degree at RIT may be obtained in more than 40 programs ranging from business administration to imaging science. (Please refer to page 7 for a complete listing of graduate programs of study.)

Upon completion of the stipulated requirements, a student's academic department certifies him or her for a degree. A statement of requirement completion will be listed on the transcript in the appropriate term. 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.

Graduate registration

Matriculated graduate students are those who have applied and been formally accepted into a graduate program through the Office of Admissions. Such students may register for graduate level courses (700-800) that fit their home department approved programs. When registering for graduate courses outside the home department which are in the normally approved program, the approval of the department offering the course is also necessary.



Non-matriculated (undergraduate or graduate) 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 non-matriculated student will not apply to any given baccalaureate or master's program.

Matriculated and non-matriculated graduate students may register for undergraduate **level** courses with the understanding that these courses may not always apply to an **RIT** master's program. In certain cases, where educationally sound programs will result, appropriate undergraduate courses as approved by the faculty advisor and by the department may be included in a master's program. However, no 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 (700-800) level.

Credit requirements

The minimum credit requirement for a master's degree is 45 quarter (or 30 semester) credit hours. Students should refer to the section covering the college in which they will enroll to earn the credit hour requirements. At least 36 of these quarter credit hours must be earned at the graduate level in residence at the Institute.

External master's degree programs allow for varying amounts of acceptable graduate transfer credits. Thus, the residency requirement may be decreased, if approved by the Graduate Council and vice president for academic affairs. Other exceptions pertaining to a group of students must be approved by the Graduate Council.

Transfer credit

A maximum of nine quarter credit hours in a 45 credit hour program or 12 quarter credit hours in a 48 credit hour program or more 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 (GPA) 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 work at another institution and transfer it 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 and thesis requirement as specified by each department. Some departments have other requirements in place of a thesis. The amount of credit the student is to receive for research and thesis guidance in any given quarter must be determined by the time of registration for that quarter, recorded on the student's card, and verified on the course list.

For the purpose of verifying credit, an end-of-quarter grade of R should be submitted for each registration of research and thesis guidance by the student's faculty advisor. Before the degree can be awarded, the acceptance of the thesis must be recorded on the student's permanent record.

Students should also note the continuation of Thesis Policy on next page.

Continuation of Thesis Policies

Basic Policy

In those programs where a thesis is required, if a student has completed his/her thesis course work but has not finished the thesis itself, it is the responsibility of the student to register for all quarters except the Summer Quarter for a Continuation of Thesis course. Although the Continuation of Thesis course carries no quarter credit hours, the Continuation of Thesis tuition is the equivalent of one graduate quarter hour. Departments may offer graduate students a one quarter extension of time before the Continuation of Thesis tuition is levied. No Continuation of Thesis registrations should be processed for either the quarter in which the Continuation of Thesis is waived, or the Summer quarters.

1. All new and readmitted students matriculated into a graduate program after September 1,1987, will be subject to this new Continuation of Thesis policy.
2. Once work has begun on a thesis, it is seen as a continuous process until all requirements are completed. It is the student's responsibility to register each quarter (except for the Summer Quarter and a quarter that may be waived by the department) for a Continuation of Thesis course if the student has completed the departmental thesis course work but not the thesis itself.
3. If the student does not register for the Continuation of Thesis course, his/her department may either: waive, for one quarter only, the need to register for Continuation of Thesis, or remove the student from the program.
4. The length of time to complete a thesis is at the discretion of the department. However, the thesis and all other graduation requirements must be completed within the seven-year period after matriculation.

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.

A student not formally admitted as a graduate student of the Institute (regardless of the number of graduate credits earned) is a non-matriculated student and not a candidate for an advanced degree. Such a student cannot be a candidate until formally admitted to the Institute as a graduate student. There is no guarantee that any credits in graduate courses earned as a non-matriculated student will apply toward an advanced degree.

Summary experience

The Graduate Council regards some form of integrative experience as necessary for graduate students. Such requirements as the comprehensive examination, 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, 9-12 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 first degree and applied again toward second degree.

In no case shall less 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 Admissions Office to the second degree program until the first program has been completed.

Financial standing

Tuition and fees paid to the Institute cover approximately 60-70 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 other 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 prices 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. Extensions 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 700-800) 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 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.

Michigan Test of English Language Proficiency

All entering students, whose native language is not English, are required to take the Michigan Test of English Language Proficiency. A score of 80 or higher is required to indicate the proficiency needed to handle university-level work. Students with scores below 80 will be referred to the English Language Center at RIT for further evaluation and assistance.

The test is given at RIT's English Language Center in the George Eastman Memorial Bldg. (475-2321) at the beginning of each quarter prior to registration. In addition, the test also can be taken during each quarter by appointment. Rhona Genzel, director, English Language Center, can be contacted at 475-6684 for further information. Students who have paid deposits will receive information on exact testing dates from Mary Ann Campbell, assistant director, International Student Affairs, who can be contacted at 475-6876.

There is no cost for the test to RIT students who have already been accepted, or their spouses. All others must pay a $30 fee.

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 program 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

E and F grades count as 0 in computing the grade point average (GPA). The GPA is computed by the following formula:

$$\frac{\text{total quality points earned}}{\text{total quality hours}}$$

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 work.

Completion of this work will be noted by having the approved/accepted thesis 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 grade 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" form from the professor by the end of the second succeeding quarter. Full tuition is charged.

Withdrawn (W)—will be assigned in courses from which a student withdraws through the end of the eighth week of classes or if a student withdraws from all courses in a given quarter.

Audit (Z)—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.

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 of any credit received through registration for the indicated course. 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 Dean of Graduate Studies 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 towards 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, thus retaining the total 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 was 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 advisor 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.

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.

Student Services

The Wallace Memorial Library

Wallace Memorial Library is a high-technology, multimedia resource center with a collection of over 500,000 items. Included in the holdings are 5,400 subscriptions, 2,300 theses, 230,000 microforms, 5,000 cassettes, tapes and records, over 200,000 books, and a growing collection of compact disk reference sources. Access to the collection is provided through an online computer catalog on site or by remote access. Services include interlibrary loans, computerized literature searching of commercial data bases, class instruction, individual taped tours and access to the Archives and Special Collections Room.

The library also contains a special collection of materials on deafness to serve the National Technical Institute for the Deaf.

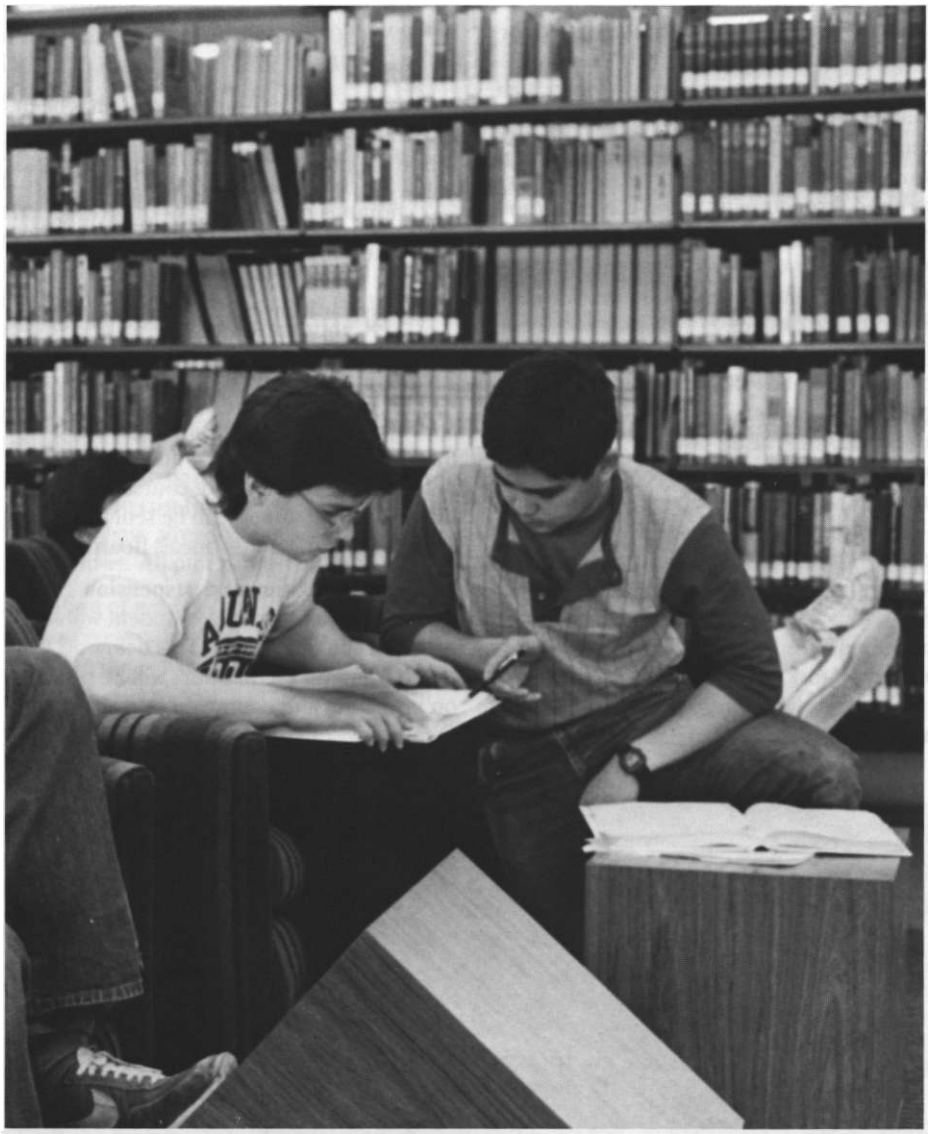
The Media Resource Center located just inside the library entrance on the main level contains a variety of audiovisual equipment and non-print media for individual use. In addition, the center contains more than 70,000 slides. Preview facilities and study carrels are also provided.

The Audiovisual Service Department houses a collection of nearly 400 films and provides materials, equipment, and assistance for classroom instruction. Approximately 3,500 films are shown in classrooms each year.

The library is open over 100 hours a week with extended hours before finals.

Reference librarians are available during the week and on weekends to provide individual assistance, and a special instruction librarian offers service for the hearing impaired and disabled. The Center for the Visually Impaired houses an Arkenstone Reader.

For library hours, call 475-2046 (voice); for Reference Desk, call 475-2664 (voice), 610WMLREF (RITVAX), or 475-2563 (TDD); for Circulation Desk, call 475-2562 (voice), 475-2962 (TDD).



Information Systems and Computing

Information Systems and Computing (ISC) **provides** computing services on VAX/VMS **and** ULTRIX (UNIX) systems and various **microcomputers** at no cost to students **regardless** of their majors. Many RIT colleges **also** have computing facilities available to **students** in their programs.

A VAX/VMS computer account is available to each registered student whether or not specific computer use is required in the student's program. The account remains active as long as the student is registered and in good standing. ISC publishes the *Computer Use Code of Conduct,* which provides guidelines on the use of computers at RIT.

Computer accounts and the files stored in those accounts are the property of RIT. ISC and departments that student accounts are associated with have the right to review and delete accounts and files. Normally accounts are deleted only if the student leaves RIT. ISC will take action against people who abuse the privilege of using RIT's computers.

Central computer systems can be accessed via telephone or terminals in the User Computing Centers (UCC) located in the James E. Gleason Memorial Building (9), Max Lowenthal Memorial Building (12), Microelectronics/Computer Engineering Building (17), Lewis P. Ross Memorial Building (10), and the Grace Watson Hall (25).

UCC and Microcomputer Lab employees assist students using the computer systems. Professional software specialists in the Academic Computing and User Services Department also are available for consultation or presentation of free seminars. Documentation is available in the UCCs and labs, and can be purchased from ISC User Services or Campus Connections' Textbook Department. The monthly *ISC News* and on-line HELP and NEWS also provide information on using ISC systems.

Questions and comments regarding ISC services and policies can be made to Academic Computing and User Services staff in the Ross Memorial Building, room A291, or by calling (716) 475-6929 (-7123TDD). VAX/VMS computer accounts can be obtained from that office. Questions regarding use of computing facilities provided by RIT colleges should be made to the specific college.

Counseling Center

The Counseling Center, located in Grace Watson Hall, offers a variety of services to RIT graduate students. These services include:

- Personal/Psychological Counseling
- Alcohol Counseling & Referral Services
- Career Counseling
- Discover (Computer-Assisted Career Guidance)
- Testing
- Developmental Programs
- Alcohol and Drug Educational Services
- Consultation
- REACT (Rape Education and Counseling Team)
- Referral Services

Counseling Center hours are 8 a.m.-5 p.m., Monday, Tuesday, Thursday; 8 a.m.-8 p.m., Wednesday; and 8:30 a.m.-4:30 p.m., Friday. For more information about Counseling Center services, call (716) 475-2261.

Learning Development Center

The Learning Development Center provides individual and group instruction in efficient reading, study procedures, mathematics and writing skills. These services are available at no additional charge during the day to all graduate students of the Institute and may be scheduled at the center, located on the second floor, north end, of the administration building.

The English Language Center

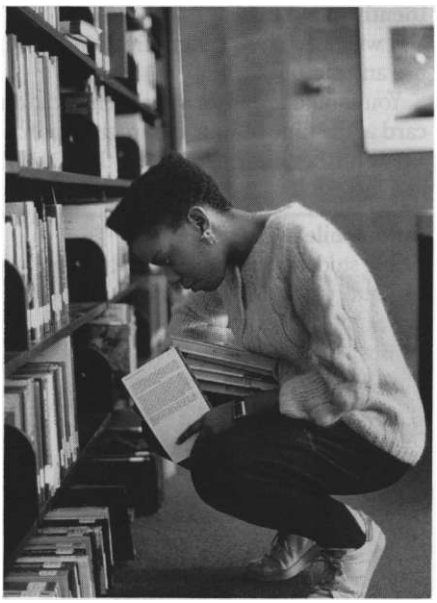
The English Language Center offers instruction in reading, writing, grammar, and vocabulary to international students at RIT. Additional course offerings include: Presentation Skills, Business Communication, Pronunciation, Conversation, and Preparation for TOEFL, among others. International students (and their spouses) may study at the English Language Center on a full or part-time basis. There is a fee for these courses. For further information, contact the Learning Development Center-English Language Center, George Eastman Building, Room 2321,475-6684.

Child care

RIT's Horton Child Care Center offers preschool and kindergarten programs for the children of students, faculty, and staff. For complete information, call (716) 475-5948.

Housing

Four apartment complexes and nearly one thousand apartment and townhouse units distinguish RIT's apartment community as one of the largest university-operated apartment programs in the country. The four



unfurnished apartment facilities—Colony Manor, Perkins Green, Racquet Club, and Riverknoll—are all different in layout and design, and all are serviced by the Institute's shuttle bus system. Apartments range in size from one and two bedroom apartments to two and three bedroom townhouse units. Although the majority of apartment residents are undergraduate students, a mixture of graduate and undergraduate and single and married students can be found in each apartment complex. Apartment contracts run from September through August, although, with proper notification, students may terminate their contracts with a thirty-day notice without penalty. Security deposits are not required, and summer storage is available to returning residents. A modified meal plan is also available to apartment residents through RIT's Food Service Department. For further information on RIT Apartment Housing, contact the Office of Apartment Life, Rochester Institute of Technology, Kate Gleason Hall, P.O. Box 9887, Rochester, N.Y. 14623-0887, or call (716) 475-6920.

The residence halls are designed and programmed primarily for undergraduate students. Due to increased enrollment and the number of returning students living in the halls, space is very limited.

A comprehensive listing of alternative off-campus housing in the Rochester area is available through RIT's Housing Connection Office at (716) 475-2575. The center also provides a free referral service for students in need of housing or roommates.

Identification cards
You will need an RIT identification card to use any campus facility.

You should apply for your identification card at the time of your first registration.

For further information, call the ID office at 475-2125.

Automobile registration
Those students having automobiles on campus must register these vehicles with Campus Safety at the time they first register for classes, or upon bringing the automobile onto campus for the first time.

Enrollment of veterans
Courses and programs at the Institute are approved for the education of veterans under the Veterans Readjustment Benefits Act, the Rehabilitation Acts, and 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 your local VA office or on campus from the Veterans Affairs Office.

Visit the Veterans Affairs Office and complete the necessary forms to ensure your benefits will arrive on time for the beginning of school.

Students who have been receiving benefit payments at other institutions or while participating in a different program and wish to transfer into one of RIT's many programs will be required to complete and submit a "Request for Change of Program or School" form.

To ensure a smooth transition and successful academic program completion at RIT, start your benefits paper work early. For benefits assistance or information, call the Veterans Affairs Office at 475-6641.

Emergencies; Escort Service
In case of emergency (fire, injury) the Institute's 24-hour emergency number, 475-3333, should be called. For routine security services, 475-2853, which is staffed 24 hours a day, should be contacted.

Office of Cooperative Education and Placement
The Office of Cooperative Education and Placement supports the Institute's commitment to preparing students for "the making of a living and the living of a life."

Since 1912 RIT has developed one of the country's largest and strongest co-op programs. In fact, RIT's program is the fourth-oldest and the fifth-largest cooperative education program in the world. Co-op allows graduate students to gain career-related work experience with a company. A co-op opportunity may lead directly to a permanent position upon graduation. Other students may find permanent positions through RIT's on-campus recruitment program or job listing service.

All RIT students (at the undergraduate, graduate, and co-op levels) and alumni find the services of the Office of Cooperative Education and Placement helpful in the job search. Individual career counseling, group skills sessions, reference/credential services, job listings, a resource library, and on-campus interviewing provide a steady linkage between campus and the workplace. Students entering the graduate program are encouraged to meet with their counselors throughout their academic programs. The Co-op and Placement Office hosts orientation sessions frequently to inform students of the many services offered.

Employers interested in hiring advanced degree candidates at either the co-op or the permanent level contact the office and set up an on-campus interview or a job listing. The Office of Cooperative Education and Placement is committed to linking RIT students to career experiences and to career entry upon graduation.

Student Health Service
The Student Health Service provides primary-level medical care on an outpatient basis. The staff includes physicians, nurse practitioners, registered nurses, an interpreter for the deaf, and a health educator. Some specialties—psychiatry, gynecology—are available on campus by appointments. Health education programs are also provided.

The Student Health Service is located on the second floor of the Administration (Eastman) Building. Students are seen on a walk-in basis (Monday-Friday, 8:30 a.m. to 4:30 p.m.). Appointments for follow-up treatment are arranged when necessary.

A registered nurse is on duty in Nathaniel Rochester Hall in the evening (6:30-10:30 p.m.). A medical provider is available from 10 a.m. to 2 p.m. in Nathaniel Rochester Hall on Saturday and Sunday. Emergencies *only* are seen the last half hour of each shift.

For **emergency transportation** the RIT Ambulance is available. The unit can be reached through Campus Safety at 475-3333 (voice) or 475-6654 (TDD).

A student health fee per quarter is mandatory for all full-time undergraduate students. All other students may pay either the quarterly fee or a fee-for-service. Some laboratory work ordered through the Student Health Service is not covered by this fee; there is a nominal charge for this service. Prescription medicines may be obtained from local pharmacies. The health fee does not include prescription medications.

The Institute **requires** students to maintain health insurance coverage as long as they are enrolled as students. They may obtain coverage either through RIT or their own personal coverage.

Questions about the Student Health Service or health insurance should be directed to the office at 475-2255.

Health Records
Medical records are **CONFIDENTIAL.** Information will not be released without the written consent of the student. Exceptions to this rule are made only when required by the public health laws of New York State.

Rape Education and Counseling Team (REACT)
R.I.T.'s Rape Education and Counseling Team (REACT) provides counseling and educational services to the RIT community. The counselors are full-time professional staff, some of whom are skilled in sign language. REACT also provides a confidential hodine for people who need to contact a counselor. The hotline is also accessible to the hearing impaired. The hodine number is 258-3399 (V/TDD). Educational programming is available to everyone in the community and can be accessed by calling the educational program coordinator at 475-6989.

Institutional and civil authority
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.

College of Applied Science and Technology

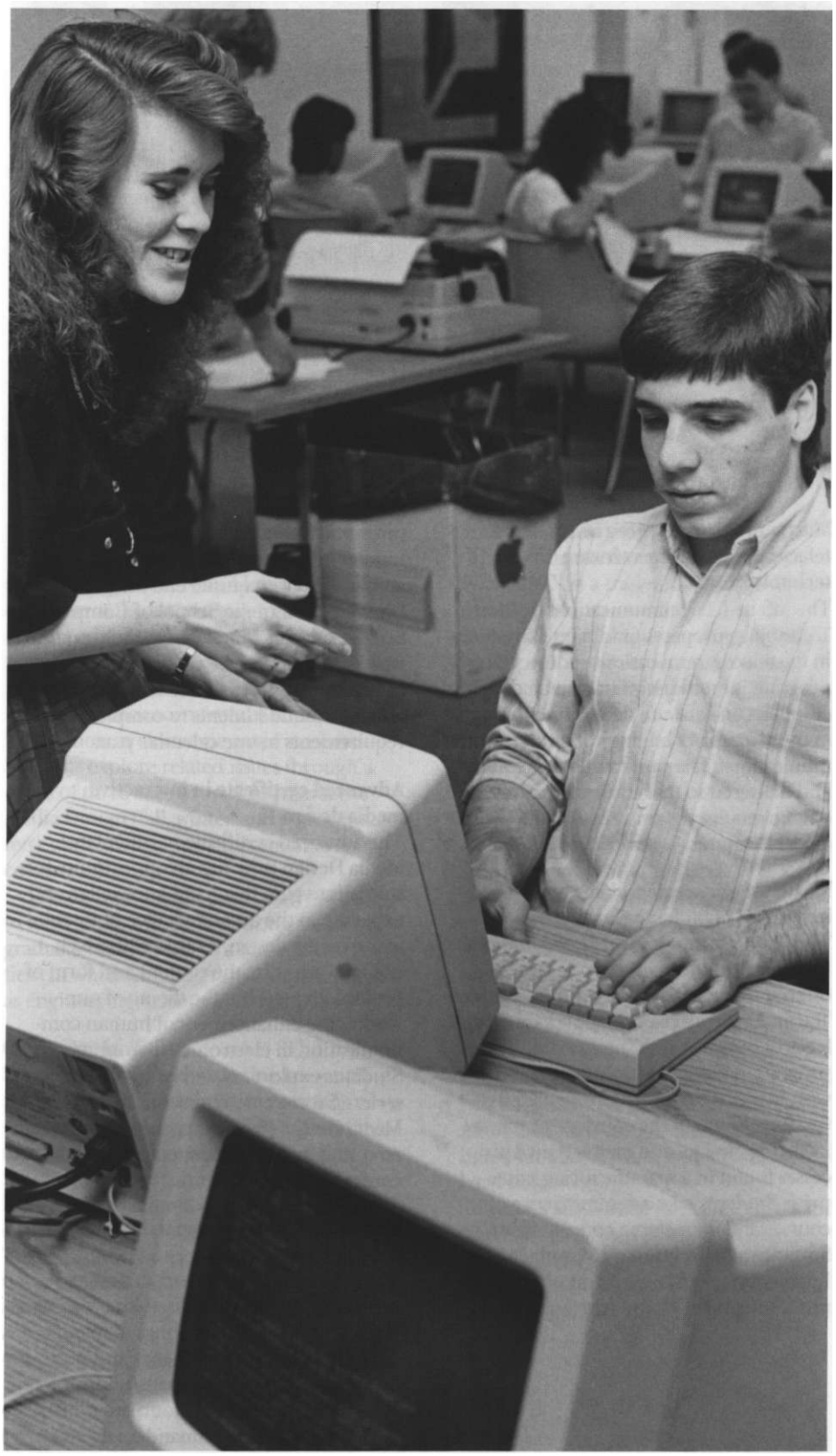
Wiley R. McKinzie, Dean

Graduate education in any discipline requires commitment of both the student and the institution involved. The graduate-level academic areas within the College of Applied Science and Technology represent RIT's commitment to auricular innovation, program flexibility, and academic rigor. The College of Applied Science and Technology is composed of four academic units: the School of Computer Science and Information Technology, the School of Food, Hotel, and Travel Management, the Department of Packaging Science, and the School of Engineering Technology. Graduate degree programs are offered in each of the first three areas, with graduate courses offered in Engineering Technology. These graduate programs are recognized as being academic leaders in the state, national, and international education communities. Graduates are employed or highly sought after by their respective industry and business groups.

Students in Applied Science and Technology have a wide variety of programs from which to choose, including several new offerings. The newest of these is an MS in Computer Integrated Manufacturing. Other MS programs are available in Software Development and Management, Computer Science, Hospitality-Tourism Management, Instructional Technology, Packaging Science, and Telecommunications Software Technology. Advanced Certificates are available in Applied Computer Studies and Interactive Media Design.

A new means of earning the MS in Hospitality-Tourism Management or the MS in Instructional Technology is designed for experienced professionals employed full time in industry. This is called the Executive Leader Program.

The following graduate programs are currently offered in the College of Applied .Science and Technology.



Master of science degree in computer science
Graduates of Computer Science, Science, Engineering, or Business programs who wish to pursue advanced technical and theoretical studies in the field, for purposes of employment or further graduate study at the doctoral level, will find this curriculum offers the opportunity to tailor a program that will satisfy their goals. Courses are offered primarily in the late afternoon and evening.

Master of science degree in software development and management
This graduate degree program prepares students for advanced-level careers in the field of software design, development, and project management. The program is oriented to students with business, computer science, or engineering undergraduate degrees who wish to pursue a career in software development. System and software design and software engineering methodologies are major elements within the curriculum. Courses are scheduled to allow both full- and part-time students to enroll in the program.

Master of science degree in telecommunications software technology
The MS in Telecommunications Software Technology prepares graduates for careers in the telecommunications industry. The program is multidisciplinary, including an emphasis on software development as well as the physical technology of modern communications. The program is structured and delivered so that students may meet degree requirements at sites remote from the RIT campus.

Master of science degree in computer integrated manufacturing
The MS in Computer Integrated Manufacturing is a multidisciplinary degree offered in the department of Information Technology, with participation by the colleges of Business and Engineering. The program is designed for individuals who wish to achieve competence in the effective integration of the computing, manufacturing, design, and maintenance processes found in a manufacturing enterprise. Students take a common core of courses and then elect a concentration in Software and Technology, Manufacturing Engineering, or Management of Computer Integrated Manufacturing.

Master of science degree in instructional technology
The MS in Instructional Technology Program prepares graduates to develop training for adult learners. The program is oriented primarily toward training and development in business, industry, and governmental organizations. The RIT Instructional Technology Program offers options in the areas of instructional design, interactive media design, and training management. While based strongly in theories of learning and instruction, the program is pragmatic and offers training in specific job-related skills. The program may be taken as a full- or part-time student. Most courses are offered in the evening hours to enable all those employed during the day to pursue degree work.

Advanced certificate in applied computer studies
This advanced certificate program provides post-baccalaureate education in computing to students who have completed an undergraduate degree other than computer science. Basic computing skills are covered in the curriculum including programming, data structuring, discrete structures, and assembly language programming. These courses may be used to accomplish prerequisite entry into degree programs within the School of Computer Science and Information Technology, as well as completing the requirements for the certificate. Courses are scheduled to allow part-time students to complete the requirements in one calendar year.

Advanced certificate in interactive media design
The advanced certificate in Interactive Media Design provides an opportunity for students to gain first hand knowledge and expertise in the art and science of interactive media 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 three core courses in Interactive Media Design (fall, winter, and spring quarters), and through one supplemental course each term.

Master of science degree in hospitality-tourism management
The MS in hospitality-tourism management is by design multidisciplinary, in part because its program offerings demand a constant integration of theory and practice. It recognizes that successful professionals in the hospitality-tourism industry must have at their command an extensive and variable set of techniques and strategies to accomplish managerial fact finding, decision making and interpersonal communications. It also acknowledges that successful professionals need intellectual abilities, which allow them to familiarize themselves quickly and thoroughly with an endless procession of new and changing situations.

Master of science degree in packaging science
This graduate program is a natural extension of the undergraduate curriculum, and is one of only a very few graduate curricula in the U.S. Students completing undergraduate studies may continue the study of packaging at a more intensive level, and those who are already working in industry can use the program to enhance career development or allow for concentrated study in an area of interest. There is enough flexibility in curriculum requirements to tailor programs to suit individual needs. Courses are generally offered late in the day so that people presently employed full-time may pursue the degree.

School of Computer Science and Information Technology

William J. Stratton, Director, School of Computer Science and Information Technology
John A. Biles, Chairperson, Department of Computer Science
Peter Lutz, Chairperson, Department of Information Technology

The School of Computer Science and Information Technology offers an MS Degree in Computer Science, an MS Degree in Software Development and Management, an MS Degree in Instructional Technology, an MS degree in Telecommunications Software Technology, an MS in Computer Integrated Manufacturing, as well as a program of study leading to an advanced certificate in Applied Computer Studies, and a program of study leading to an advanced certificate in Interactive Media Design. Graduate courses are given at times of the day convenient to both part-time and full-time graduate students: late afternoon, evening, early morning, and weekends. Students may begin their course work in any one of the four quarters at RIT. Depending on individual preparation, a full-time student can com-

plete the course work for the Computer **Science** MS Degree in as little as one calendar **year and** complete the thesis or project **in one or** two quarters. The advanced cer**tificate may** be accomplished in one calendar **year.**

The MS Computer Science Program prepares students for a wide variety of computer-related careers in business, industry, and academia. Graduates are prepared to work in computer system software development, applications development, research, and education.

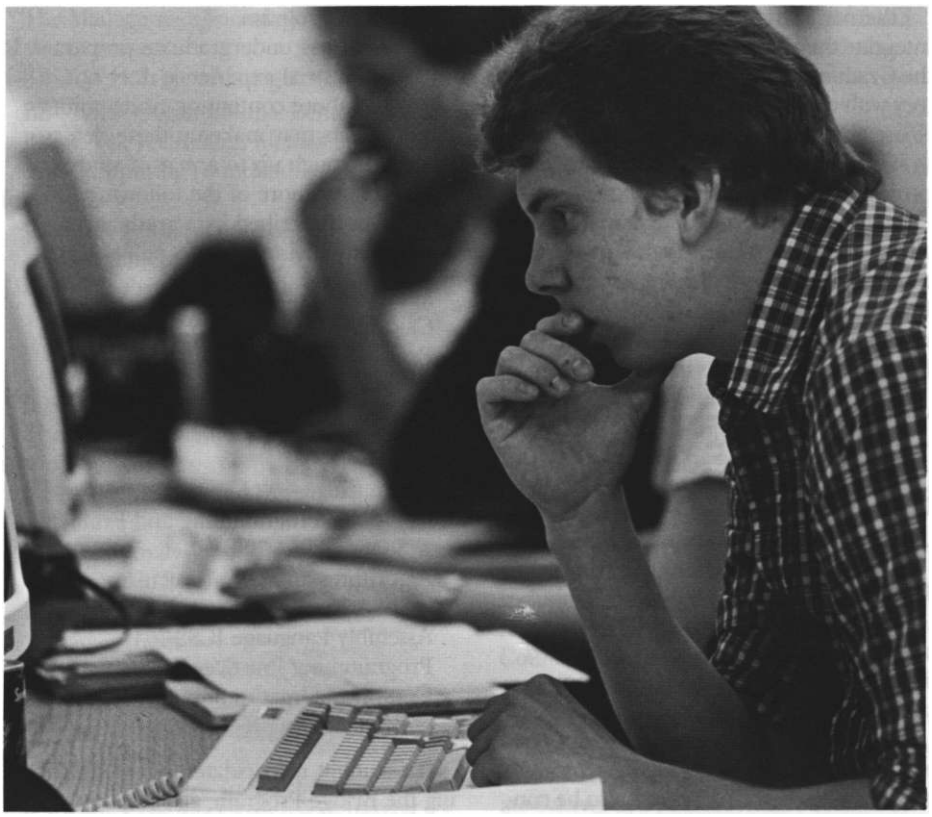
The Master of Science in Software **Development** and Management provides **students** with state-of-the-art preparation for **a broad** spectrum of software-related **careers.** Graduates acquire a solid base of **technical and** design skills along with **insights into** the importance of manage**ment** practice **for** software development

The Master of Science in Instructional Technology program prepares people to develop courses to train adult learners in technical, professional, and managerial skills. While the program is rooted in the theories of adult learning and instructional development, it still has a strong practical component that makes its graduates contributing members of a training and development team their first day on the job.

The Master of Science in Telecommunications Software Technology prepares students for career growth in the telecommunications industry. The program is multidisciplinary, including an emphasis on software development as well as the physical technology of modern communications. The program is structured and delivered so that students may meet degree requirements at sites remote from the RIT campus.

The Master of Science in Computer Integrated Manufacturing provides students the interdisciplinary background needed in modern manufacturing. Course requirements include computing, business, engineering, and manufacturing technology.

The advanced certificate in Applied Computer Studies is intended for students who have a background in some discipline other than computer science and wish to become proficient in programming and computing skills. The courses that make up the requirements for this certificate may serve as entry requirements for other degree programs, such as the Computer Science MS. Alternatively these courses will provide the student with skills that are increasingly important in many career paths in high-technology industry.



The advanced certificate in Interactive Media Design provides an opportunity for students to gain first-hand knowledge and expertise in the art and science of interactive media 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 three core courses in Interactive Media Design (fall, winter, and spring quarters), and through one supplemental course each term.

These programs are particularly suited to individuals who have a strong undergraduate background in a quantitative field in which computers are applied, such as engineering, science and business.

Computer facilities

Supplementing the computing resources provided by RIT's main Information Systems and Computing facilities, as listed in the Student Services section of this catalog, the School of Computer Science and Information Technology provides extensive facilities for students and faculty. The hardware associated with these facilities represents current distributed processing technology, including an Ethernet coupling:

- six Motorola 68000-based microcomputers (the operating systems laboratory)
- 86 SUN monochrome workstations
- 11 SUN file servers
- nine SUN color workstations
- 70 Apple Macintosh systems

These computers operate under the UNIX (UNIX is a trademark of Bell Labs) operating system.

A digital logic laboratory is equipped with single-board microcomputers supporting courses, individual student projects, and theses.

A laboratory devoted exclusively to graduate computer science students has the following equipment:

- seven SUN monochrome workstations
- an AT&T 3B2/600 computer running AT&T System V UNIX. This system supports 25 users, with 12MB RAM and over 800MB disk storage. This system also drives 10 AT&T 630 windowing terminals.
- an AT&T 3B2/500 computer running AT&T System V UNIX. This system provides file service to the graduate area, with 8MB RAM and 1GB disk storage.
- Fifteen AT&T 3B1 UNIX PCs running AT&T System V UNIX, each with a built-in modem, 2MB RAM, and 40 or 67MB hard disk.
- Fifteen AT&T WS386 workstations, each with 8MB RAM and 80MB hard disk. These and the 3B1 systems are integrated with the other systems to serve as student and faculty workstations.

Entrance requirements
Applicants should have a baccalaureate or an equivalent degree from an accredited institution and a minimum grade-point average of 3.0 (B).

Applicants from foreign universities should submit Graduate Record Exam (GRE) scores. (GRE scores can also be considered for applicants whose undergraduate grade-point average is lower than 3.0.) Applicants whose native language is other than English should take the TOEFL examination; a score of at least 535 is required. Applicants with a lower TOEFL may be admitted conditionally and will take a prescribed program in English along with a reduced program course load.

Applicants must satisfy prerequisite requirements in mathematics and computer science (listed below). If an applicant lacks some of these prerequisites, Bridge Program courses are available to allow students to meet these prerequisites and 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.

The prerequisites are:

Mathematics
Differential and integral calculus
Probability and Statistics
Discrete Mathematics

Computing
Experience with a modern high-level language (e.g., Pascal, Ada, Modula, Algol)
Data structures programming
Assembly language programming
Basic software design methodology
Introductory computer architecture and digital logic
Elementary systems programming

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 a graduate department advisor.

Mathematics
Calculus SMAM-251, 252, and 253
Probability and Statistics (Calculus based) SMAM-351 or EIEI-715
Discrete Mathematics ICSS-705 or SMAM-265

Computing
Computer Programming and Problem Solving ICSA-700
Algorithms and Data Structures ICSA-703
Assembly Language ICSS-704
Programming Practices ICSS-707
Computer Organization and Programming ICSS-708

If a student matriculates before finishing the Bridge Program, all remaining Bridge Program courses must be completed with a grade of at least B; courses with lower grades must be repeated. Bridge Program courses are not part of the 48 credits required for the master's degree, and their grades are not included in a student's graduate grade-point average.

A Bridge Program can be designed in ways different from that described above. Often, other courses can be substituted, and courses at other colleges can be applied. (See the Computer Science Graduate Studies Handbook for more details.)

The curriculum
The graduate program of study is composed of the computer science graduate core, electives, a concentration, and a thesis or project for a total of 48 credits.

The computer science core consists of six courses:
ICSG-700 Foundations of Computing Theory
ICSG-710 Programming Language Theory
ICSG-720 Computer Architecture
ICSG-730 Operating Systems, I
ICSG-740 Data Communications & Networks, I
ICSG-750 Artificial Intelligence

Students who elect the thesis option take three electives (i.e., 12 credits); project students take two electives (eight credits). 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 their graduate advisor. Refer to the Graduate Catalog course descriptions in the departments of Computer Science, Engineering, and Business for possible elective courses.

Concentration sequences are available in the six areas represented by the "core" courses. These consist of advanced courses and seminars in the chosen area. (Other concentrations are possible and may be designed with the student's advisor.)

Thesis-option students take one eight-credit concentration; project-option students take both an eight-credit and a six-credit concentration sequence.

A program of study must be designed in cooperation with a graduate advisor.

The master's thesis or project
A four-credit thesis or a two-credit project form the capstone of the MS program. In order to register for either a student must submit an acceptable proposal to the computer science faculty.

Financial aid
Scholarships and graduate assistantships are available in the Department of Computer Science. Information may be obtained from:
Chairman, Graduate Computer Science Program
Rochester Institute of Technology
Ross Memorial Building
P.O. Box 9887
Rochester, New York 14623-0887

Master of Science in Software Development and Management

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). Applicants should submit two professional recommendations.

Applicants from foreign universities should submit Graduate Record Examination (GRE) scores. These scores may also be required from those whose undergraduate grade-point average is less than 3.0.

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

In **addition,** there is a certain minimal **background** required of all students wishing **to enter** the master's program. Bridge **Program courses** are provided to allow students **to** meet these prerequisites and to **achieve** the required knowledge and skills. Generally, formal acceptance into the master's **program** is possible even though the **applicant must** accomplish some additional Bridge Program courses.

The areas that constitute the required **minimal** background are:

Mathematics
Discrete Mathematics
Statistics

Computing
Experience with the high-level language Ada
Data structures programming
Elementary computer architecture and digital logic

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 study, taking one or more of the following RIT courses, as prescribed by a graduate department advisor.

Mathematics
Discrete Structures ICSG-785

Computing
Computer Programming and Problem Solving ISCA-700
Data Structures ICSA-703 or ICSA-710
Computer Hardware Fundamentals ICSA-709

Business
Statistics BBUQ-781

The Bridge Program courses are not part of the 48 credits required for the master's degree, and their grades are not included in a student's graduate grade-point average.

A Bridge Program can be designed in ways different from that described above. Often, other courses can be substituted, and courses at other colleges can be applied.

The curriculum
The graduate program of study consists of 48 credits comprising the Management Foundation, Computing Foundation, Software Engineering Block, and Software Engineering Project. An optional cooperative work experience is possible.

The Management Foundation consists of three courses:
BBUQ-744 Project Management
BBUB-740 Organizational Behavior
BBUB-742 Technology Management

The Computing Foundation consists of four courses:
ICSA-720 Principles of Data Management
ICSA-725 Principles of Distributed Systems
ICSA-820 Systems and Software Engineering
ICSA-823 Principles of Software Design

The Software Engineering Block consists of four courses:
ICSA-821 Analysis and Design Techniques
ICSA-825 Analysis and Design of Embedded Systems
ICSA-830 Software Project Management
ICSA-835 Program Testing and Reliability

The Software Engineering Project consists of two courses:
ICSA-894 Software Tools Library
ICSA-895 Software Engineering Project

An optional Cooperative Educational experience is available for those students who wish to participate in order to gain industrial experience.
ICSA-888 Graduate Cooperative Education

Financial aid
Scholarships and Graduate Assistantships are available. Information may be obtained from:
Chairman
Department of Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester. New York 14623

Master of Science in Telecommunications Software Technology

Entrance requirements
Applicants must have completed a baccalaureate or equivalent degree from an accredited academic institution in the field of computing or telecommunications, with a minimum grade point average of 3.0 on a 4.0 scale. Students with degrees in other related disciplines will be considered on an individual basis.

Applicants should submit two professional recommendations along with the graduate application form and transcripts from previous college attendance.

GRE exams are required for international students. Other students may, if they wish, submit these scores as additional information. Students for whom English is not their first language are required to take the TOEFL and achieve a score of 550 or better. Applicants with a lower TOEFL score may be admitted, at the department's discretion and conditional upon completion of prescribed remedial work in conjunction with a reduced program load.

Curriculum
The graduate program of study in Telecommunications Software Technology includes 52 hours of graduate work. Prerequisite to this work is a number of skills. Courses in the student's academic background and work experience can be used to satisfy these prerequisites, with approval of the department. Remaining prerequisites must be met by completing appropriate courses at a post-secondary institution of the student's choosing. Courses selected for this purpose must be approved by the department.

Prerequisites
The following is a list of prerequisite topics. They are intended as a list of prerequisite skills rather than a list of specific courses, but they tend to fall into categories often used to define courses in post-secondary institutions. The short description of each course is intended as a guide to help students in course selection. All courses must be approved by the department prior to their acceptance toward satisfying prerequisite requirements.

Integral and Differential Calculus:
A standard calculus course sequence, including the study of functions, graphs, limits, the derivative and derivative algebra, the chain rule, the definite integral, methods of integration, work and distance problems, approximation techniques, exponential and logarithmic functions. The application of calculus to physical problems should be included.

Probability and Statistics:
One or two courses concentrating on statistics and their application to stochastic processes, but with an introduction to probabilities. Topics should include sampling theory, confidence intervals, analysis of variance, and the use of software packages for statistical analysis.

Introductory Programming:
A first course in programming in a high level language, such as Pascal, C, Modula2 or Ada. C is preferred, but not required. Topics should include elementary data structures (arrays and records), control structures, the application of modern structured techniques, and an overview of object-oriented design, or abstract data types.

Data Structures:
A second course in programming, focusing on more complex data structures than those built into the language. Included should be linked lists, queues, stacks, pointers and dynamic memory management, files and file I/O, sorting and searching algorithms.

Digital Computer Organization:
A first course in hardware design. This should focus on the logic components of computer organization, including some discussion of gate-level logic with emphasis on higher level components (multiplexors, adders, shift registers, etc.). Included should be a discussion of sequential and combinatorial circuits, flip flops as a memory device, and the basics of operation of a simple CPU.

Concurrent Programming:
This course should introduce the student to the basics of multitasking, including the life cycle of a task, how tasks are spawned and killed, and what constitutes a task from the system's point of view. Included should be experience in composing tasks in some language, plus experience with inter-task communication techniques, such as semaphores, shared memory, mail boxes, monitors, and the rendezvous (Ada). Resource conflict and deadlock should also be discussed. Such experience is often gained in a course on operating systems or in a real-time programming course.

Introduction to Electrical Circuits:
This will be a one- or two-course sequence, dealing with the basics of electricity and electrical circuits. Included should be both DC and AC circuits, Ohm's Law, amplification, the notions of attenuation and noise, power, efficiency.

Software Development Sequence (16 credits)

Principles of Data Management
Systems and Software Engineering
Analysis and Design of Embedded Systems
Software Project Management

Telecommunications Technology Sequence (28 credits)

Data Communications and Networks I
Switching Systems
Transmission Systems
Distributed Systems
Network Planning and Control
Enabling Technologies and Trends in Telecommunications
Telecommunications Policies and Standards

Seminar requirement (4 credits)
Each student is required to complete four credit hours of seminars. These will often be offered as two-hour courses, resulting in a two-course requirement

Comprehensive examination (no credits)
Each year a comprehensive exam will be offered. Students who have completed the software development sequence and all telecommunications technology courses, except for Enabling Technologies and Trends in Telecommunications, are eligible to take this exam. The exam must be successfully attempted before progressing on to the project course (below).

The comprehensive exam has a syllabus of its own, drawn from the topics covered in the courses required before attempting it. This syllabus is available each quarter for those who wish to prepare for the exam. It includes lists of topics and study references.

Project in Telecommunications (4 credits)
This course is self guided, resulting in the production of a software product for the telecommunications industry. The student may be part of a team working on the project. The student must assemble a committee consisting of three persons, at least one of whom must be drawn from the faculty of the Department of Information Technology, to oversee the work. The student prepares a proposal, in consultation with the committee, that outlines what the student will do, what his or her responsibilities are with respect to the project, and what deliverables will result from the project (reports, software, etc.). Upon completion of the project, the committee meets with the student for a formal defense of the project.

Financial aid
Scholarships and graduate assistantships are available in the Department of Information Technology. The distance-oriented nature of this program means that these are of minimal practical use to students who do not reside in the vicinity of R.I.T. However, at times situations do arise that allow students to perform work at a remote location, and such situations would be appropriate to any student in the program. For more information, write to:

Chairman
Department of Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester, New York 14623-0887

Master of Science in Computer Integrated Manufacturing

Entrance requirements
Applicants should have completed a bac-**calaureate or** equivalent degree from an **accredited** academic institution in the **field of** computing, business, technology, **or engineering** with a minimum grade **point average** of 3.0 on a 4.0 scale. Stu-**dents with** degrees in other disciplines **will be** considered on an individual basis. **Calculus and** computer programming are **a required** background.

Applicants should submit two profes-**sional** recommendations along with the **graduate** application form and transcripts **from** previous college attendance.

GRE exams are required for inter-national students. Students may submit **these** scores as additional information if **they** desire or may be required to do so **in** individual cases. A TOEFL score of 550 or better is required for those appli-cants with a non-English background. 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.**

Curriculum
The graduate program of study consists of 72 credits composed of the prerequi-site, core, concentration, elective, and capstone groups. Courses in the prerequi-site group may be waived from gradu-ation requirements depending on a stu-dent's academic and employment background.

Prerequisites (20 credits):
- BBUA-794 Cost Accounting
- ICSA-710 Data Structures for Experi-enced Programmers
- EMEM-343 Manufacturing Processes
- SMEM-701 Manufacturing Materials
- EIEI-715 Probability and Statistics

Core (20 credits):
- EIEI-625 Concepts of Computer-Integrated Manufacturing
- ICSA-730 Data Management and Communication
- ITEF-740 Advanced Manufacturing Processes
- EIEI-749 Quality and Reliability
- BBUQ-749 Manufacturing Strategy and Tactics

Concentration Options (20 credits):
Software and Technology Option
- ICSA-840 Data Management in CIM
- ICSA-845 Distributed Systems
- ITEF-870 Flexible Manufacturing Systems
- ITEF-850 Assembly Automation
- ICSA-820 Systems and Software Engineering

Manufacturing Engineering Option
- EENG-801 Design for Manufacture
- EIEI-710 Systems Simulation
- EMEM-618 Computer-Aided Engineering
- EMEM-615 Robotics
- EIEI-630 Computer-Aided Manufacturing **II**

Management of CIM Option
- BBUB-740 Organizational Behavior
- BBUQ-743 Operations Management
- BBUB-742 Technology Management
- BBUB-795 Financial Management
- BBUG-796 Information Systems Management

Elective (8 credits):
- Elective 1
- Elective 2

Capstone (4 credits):
- ICSA-896 Project Management in CIM
  or
- ICSA-897 Thesis

An optional cooperative educational experience is available for those students who wish to participate in order to gain industrial work experience.

Financial aid:
Scholarships and graduate assistantships are available in the Department of Infor-mation Technology. Information may be obtained from:

Chairman
Department of Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester, New York 14623-0887

Master of Science in Instructional Technology

RIT's nationally known Instructional Tech nology Program prepares instructional designers to develop training in a variety of organizations. The majority of gradu-ates find ready employment in business and industry, although some work in the public sector. While their responsibilities vary, most graduates design courses or manage course design projects in some area of performance technology. The emphasis is on strong analysis techniques to define performance problems, followed by proven instructional technology and performance technology solutions to solve those problems.

Because today's work environment requires a team approach to solving train-ing and performance problems, RIT's Instructional Technology Program includes strong interpersonal skills to complement the instructional design and performance technology skills.

The program
The Instructional Technology degree requires 48 credits (quarter hours)—28 hours of required core courses and 20 hours of electives. Most students select one of two options—instructional design or interactive media design. The instruc-tional design option prepares graduates for a broad range of positions while inter-active media design is a specialized degree in an expanding new area of instructional technology. There is also a training management option to prepare experi-enced trainers and training managers to stay current with innovative instructional design methods.

Admission requirements
Admission decisions for the instructional technology program are based on a review of the baccalaureate degree and any other course work, including grades; scores from the Graduate Record Examination or the Miller Analogies Test; letters of reference from academic advisors or major pro-fessors and from supervisors or managers; and a personal statement of how the degree can contribute to the applicant's career goals.

Nonmatriculated students with a bacca-laureate degree may, with special permis-sion, take two courses from a list of selected courses. 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 any ques-tions about the program, job prospects, or the relation of the degree to any personal goals, the student should contact the pro-gram faculty. Application forms are avail-able from the RIT Admissions Office.

Financial assistance
Financial assistance is available through the RIT Financial Aid Office (716/475-2186) or the Dean of Graduate Studies (716/475-6523).

Scholarships and graduate assistantships are available. Information may be obtained from:

Chairman
Department of Information Technology
Rochester Institute of Technology
RO. Box 9887
Rochester, New York 14623-0887

Degree requirements
The degree requires the completion of a minimum of 48 quarter hours at the graduate level. Of the 48 hours, 28 are in eight core courses required for all students. In addition, all students are required to complete an instructional design project that can serve as part of a portfolio for prospective employers. The degree may be completed in four consecutive quarters if the student starts in the fall quarter. However, the majority of students attend part time and take from two to four years to complete the degree work. A student *must* complete the degree within seven years of matriculation. Almost all courses are offered in the evenings so that students may work in the daytime as they take courses.

Of the 20 credits of electives, students must select one of the options below. Other electives must meet the following criteria:

- all courses must be graduate level courses;
- a maximum of nine quarter hours (not counted toward another degree) may be transferred from another college or university;
- a maximum of 12 hours may be taken outside the Instructional Technology Department.

Prerequisite skills
These topics represent skills that will be required for all entering students and may be waived based on undergraduate or work experience:

Computer literacy—Knowledge of basic software tools (word processors, spreadsheets, data bases, etc.) and their applications. ICSA-200 or ICSA-706.

Descriptive statistics—Knowledge of basic skills in descriptive statistics through evidence of completed courses, proficiency by exam. CQAS-701 or BBUQ-781.

Each student has an academic advisor to help develop a plan of study. 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 ICST 707, 735, 755, 756, 753 within the first 20 hours of course work. For specific questions, the student should see his/her academic advisor.

Core Requirements (28 credits):	**Credits**
ICST-707 Presentation Skills	2
ICST-735 Theories of Learning	4
ICST-755 Criteria Referenced Instruction and Technical Training I	3
ICST-756 Criteria Referenced Instruction and Technical Training II	3
ICST-753 Interpersonal and Group Communications	4
ICST-780 Instructional Development I	4
ICST-781 Instructional Development II	4
ICST-782 Instructional Development III	4

Elective Options (20 credits):

Instructional Design Option	
ICST-712 Computer Assisted Instruction	4
ICST-721 Evaluation of Training and Instruction	4
ICST-757 Techniques of Work Analysis	3
ICST-758 Developing Instructional Models	3
Interactive Media Design Option	
Optional Certificate in Interactive Media Design at completion of 24 credits	
ICST-741 Fundamentals of Interactive Computing	4
ICST-742 Interactive Media Design	4
ICST-743 Interactive Media Project	4
ICST-746 Programming for Interactive Media	4
ICST-744 Imagebank Management	4
ICST-745 Communication Theory	4
Training Management Option	
ICST-777 Training the Training Manager	3
ICST-721 Evaluation of Training and Instruction	4
BBUA-703 Accounting Concepts for Managers	4
Total Credit Requirements:	48

Advanced Certificate in Applied Computer Studies

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).

Applicants should submit two professional recommendations.

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

The curriculum
The graduate program of study consists of 28 credits comprising the Programming Skills Block, Computer Hardware Block, Math Skills Block, and Advanced Elective.

The Programming Skills block consists of four courses:

ICSA-700 Computer Programming and Problem Solving
ICSA-703 Algorithms and Data Structures
ICSG-784 Assembler Language
ICSG-787 Programming Practices

The Computer Hardware Block consists of one course:

ICSG-788 Computer Organization and Programming

The Mathematics Skills Block consists of one course:

ICSG-785 Discrete Structures

The Elective Block consists of one course:

Elective selected from any graduate curriculum within the School of Computer Science.

Students' programs of study must be designed in cooperation with a graduate advisor.

Financial aid
Scholarships and graduate assistantships are available. Information may be obtained from:

Chairman, Department of Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester, New York 14623-0887

Advanced Certificate in Interactive Media Design

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).

Applicants should submit two professional recommendations.

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

The curriculum

The advanced certificate in Interactive Media Design provides an opportunity for students to gain first-hand knowledge and expertise in the art and science of interactive media 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 three core courses in Interactive Media Design (fall, winter, and spring quarters), and through one supplemental course each term.

In the fall, Communication Theory presents and explores the concept of human communication as our fundamental reason for being. During Winter Quarter, Micro-Computer Control teaches programming as it relates to interactive media. In the spring, Image Bank Management concerns the application of database management techniques to the particular technologies and needs of interactive media.

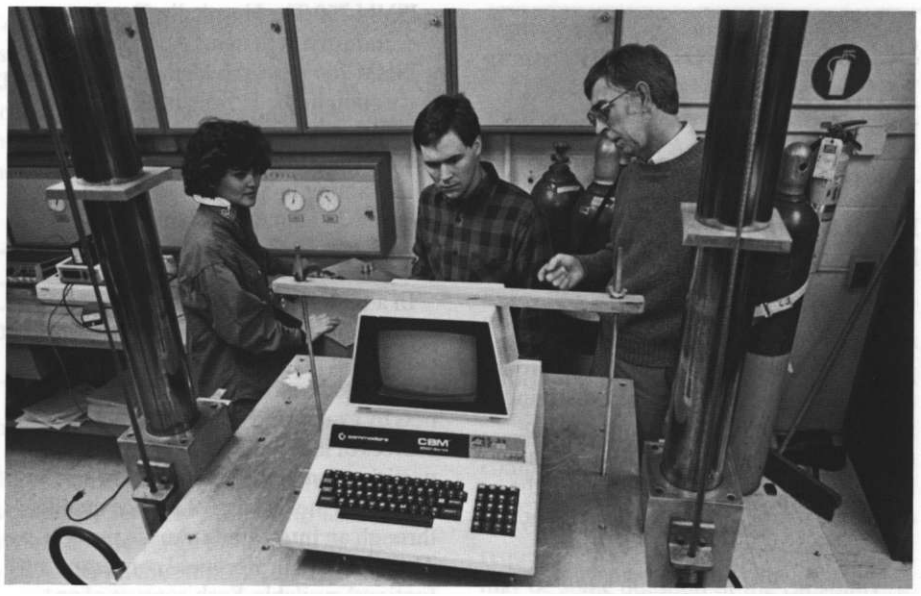
Students who successfully complete the requirements of all six courses will receive the advanced certificate in Interactive Media Design.

Students will have at their disposal a variety of computer, video, and digitizing equipment. Lab facilities are provided and frequendy updated, often through collaborative efforts with other departments at RIT.

Financial aid

Scholarships and graduate assistantships are available. Information may be obtained from:

Chairman, Department of
Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester, New York 14623-0887



Fall
ICST-741 Fundamentals of Interactive Computing 0604-741 4 credits
ICST-745 Communication Theory 0604-745 4 credits

Winter
ICST-742 Interactive Media Design 0604-742 4 credits
ICST-746 Programming for Interactive Media 0604-746 4 credits

Spring
ICST-743 Interactive Media Project 0604-743 4 credits
ICST-744 Imagebank Management 0604-744 4 credits

Department of Manufacturing Engineering Technology

W. David Baker, Director, School of Engineering Technology
V. Raju, Chairman, Manufacturing Engineering Technology

The Manufacturing Engineering Technology Department in the School of Engineering Technology offers undergraduate and graduate courses as part of the multidisciplinary master of science degree in Computer Integrated Manufacturing. The specific courses offered by the department include:

Undergraduate Level Prerequisite:
ITEF-405 Materials in Manufacturing
ITEF-420 Manufacturing Processes

Graduate Core:
ITEF-740 Advanced Manufacturing Processes

Software and Manufacturing Technology Concentration:
ITEF-850 Assembly Automation
ITEF-870 Flexible Manufacturing Systems

Manufacturing Technology Electives:
ITEF-810 Machine Vision
ITEF-820 Lasers in Manufacturing
ITEF-830 Computer Aided Process Planning
ITEF-840 CIM Implementation

The general degree requirements and the curriculum details on the MS in CIM program are outlined on page 25. Further information may be obtained from:

Chairman
Department of Information Technology
Rochester Institute of Technology
P.O. Box 9887
Rochester, New York 14623-0887

School of Food, Hotel and Travel Management

Francis M. Domoy, Ph. D., Director
Richard Marecki, Ph. D., Chairman

The MS in hospitality-tourism management provides the industry with trained professionals who can step into numerous mid-level service management and training director positions. The major orientation of the program is focused on training and supervision functions within the corporate setting, as well as those found at post-secondary 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.

The curriculum

The curriculum is a combination of required core courses in addition to required professional concentration courses in one of five specialized areas. 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 late in the day as well as during the summer months to facilitate part-time students.

Program requirements

The required core courses are broad in orientation and provide a basic understanding of the functional integration that typifies service management organizations. The required core also provides insights into the relevant fact finding and service management strategies associated with empowerment, relationship management, and customers' perception of quality (augmenting service intangibles). The required core courses are:

ISMM-750 The Hospitality-Tourism Industry: A Systems Approach
ISMM-760 Research Methods and Application in the Hospitality-Tourism Industry
ISMM-770 Employee Relations and Training in Service Industries
ISMM-780 Financial Management of Hospitality-Tourism Firms

In addition to the required core the student must also declare a professional concentration. The focus of these courses is to assess service management effectiveness by examining operational strategies, sources of leverage, the nature of customer participation in the technology of service firms, and the delivery of service quality through an integrated strategic process. There are five professional concentrations (options) available. Each consists of an integrated series of three courses that focus on the specific issues and applications within each professional field.

Foodservice/Restaurant Management Option:
ISMM-821 Perspectives on the Food Industry
ISMM-842 Food and Beverage Marketing Strategies
ISMM-864 Problem Analysis and Decision Making in the Service Economies

Nutrition/Health Management Option:
ISMM-821 Perspectives on the Food Industry
ISMM-832 Public Policy Analysis in Nutrition
ISMM-834 Strategic Planning and Marketing of Nutrition Services

Hotel/Resort Management Option:
ISMM-824 Organizational Strategies of Hospitality Firms
ISMM-844 Hospitality Resource Management
ISMM-864 Problem Analysis and Decision Making in the Service Economies

Travel and Tourism Management Option:
ISMM-826 Tourism Policy Analysis
ISMM-846 Travel Marketing Systems
ISMM-866 Tourism Planning and Travel Product Development

Meeting Planning/Conference Management:
ISMM-828 Meeting Planning Management
ISMM-848 Convention and Exhibition Management
ISMM-868 Legal Issues and Evaluation of Events

Elective courses provide students with an opportunity to individualize their graduate programs in line with their career and professional interests. Students are allowed a wide selection of courses from the School of Food, Hotel and Travel Management, the College of Business, and the Department of Information Technology. However, students are cautioned to observe course prerequisites in their selections. The following courses are offered as illustrations of the course offerings available as potential electives.

Department of Information Technology
(Students must be matriculated into program)
ICST-721 Evaluation of Training and Instruction
ICST-735 Psychology of Learning and Teaching
ICST-736 Interviewing, Counseling, and Coaching in Training
ICST-757 Techniques of Work Analysis
ICST-770 Interpersonal Communications

Of the 11 to 17 hours of electives, students are relatively free to select courses that they feel best meet their needs. The only limitations are:

- All courses must be graduate-level courses
- 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 be chosen which 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. The graduate faculty, in addition to the director of the program, can aid the candidate in selecting a thesis topic which has current hospitality-tourism industry relevance.

Projects are by nature of an applied research genre, reflecting the student's ability to utilize professional modelling and forecasting techniques to explain decision making within the hospitality-tourism industry. When the project option is selected, the candidate must complete a minimum of six additional hours of electives.

Admission requirements

Prior to admission to the master of science degree program, applicants must satisfy 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 CPAs of 3.0 or higher, and will be required to take the Graduate Record Examination (GRE) or the Miller's Analogy Test (MAT). The complete list of admission requirements are:

- Graduate application
- **Earned** baccalaureate degree
- Graduate Record Exam or Miller's Analogy Test
- Official undergraduate transcript(s)
- Two professional recommendations
- An on-campus interview (when possible)
- Undergraduate GPA of 3.0 or higher (a CPA of 2.75 will be considered, if applicant has superior recommendations; high GRE or MAT scores; 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 (international students).

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.

Financial aid

Scholarships and graduate assistantships are available in the School of Food, Hotel, and Travel Management. Information may be obtained from:

Graduate Studies Chairman
School of Food, Hotel, and
Travel Management
Rochester Institute of Technology
One Lomb Memorial Drive
P.O. Box 9887
Rochester, New York 14623-0887

Executive Leader MS Program

This is an intensive program consisting of four two-week summer sessions 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 life-long 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 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, CHA, CTC, CTP, CMP) is accepted as documentation of professional commitment. Endorsements from senior management and administrators are preferred.

Department of Packaging Science

Daniel L. **Goodwin,** Acting Chairman

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.

Requirements

Students entering the program will have a graduate academic advisor appointed and will develop their programs of study in consultation with their advisor. 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 list of 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 CTAM-711, and having completed a course in computer applications. Lacking this background, applicants will be required to take CTAM-711 and/or IPKG-341, or equivalent course work to remedy a background deficiency.

Application for admission for graduate study in packaging will be made through the RIT Office of Admissions. Final acceptance of the candidate for graduate study will be determined by the Department of Packaging Science. All applicants must (1) have earned a B (3.0) average grade in their final two years of undergraduate degree work, (2) submit transcripts of undergraduate work to the RIT Office of Admissions, and (3) 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.

The curriculum

The curriculum is comprised of three components identified as (1) packaging core courses, (2) research, and (3) 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 IPKG-701, Research Methods, and any four of the following:

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

Research

Students in the master's program will be required to prepare and defend a 12-credit thesis which has been completed under the supervision of their advisor. They may also elect to take up to 8 credits of independent study credit, but this may NOT be used as credit towards the 20 credits of packaging core course work.

IPKG-798 Independent Study
1-4 credits, maximum of 8 credits; does not count as "core"

IPKG-890 Graduate Thesis
12 credits; required. The type of research done and the area of study will be agreed upon by the student and the advisor before enrolling for graduate thesis credits.

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 advisor, 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

Graduate Faculty College of Applied Science and Technology

Wiley R. McKinzie, MS, SUNY at Buffalo —Dean, Professor

John A. **Stratton,** MS, Rensselaer Polytechnic Institute—Associate Dean, Professor

William J. Stratton, Ph.D., SUNY at Buffalo—School of Computer Science and Information Technology, Director, Associate Professor

Daniel L. Goodwin, Ph.D., Michigan State University—Department of Packaging Science, Acting Chairman, Professor

Francis Domoy, Ph.D., Michigan State University—School of Food, Hotel, and Tourism Management, Director, Professor W. **David Baker,** MS, Rochester Institute of Technology—Director, School of Engineering Technology; Professor

School of Computer Science and Information Technology

William J. Stratton, Ph.D., SUNY at Buffalo—Director, Associate Professor

Department of Computer Science

John A. Biles, MS, University of Kansas-Chairman, Department of Computer Science, Associate Professor

Peter G. **Anderson,** Ph.D., Massachusetts Institute of Technology—Graduate Program Chairman, Professor

Rodger Baker, MS, University of Rochester—Undergraduate Program Chairman, Associate Professor

Warren Carithers, MS, University of Kansas—Associate Professor

Lawrence Coon, Ph.D., Ohio State University—Associate Professor

Henry Etlinger, MS, Syracuse University-Associate Professor

James Heliotis, Ph.D., University of Rochester—Associate Professor

Fereydoun Kazemian, Ph.D., Kansas State University—Assistant Professor

Andrew Kitchen, Ph.D., University of Rochester—Associate Professor

Edith A. Lawson, MS, Rochester Institute of Technology—Assistant Director, Part-Time Studies, Assistant Professor

Michael J. Lutz, MS, SUNY at Buffalo-Associate Professor

Rayno Niemi, Ph.D., Rensselaer Polytechnic Institute—Professor

Stanislaw Radziszowski, Ph.D., University of Warsaw—Associate Professor

Kenneth Reek, MS, Rochester Institute of Technology—Associate Professor

Margaret Reek, MS, Rochester Institute of Technology—Associate Professor

Nan Schaller, MS, Union College—Associate Professor

Walter A. Wolf, Ph.D., Brandeis University—Assistant Professor

Department of Information Technology

Peter Lutz, Ph.D., SUNY at Buffalo-Chairperson, Professor

Kevin Donaghy, Ph.D., University of Toronto—Assistant Professor

Gordon Goodman, MS, Rochester Institute of Technology—(Assistant Professor)

James Hammerton, MBA, New York University—Assistant Professor

Daryl Johnson, MS, Rochester Institute of Technology—(Instructor)

Guy Johnson, MS, Syracuse University-Professor

Alan Kaminsky, MS, University of Michigan—Assistant Professor

Stephen Kurtz, MS, Rochester Institute of Technology—Assistant Professor

Jeffrey Lasky, MBA, City University of New York—Associate Professor

Elizabeth Paciorek, MS, University of **Rochester—**Assistant Professor

Ronald Perry, MS, Rochester Institute of Technology—Assistant Professor

Evelyn P. Rozanski, MS, Syracuse University—Coordinator of Graduate Studies, Professor

William Stratton, Ph.D., SUNY at Buffalo—Associate Professor

Clinton J. Wallington, Ph.D., University of Southern California—Professor

Timothy Wells, MBA, California State Bakersfield—Assistant Professor

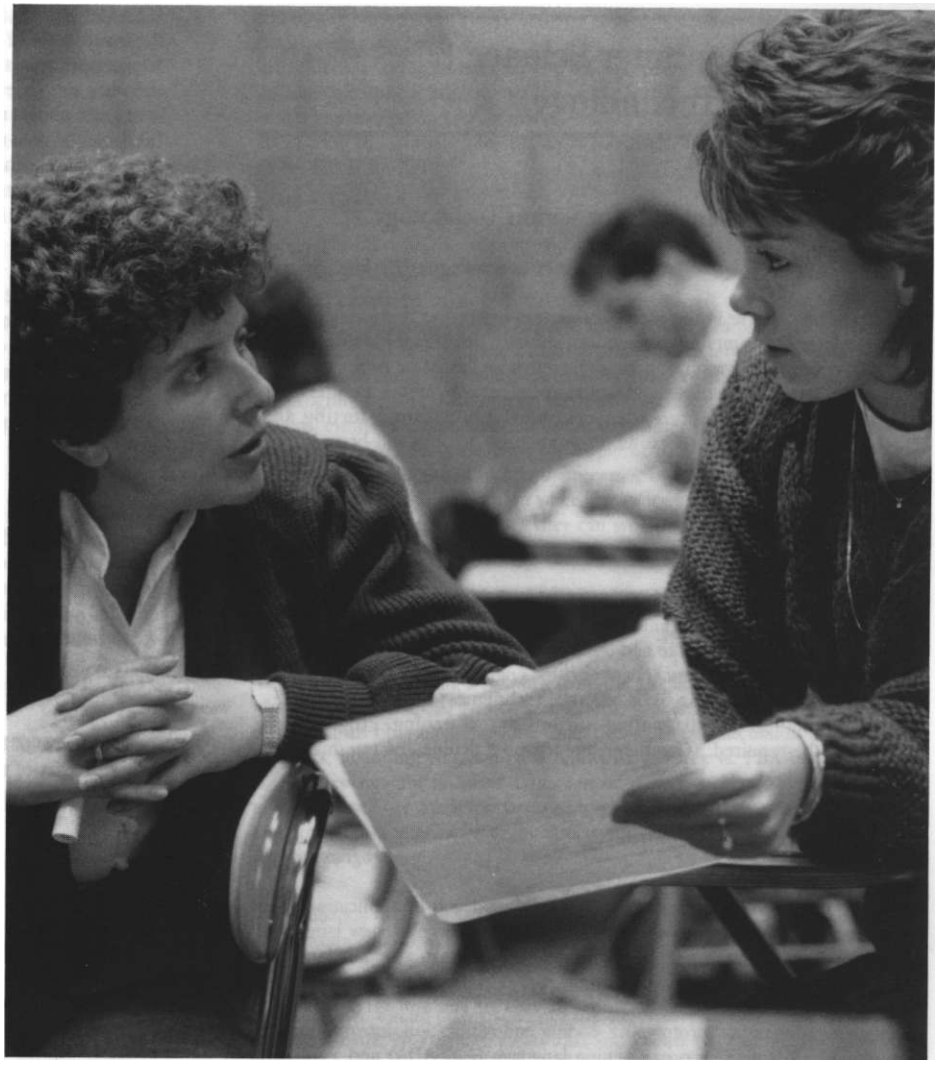
Michael A. Yacci, Ph.D., Syracuse University—Assistant Professor

William Stratton, Ph.D., SUNY at Buffalo—Associate Professor

Clinton J. Wallington, Ph.D., University of Southern California—Professor

Timothy Wells, MBA, California State Bakersfield—Assistant Professor

Michael A. Yacci, Ph.D., Syracuse University—Assistant Professor



Adjunct Faculty—School of Computer Science and Information Technology

Gordon Bleach, Ph.D., University of Capetown, South Africa

Merrie David, MS, Rochester Institute of Technology

John D. Hanson, MS, Rochester Institute ofTechnology

Susan K. Heard, Ed.D., University of Rochester

Burton Kaliski, Ph.D., Massachusetts Institute ofTechnology

Narayan Kulkarni, MS, Rochester Institute ofTechnology

Bruce Lyon, MS, Rochester Institute of Technology

Daniel Sorrentino, MS, Rochester Institute ofTechnology

Albro C. Wilson, MS, Rochester Institute ofTechnology

Carl Winkelbauer, Ed.D., University of Rochester

Manufacturing Engineering Technology Department

Venkitaswamy Raju, Ph.D., Gujart, India

Jeffrey Koff, MS, University of Massachusetts

School of Food, Hotel, and Travel Management

Richard Marecki, Ph.D., SUNY Buffalo-Chairman, Professor

James Burke, Ph.D., University of Minnesota—Associate Professor

Barbara Cerio, M.Ed., SUNY Buffalo-Assistant Professor

Francis M. Domoy, Ph.D., Michigan State University—Director, School of Food, Hotel, and Tourism Management, Professor

Eric Hardy, MS.Ed, FCA, MCR, State University of New York—Adjunct Professor

James Jacobs, MS, Troy State University, Alabama—Assistant Professor

Elizabeth Kmiecinski, MS, Ohio State University—Assistant Professor

Edward Marecki, MS, EA, Canisius College—Adjunct Professor

Warren Sackler, MA, New York University—Assistant Professor

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

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

Carol Whitlock, R.D., Ph.D, University of Massachusetts—Associate Professor

Department of Packaging Science

Daniel L. Goodwin, Ph.D., Michigan State University—Acting Chairman, Professor

A. Ray Chapman, MBA, Rochester Institute of Technology—Associate Professor

Deanna M. Jacobs, MS, Rochester Institute of Technology—Assistant Professor

David L. Olsson, Ph.D, Michigan State University—Professor

Karen L. Proctor, MBA, Rochester Institute of Technology—Associate Professor

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

School of Computer Science & Information Technology

Department of Information Technology

ICSA-700 **Computer Programming and Problem Solving**
Registration #0602-700
An introductory course in the use of computers, interactive environments, file systems, editor. Programming in a modern software development environment with a structured programming language such as Pascal or Ada, covering: control structures, procedures and functions, recursion, arrays, pointers, file I/O, records. Application areas cover: numerical methods, sorting and searching, graphics, text processing. Programming projects will be required. (Pre-calculus)
Credit 4

ICSA-701 **Programming I**
Registration #0602-701
Fundamentals of computer programming and problem solving using a modern software development environment and a structured programming language (Pascal or Ada). Introduction to and use of an interactive editor and file system. Applications in business, science, mathematics, engineering, education, systems programming, and graphics will be covered. Techniques will be introduced for data representation and structuring, sorting, and searching. Programming projects will be required. (Computer literacy, pre-calculus; discrete math is a corequisite)
Credit 8

ICSA-702 **Programming II**
Registration #0602-702
The concept of computer programming at various levels of application. At a lower level is a macro assembly language. At a higher level, a new language-APL, Snobol, etc. Combining program segments written in assembly language with segments in a known high-level language. Modern programming practices, tools and techniques from the point of view of the software life-cycle: specification, design and prototyping, coding and verification, integration, and maintenance. A study of a programming language (e.g., ADA) and a software engineering environment (e.g., Unix) that supports these programming practices. Programming projects will be required. (ICSA-701 or equivalent)

Credit 8

ICSA-703 **Algorithms and Data Structures**
Registration #0602-703
Topics include data abstraction, data representation, data structures, such as linked lists, trees, stacks, queues, hash tables, sparse matrix techniques, searching and sorting techniques, file structure and maintenance. Programming projects will be required. (Programming proficiency in some high-level structured programming language, discrete mathematics)

Credit 4

ISCA-706 **General-Purpose Software Tools**
Registration #0602-706
In this course students will be introduced to computers and problem solving by learning to use general-purpose software tools such as spreadsheet, data base package, outline and word processors, and graphics software to complete a series of required projects. Emphasis is on using software for personal productivity and to enhance effectiveness and communication. Required projects will utilize packages individually and in an integrated fashion. (Graduate standing)
Class 4, Credit 4

ISCA-709 **Fundamentals of Computer Hardware**
Registration #0602-708
A study of the concepts of computer hardware design and organization needed for effective computer software design and system implementation. Topics include computer peripherals and interfacing techniques; Boolean algebra; digital logic design; integrated circuit logic families; central processing unit design; microprogramming; buses and addressing; interrupts and direct memory access; hierarchical memories; system performance evaluation; and survey of commercially available computers. (ICSA-700, ICSA-703)
Class 4, Credit 4

ICSA-710 **Data Structures for Experienced Programmers**
Registration #0602-710
A course in data structures in the ADA programming language for students in software engineering who have prior experience in another structured language programming (PASCAL, MODULA-2). Assignments focus on fundamental data representation in programming systems, to include complex data structures, linked lists, trees, stacks, queues, hash tables and sparse matrix techniques. (Prior programming experience)

Class 4, Credit 4

ICSA-720 **Principles of Data Management**
Registration #0602-720
Introduction to topics in analysis and design of data representations. This includes external data structuring for sorting and searching applications, file structures; sequential, indexed, random, and inverted, and data base concepts: views, architectures, normalization, and data manipulation. Programming projects will be required. (ICSA-700, ICSA-703, ICSA-709)

Class 4, Credit 4

ICSA-725 **Principles of Distributed Systems**
Registration #0602-725
Introduction to data communications, transmission, terminal handling, fundamentals of networking, high-level protocols, local networks. Issues in control of distributed systems. Communicating sequential processes, concurrency, redundancy, reliability. (ICSA-700, 703)

Class 4, Credit 4

ICSA-730 **Data Management and Communications**
Registration #0602-73
The first part of this course will discuss elementary data management topics such as data storage and retrieval, the use of commercial DBMSs, and the relational model. It will also discuss the data representation problem in CIM and the melding of representation schemes used by CAD systems, robotics systems, CNC/DNC machines, and commercial DBMSs. The second part of the course will focus on data communications. This will introduce the student to concepts such as synchronous and asynchronous communications, parallel and serial communications, modulation, point-to-point and broadcast networks, and baseband and broadband networks. Emphasis will be placed on standards employed by CIM and other areas on which CIM depends. (ICSA-710)
Class 4, Credit 4

ICSA-740 **Switching Systems for Software Developers**
Registration #0602-740
A course in telephony and switching. Topics include an introduction to the public switched network in North America; international networking; switching of voice, data, and video; call and feature processing; space and time division switches; signaling (in band, out of band, CCS7); queuing theory and modeling of switching systems; the intelligent network; error control; throughput; delay; congestion; routing and addressing; switching of cellular networks. Existing switches will be studied. Downstream processing (billing, administration, etc.) and its relevance to the switching function will also be discussed. NOTE: the prerequisite may be interpreted as a corequisite, with permission of instructor. (ICSG-740)

Credit 4

ICSA-745 **Transmission Systems for Software Developers**
Registration #0602-745
This course focuses on details of transmission in telephone networks. Included are discussions on analog and digital modulation (PCM, ASK, FSK, PSK), signal-to-noise ratios, sampling theory, transmission via copper , (including different types of copper systems, such as T carriers), microwave, satellite, RF broadcast, and Fibre optics. SONET will be discussed when studying fibre systems. Different types of transmission media will be compared with respect to band width, error rates, and cost effectiveness. (ICSA-740)

Credit 4

ISCA-750 **Distributed Systems**

Registration #0602-750

The course in distributed systems centers around multitasking and the use of tasks as an implementation mechanism for objects. OSI protocols above the network layer are studied, and different means of sharing information in a distributed environment are explored (electronic mail, network file systems, distributed data base systems, remote access to centralized facilities, etc.). Also included in this course is a discussion of the unique needs and standards of the telecommunications industry as regards reliability, maintainability, and integration of software. (ICSG-740)

Credit 4

ICSA-820 **Systems and Software Engineering**

Registration **#0602-820**

A high-level examination of the system development process. Topics include the system life cycle, requirements engineering, hardware/software architectures, risk assessment, human factors, system safety, life cycle cost analysis, and software quality. (ICSA-700, 703, 709, ICSG-785; BBUQ-781)

Class 4, Credit 4

ICSA-821 **Analysis and Design Techniques**

Registration **#0602-821**

An examination of current methodology and techniques in systems analysis and design. Methodologies covered include those of Yourdon, Warnier, and Jackson. Students will be required to demonstrate a practical mastery of a combination of several of the techniques that are presented. Application areas will include traditional information systems, distributed systems, and real-time systems. (ICSA-720, 725, 820)

Class 4, Credit 4

ICSA-S23 **Principles of Software Design**

Registration **#0602-823**

Presents techniques for developing, expressing and implementing program and system designs. Emphasis is placed on the use of formal tools in the production of correct and reliable programs. Application areas will include traditional information systems, distributed systems and real-time systems. An introduction to formal proofs of program correctness is included. Course work is expressed in a program design language and implemented in a modern programming language such as ADA, MODULA-2 or MESA as part of a team effort. Programming projects will be required. (ICSA-700, 703)

Class 4, Credit 4

ICSA-825 **Analysis and Design of Embedded Systems**

Registration **#0602-825**

Study of large real-time embedded systems-computer systems that have critical response time requirements and that sense and control external hardware. Embedded system design issues. Methods for specifying, modeling, and analyzing large embedded system functional and performance requirements. Methods for designing large embedded systems as a group of cooperating, communicating, concurrent processes. Program design projects will be required. (ICSA-720, 725, 820, 823)

Class 4, Credit 4

ICSA-830 **Software Project Management**

Registration #0602-830

An examination of the organizational, managerial and technical aspects of software development. Examines the use of models and software metrics in the following areas: cost estimation and manpower allocation, evaluation of alternative designs, implementation measures, and test management. Other 'opics include: configuration management, reviews, and inspections, management and control of the maintenance process. (BBUQ-774)

Class 4, Credit 4

ICSA-835 **Software Verification and Validation**

Registration #0602-835

Topics include testing schemes (black box, white box), integration schemes, validation testing, graphic analysis. Reliability models (seeding, hazard) are covered. Software maintenance techniques and tools are covered. (ICSA-820)

Class 4, Credit 4

ICSA-840 **Data Management in CIM**

Registration #0602-840

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. (ICSA-710, ICSA-730)

Class 4, Credit 4

ICSA-845 **Distributed Systems**

Registration #0602-845

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. (ICSA-710, ICSA-730)

Class 4, Credit 4

ICSA-850 **Network Planning and Control**

Registration #0602-850

An overview of analyzing a network from the global level, this course examines network traffic analysis, growth predictions, growth options, and issues in the control of an operating network. Included will be a discussion of corporate networks, including virtual private networks, Centrex vs. PBX considerations, the business case for ISDN, and other issues from the client's perspective. Also to be discussed are the importance of international telecommunications issues and problems of interfacing to the international switched network. (ICSA-745)

Credit 4

ICSA-855 **Telecommunications Policy and Standards**

Registration #0602-855

This course studies forces on the telecommunications industry from outside. These come from two principal directions—public policy and standards organizations. Public policy refers to the regulatory agencies that govern the industry. Both North American and European systems will be covered. Standards bodies and their role in the international standards arena will be discussed. Included will be CCITT, ANSI, ISO, and NIST. (ICSA-740)

Credit 4

ICSA-860 **Enabling Technologies and Trends**

Registration #0602-860 **In Telecommunications**

This course endeavors to predict the effects of future technological innovations. To facilitate this, a number of new and promising technologies in transmission, switching, mass storage, processing, and other areas are studied. Included will be study of new software technologies such as systems integration strategies, software reusability, and object-oriented design methodologies. (ICSA-745, ICSA-750)

Credit 4

ICSA-888 **Graduate Cooperative Education**

Registration #0602-888

One quarter of appropriate software development work experience. (ICSA-720, 725,820,823)

Credit 0

ICSA-890 **Graduate Seminar in Applied Computer Studies**

Registration #0602-890

Current topics and advances in applications of computer technology for graduate students (Permission of instructor)

Credit variable 24

ICSA-891 Graduate Seminar in Telecommunications Software
Registration #0602-891

The faculty of the MS in Telecommunications Software Technology Program will offer regular seminars on topics of interest to themselves and students. These will be guided self-study courses, requiring a degree of self-direction on the part of the student The credit load and prerequisites for each seminar will vary with the topic and will be specified by the instructor at time of course offering. Each seminar will require of the student a written report and/or an oral presentation as a major part of the grade. Seminars from the computer science master's degree program will be allowed with consent of the program chair.

Credit 1-4

ICSA-894 Software Tools Laboratory
Registration #0602-894

Within a controlled laboratory environment small student teams work on a never-ending software development project. Computer-aided software engineering workstations and automated tools are covered, including analysis, design, coding, testing, configuration management, quality metrics, and project management tools. Emphasis on the use of good software engineering practice and the holistic use of software engineering tools to achieve product continuity and integrity. Students will make presentations of results. (ICSA-821 or 823 and 830,835)

Class 2, Lab 4, Credit 4

ICSA-895 Software Engineering Project
Registration #0602-895

Under faculty supervision, student teams participate in an industry-sponsored software development project. The project will apply the knowledge and technology mastered in all previous software engineering course work and laboratories. (ICSA-823,835)

Class 4, Credit 4

ICSA-896 Project Management in CIM
Registration #0602-896

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)

Class 4, Credit 4

ICSA-897 MS Thesis
Registration #0602-897

Interdisciplinary thesis on CIM research area to be monitored and advised by committee of three faculty. 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

ICSA-898 Project in Telecommunications Software
Registration #0602-898

This capstone course will be a software development project in tele-communications. The project will address a major design or implementation issue and will be carried out by the student in consultation with a committee. The committee will consist of a member of the faculty and another member who may be a practicing professional in the telecommunications industry. The student may be part of a team working on a large project as part of his or her employment, for example. The committee is responsible for ascertaining how much of the project was the student's responsibility and ensuring that the project meets the norms for both quantity and quality of work. (Completion of required courses in Telecommunications Software Technology curriculum)

ICSA-899 Independent Study
Registration #0602-899

Faculty directed study of appropriate topics on a tutorial basis. This course may be used by a graduate student to study particular applications of computers that are not covered in depth in other courses. (Permission of instructor)

Credit variable 24

ICST-707 Presentation Design
Registration #0604-707

An overview of the process of designing and giving training presentations. Includes principles of presentation design, selection and production of presentation media, basic research on presentation design, and presentation media. (Required for graduation)

Credit 2

ICST-712 Computer-Assisted Instruction (CAI-I)
Registration #0604-712

Students learn the use of the computer for instruction (computer-assisted instruction) and then produce their own computer-assisted instruction programs. Students review research and computer-assisted instruction, various hardware and software configurations, programming languages, and sources of already developed computer-assisted courses. Covers some methods of course and lessons development. Project required. (ICST-755 or permission of department)

Credit 4

ICST-713 Computer-Assisted Instruction (CAI-II)
Registration #0604-713

The student develops 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. (ICST-712)

Credit 4

ICST-721 Evaluation of Training and Instruction
Registration #0604-721

A course to train students in the development and application of testing methods used in measuring performance, principally cognitive and psychomotor skills, as well as methods to determine overall course effectiveness. Covers methods for both formative and summative evaluation, test construction, and means of validating instructional materials and instruct onal systems.

Credit **4**

ICST-722 Research Project
Registration #0604-722

A variable-credit course which allows a student to conduct a research project based on the student's interests and with the advice and consent of a faculty member. A formal research proposal must be submitted before registering for this course (guidelines available from the department). (ICST-780, 781)

Credit variable 1-3

ICST-735 Theories of Learning
Registration #0604-735

Relates various theories of learning to actual teaching and training. Students review learning principles and apply them to practical instructional situations. Emphasis on behavioral approach to developing instruction and training. (Required for graduation)

Credit **4**

ICST-736 Interviewing, Counseling, and Coaching in Training
Registration #0604-736

The course distinguishes between counseling, coaching, and training, stressing j task-related interpersonal and cognitive skills such as working with a subject! matter expert of job counseling. Includes methods of interaction to maintain communications and to shape behavior. (ICST-735, 753, or concurrendy)

Credit 3

ICST-741 Fundamentals of
Registration #0604-741 Interactive Computing

IMD I is designed to introduce students to the tools and techniques used in developing interactive media applications. The emphasis of the course is for' students to become familiar with the hardware/software tools and how they can be appropriately applied. Material will be presented in classroom lectures] and through hands-on use of hardware and software. Several small projects will be completed by the students utilizing various video, audio, and computing! tools.

Credit **4**

ICST-**742** **Interactive Media Design**
Registration **#0604-742**
This course will focus on Interface Design. Through readings, critiques, exercises and discussions, students will explore what makes an interactive application successful and what types of applications are best suited to interactive media. Other topics will include the psychology, aesthetics, and business aspects of interactive media design. Students will also begin work on a large scale project to be completed in IMD III.

Credit 4

ICST-743 **Interactive Media Project**
Registration **#0604-743**
Having achieved proficiency with the tools and concepts of interactive media, students will undertake a group/individual project that will allow them to fully utilize their skills and apply the techniques in a fully developed project.

Credit 4

ICST-744 **Imagebank Management**
Registration **#0604-744**
The application of data base management techniques to the particular technologies and needs of interactive media. Other topics will include knowledge-bases and expert systems as they relate to interactive media applications. Course content will be related to the current IMD class project whenever possible.

Credit 4

ICST-745 **Communication Theory**
Registration #0604-745
This course presents and explores the concept of human communication as our fundamental reason for being. Analysis will be based on a classification tree which fundamentally divides communication into "mediate" vs "immediate" classes, then into subclasses, categories, and finally into specific forms of communication such as television, the responsive system, lecture, and conversation. Assignments will be given to observe the communications of your own and others, then report back to the class. Particular attention will be given to how communication form affects content. Related topics will also be considered, including mixing forms, alternating forms, and the processes of impression and expression. Class format will include lectures and informal discussions.
Credit 4

ICST-746 **Microcomputer Control**
Registration #0604-746
The goal of this course is to advance the student's programming skills for interactive media. This will include programming to control graphics, text, audio, and video images. Learning will be project-based and, whenever possible, directly related to the current IMD class project (understanding of basic programming concepts such as loops, variables, and procedures)
Credit 4

ICST-749 **Seminars in Strategy, Technology and Futuring**
Registration #0604-749 **in Human Resource Development**
Training and development, especially in business and industry, and human resource development exist within the larger context of national and global economics. Trends in business directly affect the development of human resources into an effective work force. This closing seminar examines future directions as they relate to, and may have an impact upon, training and human resource development in various sectors of the economy. After reviewing past, current, and projected economic and societal trends, seminar participants are required to analyze and project various possible developments in an area of their own interest. (Required for graduation) (Prerequisites or corequisites: all core courses and 40 hours of course work.)
Credit 3

ICST-753 **Interpersonal and Group Communications**
Registration **#0604-753**
Activities and experiences in human communication, specifically within groups. The course discusses theory and research underlying the communication process and the application of principles to practical situations. (Required for graduation)
Credit 4

ICST-755 **Criterion Referenced Instructional**
Registration #0604-755 **and Technical Training I**
The first course of a two-course sequence which 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. The course is largely self-paced and self-instructional, and the student must complete a project in the technical training area. (Required for graduation)

Credit 3

ICST-756 **Criterion Referenced Instructional**
Registration #0604-756 **and Technical Training II**
The second course of a two-course sequence which 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. The course is largely self-paced and self-instructional, and the student must complete a project in the technical training area. (Required for graduation)

Credit 3

ICST-757 **Techniques of Work Analysis**
Registration #0604-757
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. Students learn to develop job inventories and checklists for gathering tasks information for a number of interrelated purposes.

Credit 3

ICST-758 **Developing Instructional Modules I**
Registration #0604-758
This course is designed to follow ICST-756 to give the student extended 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 revision procedures. Students must have already selected a content area and developed objectives, a course plan, and criterion test. (ICST-755, ICST-756)
Credit 3

ICST-759 **Technical Writing for Instructional Developers**
Registration #0604-759
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, ICST-700, 755, 756,758)

Credit 3

ICST-763 **Developing Instructional Modules II**
Registration #0604-763
In this extension of Developing Instructional Modules I (ICST-758), the student completes additional course modules and develops course control documents for both the course manager and the student. (ICST-755, 756, 758)

Credit 2

ICST-765 **Individual Learning Style Analysis**
Registration #0604-765
Examines the ways different individuals learn and relate instructional strategies to learning styles. Covers cognitive style mapping aptitude treatment interaction, application of norm and criterion reference tests as each relates to individual learning style. (ICST-735)
Credit 4

ICST-777 **Training the Training Manager**
Registration #0604-777
The management of the process of training, instructional design and development, and performance technology. Includes principles of needs assessment and evaluating the worth of training and trends in instructional design and training delivery systems. (Required for Training Management option) (ICST-755, 756)
Credit 3

ICST-780 **Instructional Development I**
Registration #0604-780
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. A limited instructional development project is part of the course. (Required for graduation) (ICST-755)

Credit 4

ICST-78I **Instructional Development II**
Registration #0604-781
A continuation of Instructional Development (ICST-780) in which instructional development principles are applied in an actual project selected by the student. More sophisticated means of development. Literature of field is also covered. (Required for graduation) (ICST-780)

Credit **4**

ICST-782 **Instructional Development III**
Registration #0604-782
Stresses the difference between personnel/faculty development, instructional/program development, and curriculum/organizational development and how the instructional developer or trainer becomes an agent for change. Examines the methods of disseminating and promoting the adoption of innovative methods and materials. Students research special problems related to selected areas of instructional development. (ICST-780, 781)

Credit 4

ICST-888 **Internship**
Registration #0604-888
Special opportunities may occur for students to obtain work experience in ajob 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. (ICST-780, ICST-781 plus 20 hours of course work)

Credit variable 1-3

ICST-890 **Independent Study**
Registration #0604-890
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.

Credit variable 1-3

Department of Computer Science

Undergraduate Computer Science students may take 700- and 800-level courses only by consent of the school director and the instructor. Graduate students must obtain the consent of a graduate advisor in order to enroll in graduate courses not listed in their own program of study.

ICSS-704 **Assembly Language**
Registration #0603-704
Introductory computer architecture (von Neumann machine): addressing methods-direct, indirect, immediate, absolute, indexing, base register, etc.; operation-machine instructions, directives or pseudo-operations, and macros; representing program paradigms in assembler language-decisions, loops, subroutines, arrays, links, etc.; assembly language program design techniques; macro definitions and use; libraries. Programming projects will be required. (ICSA-700, 701 or a programming proficiency in some high-level language)
Credit 4

ICSS-705 **Discrete Structures**
Registration #0603-0705
The fundamental concepts of discrete mathematics which are necessary for understanding the mathematical foundations of computer science. Topics include: structures defined on countable sets, elementary symbolic logic, patterns of mathematical proof, vectors and matrices, graphs and networks, cominatorics, formal languages, abstract mathematical systems. The relevance of the chosen topics to Computer Science and the applications of computers to these topics are stressed. (College algebra, computer literacy)
Credit 4

ICSS-707 **Programming Practices**
Registration #0603-707
An introductory course in the life-cycle issues of large and single/multi programmer programs. Structures and modular programming, data abstraction and information hiding. The Chief programmer concept. Specific focus on modern programming practices (specification, design and prototyping, coding and verification, integration and maintenance) and tools (software engineering environments such as Unix and software engineering languages such as ADA). Programming projects will be required. (ICSA-703)
Credit 4

ICSS-708 **Computer Organization and Programming**
Registration #0603-708
An introduction to the basic concepts and terminology of hardware and software systems. Basic hardware is elementary circuit-gates, Boolean algebra, simple combinational circuits (adders, decoders, multiplexers) and simple sequential circuits (various flip-flops, registers, serial adders, counters). The operating system as the major software providing a "virtual" interface, virtual memory (paging, segmentation, etc.), file systems, multi-programming, traps and interrupts, etc. The intent of this course is to prepare the student for future courses in computer architecture and operating systems. Programming projects will be required. (ICSS-704, ICSA-703)

Credit 4

ICSG-700 **Foundations of Computing Theory**
Registration #0605-700
Review of discrete mathematics with emphasis on graph theory and proof techniques. A study of computer programs in the abstract, including program flow graphs, program transformations, the structuring theorem, abstract automata, and formal languages. An overview of computability and algorithmic complexity. (ICSS-705, ICSA-703)

Class 4, Credit 4

ICSG-701 **Computability**
Registration #0605-701
Computability is the heart of theoretical computer science for it is the theory which attempts to formalize the notion of computation. Topics include computation by while-programs, Turing machines, recursive function theory, symbol manipulation systems, program methodology, the limitation of the concept of effective computability. (ICSG-700)

Credit 4

ICSG-702 **Computational Complexity**
Registration #0605-702
This course is concerned with the mathematical analysis of computer algorithms. Topics include matrix operations, combinatorial algorithms, integer and polynomial arithmetic, NP-completeness, and lower bounds on algorithms involving arithmetic operations. (ICSG-700)
Credit 4

ICSG-703 **Coding Theory**
Registration #0605-703
The study of error-correcting codes and their application to reliable communication of digitally encoded information. Topics include cyclic codes, hamming codes, quadratic residue codes, B.C.H. codes, designs and codes, weight distribution. (ICSG-700)

Credit 4

ICSG-709 Topics in Computer Science Theory

Registration **#0605-709**

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 Fourier Transform; combinatorial optimization; logic. Programming projects **may be** required. (Permission of the instructor)

Credit variable 14

ICSG-710 Programming Language Theory

Registration **#0605-710**

An introduction to several important programming languages and the basic concepts of language design and specification. Topics will include data and control structures, subprogram sequencing and control, and parameter passing. Languages selected will include examples of string processing, applicative, systems programming, and concurrent languages. Programming projects will **be** required. (ICSA-702 or equivalent)

Credit 4

ICSG-711 Compiler Construction

Registration **#0605-711**

The structure of language translators, lexical and syntactic analysis, storage allocation and management, code generation, optimization, error recovery. Programming projects will be required. (ICSG-700, 710)

Credit 4

ICSG-712 Theory of Parsing

Registration #0605-712

Application of theoretical concepts developed in formal language and **automata** theory to the design of programming languages and their processors, **syntactic** and semantic notation for specifying programming languages, theoretical properties of some grammars, general parsing, non-backtrack **parsing,** and limited backtrack parsing algorithms. (ICSG-700)

Credit 4

ICSG-715 Parallel Algorithms and Program Design

Registration #0605-715

A study of the principal trends in parallel algorithm design, through the analysis of algorithms used in various areas of application. Specific techniques that have gained widespread acceptance will be highlighted. 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. Each student will be required to research an area of parallel program design and then implement a parallel computing project for an application within this area of study. Programming projects will be required. (ICSG-735)

Credit **4**

ICSG-719 Topics in Programming languages

Registration #0605-719

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)**

Credit variable 14

ICSG-720 Computer Architecture

Registration **#0605-720**

Review of classical computer architectures, the design of operation codes and addressing modes, data formats, and their implementation. Analysis of internal **and** external bus structures. Architectural features to support virtual storage **and** page-replacement policies, high-level language features, and operating **systems.** Speed-up techniques. Future directions. Programming projects will **be** required. (ICSS-708)

Credit 4

ICSG-721 Microprocessor and Microcomputers

Registration #0605-721

A study of microprocessors, microcomputers and microcomputer applications. Topics to be covered include microprocessor architecture, microcomputer organization and buses, parallel and serial interface techniques, analog interfacing, interrupts, and development trends in microprocessors. Emphasis will be on the use of microprocessors and small microcomputers. Single board microcomputer systems are used in laboratory projects to explore hardware and software design issues, as well as memory design and I/O interface techniques. Programming projects will be required. (ICSG-720)

Credit 4

ICSG-729 Topics in Computer Architecture

Registration #0605-729

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. Topic covered in the past: neural networks. Programming projects will be required. (Permission of the instructor)

Credit variable 1-4

ICSG-730 Operating Systems I

Registration #0605-730

Solving problems using cooperating parallel processes; the concepts of operating systems design. Emphasis will be on the use of operating systems from the programmer's point of view and on the design of operating systems from a conceptual rather than an implementation-oriented point of view. Students will construct software systems of parallel processes and study operating systems that support such parallelism. Students will become conversant in the issues facing the operating system designer and will be able to evaluate trade-offs inherent in the design process. Programming projects will be required. (ICSS-708)

Credit 4

ICSG-731 Operating Systems II

Registration #0605-731

A laboratory practice course which provides the student with practical experience in implementing many of the notions discussed in Operating Systems I. The class, with the instructor serving primarily as a technical advisor, designs the kernel of a small operating system in class. This kernel is module tested and downloaded to a stand-alone processor and test run until it is debugged. Then students form into groups of three to five persons each and choose a project implementing additional features of the operating system. Typical projects are: file systems, memory management, scheduling, and inter-process communications. Programming projects will be required. (ICSG-730)

Credit 4

ICSG-735 Introduction to Parallel Computing

Registration #0605-735

A study of the hardware and software issues in parallel computing. Topics include an introduction to the basic concepts, parallel architectures, parallel algorithms, parallel languages, network topology, coarse- versus fine-grained parallelism, applications, parallel programming design and debugging. Programming projects will be required. (ICSG-710, ICSG-730)

Credit 4

ICSG-739 Topics in Operating Systems

Registration #0605-739

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: parallel programming; Unix™ internals; concurrency methods; security; operating systems performance; software environments. Programming projects will be required. (Permission of the instructor)

Credit variable 1-4

ICSG-740 Data Communications and Networks I

Registration #0605-740

Fundamentals of data communication, including terminal communication and computer-to-computer communication. Emphasis in the first course will include the theoretical basis for data communication, terminal handling, data transmission and multiplexing, error detection and correction, as well as an introduction to the hierarchical model for computer networks; an introduction to graph theory and the topological design of networks, queuing theory and delay analysis; the fundamental protocols for computer communication. (Statistics, ICSS-708)

Credit 4

ICSG-741 **Data Communication and Networks II**
Registration #0605-741
A second course in communication and networks. Emphasis is on higher level protocols and local networks. Included are design and analysis of communication protocols, routing algorithms, satellite and local networks; higher-level protocols and the application of computer networks. (ICSA-720, 730, 740)
Credit 4

ICSG-749 **Topics in Data Communication**
Registration #0605-749
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)
Credit variable 14

ICSG-750 **Introduction to Artificial Intelligence**
Registration #0605-750
The theory and techniques underlying the development of "intelligent" computer software. Emphasis will be placed on programming techniques and languages used in artificial intelligence research. Students will be required to design and implement programs that use these techniques to build expert systems, theorem provers, natural language understanding systems and other artificial intelligence projects. Programming projects will be required. (ICSS-707,708)

Credit 4

ICSG-751 **Knowledge-Based Systems**
Registration #0605-751
An introduction to the issues and techniques of building knowledge-based systems. Topics will include knowledge representation techniques, expert system building tools, knowledge acquisition, uncertainty handling techniques, induction, and machine learning techniques. Programming projects will be required. (ICSG-750)
Credit 4

ICSG-759 **Topics in Artificial Intelligence**
Registration #0605-759
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: speech processing; logic programming; natural language processing; pattern recognition; genetic algorithms; AI programming paradigms. Programming projects will be required. (Permission of the instructor)

Credit variable 14

ICSG-761 **Fundamentals of Computer Graphics**
Registration #0605-761
Topics include basic concepts, 2-D transformations, windowing, clipping, interactive and raster graphics, 3-D transformations and perspective, hidden line and surface techniques, graphical software packages and graphics systems. Programming projects will be required. (ICSA-703)

Credit 4

ICSG-769 **Topics in Computer Graphics**
Registration #0605-769
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: animation techniques and packages; modeling of solids, including shading, perspective, hidden line and surface removal; three-dimensional graphics software packages; algorithms and heuristics; special purpose computer hardware for graphics. Programming projects will be required. (Permission of the instructor)

Credit variable 14

ICSG-771 **Data Base Systems**
Registration #0605-771
The storage and processing of formatted data using data base management systems. Topics include: objectives of data base management, file and indexing structures, data base system architectures, normalization theory, data base machines and distributed data bases. Several existing and experimental systems will be studied. (ICSA-703, ICSS-708)

Credit 4

ICSG-772 **Data Base System Implementation**
Registration #0605-772
An examination of the technical issues related to the implementation of shared access data bases. Topics include concurrency control, transaction processing, reliability and recovery. Extensions to the distributed processing environment also are covered. Programming projects will be required. (ICSG-771)
Credit 4

ICSG-773 **Information Storage and Retrieval**
Registration #0605-773
A study of contemporary approaches to the storage and retrieval of unformatted text with emphasis on document databases. Topics include: traditional approaches to indexing and retrieval, text analysis and automatic indexing, clustering algorithms, the SMART system, the extended Boolean logic model, pattern matching algorithms, and videotex. (ICSS-707)

Credit 4

ICSG-791 **Simulation *&c* Modeling I**
Registration #0605-791
Computer simulation techniques are examined. Topics include abstract properties of simulations modeling, analysis of a simulation run, and statistics. A general purpose simulation language will be taught. Programming projects will be required. (ICSA-703, Statistics)

Credit 4

ICSG-799 **Topics in Simulation & Modeling**
Registration #0605-799
The format of this course is a combination lecture and seminar covering current topics in the field. Students may register for this course more than once. Topics covered in the past include: continuous systems simulation; applications to world population models, operating systems; programming languages that support simulation and procedural applications (e.g., Simscript, Simula, SLAM, Ada [TM]). Programming projects will be required. (Permission of the instructor)

Credit variable 14

ICSG-829 **System Programming Seminar**
Registration #0605329
The format of this course is a combination lecture and seminar covering current topics in the field. Students may register for this course more than once. Students will be guided through the construction of large software projects. Programming projects will be required. (Permission of the instructor)

Credit variable 14

ICSG-888 **Graduate Cooperative Education**
Registration #0605-888

One quarter of appropriate work experience.

Credit 0

ICSG-890 **MS Thesis**
Registration #0605-890
Capstone of the master's degree program. Student must submit an acceptable thesis proposal in order to enroll. (Permission of the Graduate Program Committee)

Credit variable 14

ICSG-891 **MS Project**
Registration #891
Capstone of the master's degree program. Student must submit an acceptable project proposal in order to enroll. (Permission of the Graduate Program Committee)

Credit 2

ICSG-898 **Independent Study**
Registration #0605-898
Faculty directed study of appropriate topics on a tutorial basis. This course will generally be used to enable an individual to study computer science topics in greater depth and more detail. (Faculty approval)

Credit variable 14

ICSG-899 **Seminar**
Registration **#0605-899**
Current advances in computer science. Previous topics have included: data encryption, arithmetic algorithms, natural language processing, robotics, computer animation, speech processing, syntactic pattern recognition. (Permission of the instructor)

Credit variable 14

School of Engineering Technology

Department of Manufacturing Engineering Technology

jTEF-740 **Advanced Manufacturing Processes**
Registration #0617-740
Presents a comprehensive treatment of the manufacturing processes and their role in the changing manufacturing environment Special emphasis on mechanical, electrical, thermal, and chemical processes. (Manufacturing Processes)

Class 4, Credit 4

ITEF-810 **Machine Vision**
Registration **#0617-810**
The course will deal with the principles and application of machine vision systems in manufacturing processes. Topics will include the state-of-the-art in manufacturing automation, the need for machine vision in industry, principles of digital image processing, image acquisition, lighting and viewing techniques, camera systems, solid state image sensors, computer approaches to vision image understanding, role of vision in robotics, model machine vision systems, use of vision in such applications as assembly, welding, painting, material handling, gaging, and inspection, economics of machine vision, issues in the implementation of machine vision in the industry, and case studies.

Class 3, Lab 2, Credit 4

ITEF-820 **Lasers in Manufacturing**
Registration #0617-820
The course will deal with the fundamentals of lasers; lasing materials; characteristics of lasers; categories of lasers; effects of lasers on materials; applicability of lasers in manufacturing; laser beam and metal interaction; reflectivity, heat flow; phase change; laser-based process systems; application of lasers on such processes as micromachining, drilling, marking, welding, cladding, heat treating, and inspection; safety issues in laser-based manufacturing systems; role of lasers in flexible manufacturing systems; and case studies of flexible manufacturing systems with lasers. (Manufacturing Processes)
Class 4, Credit 4

ITEF-830 **Computer-Aided Process Planning**
Registration #0617-830
The course deals with the practical aspects of developing and implementing automated process planning systems in computer-integrated manufacturing environments. Topics will include design representation in CIM, group technology coding and classification, traditional approaches to process planning, automated approaches to process planning, developing automated process planning using variant and generative approaches, survey of various process planning systems, and issues in the development and implementation of process planning systems. The lab projects will involve implementing a process planning system in the real-world environment. (Manufacturing Processes)

Class 3, Lab 2, Credit 4

ITEF-840 **CIM Implementation**
Registration #0617-840
The course deals with the technical and management aspects of implementing CIM systems. Major topics will include strategic thinking, conceptual planning, system design, system implementation, and case studies in CIM implementation. (ITEF475 or equivalent)
Class 4, Credit 4

ITEF-850 **Assembly Automation**
Registration #0617-850
The course deals with the concepts in the design of products for assembly, state-of-the-art in the general purpose assembly systems, and software for automated assembly.

Class 4, Credit 4

ITEF-870 **Flexible Manufacturing Systems**
Registration #0617-«70
This course deals with the design and operation of FMS. Topics covered include components of FMS, distribution processing in FMS, integration of CAD and CNC, processing machines, tooling and tool management, part-holding devices, material handling systems, robots, AGVS, coordinate measuring machines, sensors, system controls, design of FMS, and management issues in FMS. (Manufacturing Processes)

Class 4, Credit 4

Department of Packaging Science

IPKG-701 **Research Methods in Packaging**
Registration #0607-701
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

IPKG-721 **Packaging Administration**
Registration #0607-721
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

EPKG-731 **Advanced Packaging Economics**
Registration #0607-731
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

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

Credit 4

IPKG-750 **Graduate Seminar**
Registration #0607-750
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

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

Credit 4

EPKG-763 **Packaging for End Use**
Registration #0607-763
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

IPKG-770 **Advanced Computer Applications**
Registration #0607-770
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

IPKG-783 **Packaging Dynamics**
Registration #0607-783
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. Individualized instruction appropriate to student's interests.

Credit 4

IPKG-798 **Independent Study**
Registration #0607-798
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)

IPKG-799 **Advanced Package Design**
Registration #0607-799
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 14

IPKG-890 **Graduate Thesis**
Registration #0607-890
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)

School of Food, Hotel, and Travel Management

ISMM-750 **The Hospitality-Tourism Industry:**
Registration #0624-750 **A Systems Approach**
General systems theory is used to explore the concept of service as a philosophical framework in the hospitality-tourism industry. The interaction and interdependencies of these components are discussed within the framework of developing a service-management strategy to insure quality service.

Credit 4

ISMM-760 **Research Methods and Applications**
Registration #0624-760
A survey of the research methods that are especially applicable to hospitality-tourism practitioners. Emphasis is on primary data collection and its applications to specific forecasting, modeling, and indexing (e.g., creation of service indices) techniques used within the service industry.
Credit 4

ISMM-770 **Employee Relations & Training**
Registration #0624-770 **in Service Industries**
An overview and examination of personnel leadership functions as applied to the delivery of service excellence. Concepts discussed: teamwork, empowerment, relationship management, "moments of truth," the "cycle of service," and the institutionalization of service.
Credit 4

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

ISMM-821 **Perspectives on the Food Industry**
Registration #0624-821
The food industry is examined as a whole and from the perspectives of major segments: consumers, producers, processors, regulatory agencies, distributors, and retailers, including food service operators. Specific issues examined include the use of chemicals in growing and in processing; processing and packaging techniques; international government policies, consumer expectations; and the impact of these on the producer, food market distribution system, and the end users, be they retailers or food operators.

Credit 4

ISMM-822 **Computerized Systems for Food Service**
Registration #0624-822
Survey of computer information systems for planning and control in food service and restaurant operations. Various software and hardware packages are explored in relation to planning and control functions. These include: presale, point-of-sale (production, service and check handling) and postsale (post costing, check statement, menu adjustments, accounting, etc.)

Credit 4

ISMM-824 **Organizational Strategies of Hospitality Firms**
Registration #0624-824
An analysis of the organizational structure, operational procedures, corporate policies, financial growth, and related factors in specific hospitality firms. Traces the evolution of various selected companies to reveal individual growth strategies.
Credit **4**

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

Credit **4**

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

Credit **4**

ISMM-832 **Public Policy Analysis in Nutrition:**
Registration #0624-832 **Legal and Ethical Issues**
A survey of issues that affect interactions between the consumer of nutrition services and the practitioner in a variety of settings. Case studies will be used to depict issues surrounding patient/client rights, regulatory agencies, and public policy related to food and nutrition practice. These topics will explore the many ethical and legal ramifications of individual practitioners, institutions, and health care providers.
Credit 4

ISMM-834 **Planning and Marketing of Nutrition Services**
Registration #0624-834
This course explores the strategic planning and marketing processes that may help the professional identify and promote nutrition services in various environments. Useful concepts and methods for recognizing internal and external opportunities are presented. Learning experiences will include case analysis, interaction with entrepreneurial leaders and student investigations.

Credit 4

ISMM-842 Food and Beverage Marketing Strategies
Registration #0624-842
Market segmentation; methods in marketing research; creating a menu, environment, theme for a defined market; improving the market share through quality control, innovation, promotions, public relations, menu engineering and community involvement; premarketing; creating a new image; marketing to increase profitability. Case studies and projects.

Credit 4

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

Credit 4

ISMM-846 Travel Marketing Systems
Registration #0624-846
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

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

Credit 4

ISMM-862 (elective) Product Development and
Registration #0642-862 Problem Solving in Food Service
Evaluation of food ingredient interactions and quality standards of food products by sensory (taste) panels and objective measures. Creation of new food products or special dietary products; evaluation of new food ingredients or preparation methods; comparison of time and/or labor-saving products/methods. Emphasis on practical applications, experimental design and communicating the results both orally and in writing.
Credit 4

ISMM-864 Problem Analysis and Decision Making
Registration #0624-864 in the Service Economies
Specific hospitality-tourism industry and enterprise problems are analyzed using various problem-solving frameworks. The student will structure individual problems and design an appropriate analytical and decision-making framework for each.
Credit 4

ISMM-866 Tourism Planning and Travel Product Development
Registration #0624-866
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

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

Credit 4

ISMM-880 Seminar: Current Issues
Registration #0624-380
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**

ISMM-884 Professional Writing in Hospitality/Tourism
Registration #0624-884
A course designed to develop writing skills necessary to the composition of research reports, manuscripts, and articles for publication in professional journals, trade publications, and books. The elements of a research manuscript, including technical content, organization, style (APA), data presentation, abstracting, documentation formats (in-text citations, footnotes, endnotes, and bibliography) and editing will be discussed and put into practice. Students enrolling in the course should have command of standard written English prose.

Credit **4**

ISMM-885 Grantsmanship Techniques
Registration #0624-885
A course designed to develop skills necessary for a comprehensive understanding of the grantsmanship process for researching, preparing, and submitting successful grant proposals. Students will be expected to prepare a draft proposal. They will receive supportive instruction throughout its development and feedback on its final form.

Credit variable 14

ISMM-890 Practicum in Hospitality-Tourism Training
Registration #0624-890
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

ISMM-892 Training the Trainer
Registration #0624-892
This course is concerned with the principles governing the way people learn and the various ways these principles can be applied to instructional situations. Specifically, this course surveys instructional design as an interactive system where each systematic step leads to decisions that become "inputs" to the next step in the planning, implementation, and evaluation of instruction. A lecture/group discussion, and role play instructional delivery is utilized.

Credit 2

ISMM-896 Graduate Project
Registration #0624-896
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

ISMM-898 Thesis
Registration #0624-898
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

ISMM-899 Independent Study
Registration #0624-899
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

College of Business

Dr. Richard N. **Rosett,** Dean
Ms. Mary Hope, Director

The College of Business offers the master of business administration, or MBA, with concentrations in corporate accounting, public accounting, finance, marketing, management, the management of technology, manufacturing management, and international business. The program is balanced in several respects. Both the quantitative and qualitative sides of management are included. Both the applied dimension of managing real problems in actual companies, and the theoretical underpinnings of decision-making strategies are integral parts of the MBA program. And last, the student is considered as a whole person ... attention is paid to both personal growth and achievement and to developing the professional skills necessary for intelligent management in today's business community.

The strength of the MBA program comes from several sources. Faculty are nationally recognized. Applied research and writing bring recognition from both academic and business centers, while consulting activities link the faculty firmly to the business community.

Another part of RIT's strength is the long-standing institutional commitment to technological leadership and career development. A cooperative education experience at the graduate level and managerial skills workshops further develop the interpersonal skills and career objectives of students. Cooperative education is a tradition at RIT, and the MBA program provides opportunities for students to alternate quarters spent in class and quarters spent at full-time work.

Finally, students themselves bring a unique mix of talents and experiences to the MBA program. A group of full-time students works closely with faculty on a variety of academic and research projects. And a group of part-time students brings information, insights, and ideas to the classroom from their collective work experience. At last count, more than 170 different work organizations were represented by students in the MBA program.

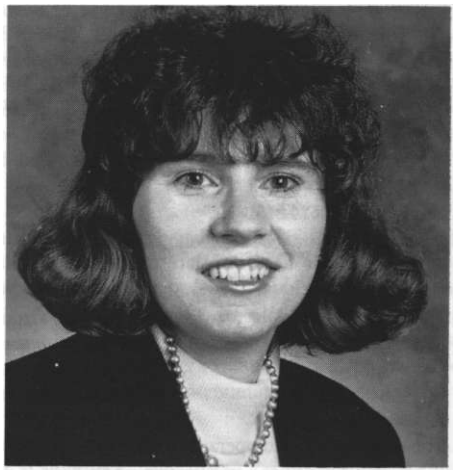
A synergy flows from the combination of a carefully planned program, outstanding faculty, and talented and experienced students. Many graduates of the MBA program have gone on to positions of leadership in a number of large corporations, and many have done well as entrepreneurs developing their own business enterprises.

Master of Business Administration

The purpose of the MBA program is to enhance the depth and breadth of general management capabilities of the student. This is accomplished by providing the student with a basic core of coursework in the disciplines of management, economics, statistics, management science, and information systems. Functionally oriented courses include accounting, finance, marketing and operations. These are followed by advanced courses, some of which are directed toward an area of concentration, while the remainder are chosen in elective areas designed to provide breadth to the student's program.

The traditional MBA program requires 80 quarter credit hours (20 courses) and is designed so that a student will progress through the program in a logical sequence while allowing some program flexibility. Those students with previous course work in business may be eligible for the waiver of specified foundation courses thereby reducing the length of their program.

An accelerated MBA program for recent graduates of accredited business schools is also offered. Outstanding undergraduate candidates from American Assembly of Collegiate Schools of Business (AACSB) business programs may apply for the One Year MBA program, (see page 46 for details)



Ms. Mary Hope

Students entering the traditional program have widely varied academic backgrounds. To assure that all students are adequately prepared in the area of mathematics, a diagnostic test is administered to all new students. Those students who need review in mathematics will be required to successfully complete preparatory course work in algebra and calculus during their first quarter of study.

Students in the traditional and accelerated programs are able to take course concentrations in: corporate accounting, finance, marketing, management, the management of technology, manufacturing management, and international business.

In addition, in the traditional MBA, a public accounting concentration may be chosen which provides students with general management skills and prepares them for public accounting careers. Graduates of this program meet the educational requirements for either the Uniform Certified Public Accounting Examination or the Certified Management Accountant examination.

General Information and procedures

Facilities
The College of Business is housed in the Max Lowenthal Memorial Building on RIT's suburban Rochester campus. Facilities include a fully staffed Learning Support Center, extensive time-sharing computer terminals on line with RIT's computer system, microcomputer labs, state of the art software support and an up-to-date collection of business texts, periodicals and reference services in the Wallace Memorial Library.

Admission to the traditional MBA
RIT operates on a quarter system calendar, thus part-time students may apply for entry into the traditional MBA program in the fall, winter, spring or summer. However, applicants planning full-time study begin their studies in the fall quarter. Completed applications for admission should be on file in the Office of Admissions five weeks prior to registration day for the upcoming academic quarter to ensure adequate time for consideration by the Graduate Review Committee.

Admission to the MBA program will be granted to graduates of accredited baccalaureate degree programs who, in the opinion of the Graduate Review Committee of the College of Business, have demonstrated their potential to successfully complete graduate business studies through their achievements in their undergraduate program and through the results of the Graduate Management Admission Test.

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.

Students who have been accepted in a program are allowed to defer enrollment (admission) for up to one year. If a student wishes to defer enrollment beyond one year, a new application must be submitted, and credentials will be reevaluated on the basis of current admission standards.

Prerequisite skills
It is not necessary for students to have completed any undergraduate course work in business to be admitted to, or succeed in, the graduate business program. It is necessary, however, for students to possess a working knowledge of algebra and elementary calculus to undertake graduate business courses. The mathematics skills of all entering students are assessed prior to the first day of classes by means of a diagnostic exam. Students who need further preparation will be required to successfully complete either self-instructional modules or formal review courses in mathematics during their first quarter of study.

Foreign students
International applicants are urged to apply for admission for the fall quarter. Applicants from foreign countries, where a degree or diploma is granted by an institution not holding accreditation, may be admitted provided their study and performance approximates the standards of an accredited bachelor's degree and an ability to meet graduate standards is indicated. International applicants must take and submit the results from the Graduate Management Admission Test. In addition, the TOEFL score (minimum 550) must be submitted by applicants with limited or no experience in an academic program in the United States.

Procedures
To be considered for admission it is necessary to file an application with two letters of recommendation, submit transcripts of all previous undergraduate and graduate work, submit results of the Graduate Management Admission Test, and provide an up-to-date resume. Information on the test may be obtained from the College of Business or by writing to the Graduate Management Admission Test, Educational Testing Service, Box 966, Princeton, NJ., 08540. The test is usually given four times a year in convenient locations, including RIT.

Orientation
All new students are required to attend an orientation session prior to enrolling in courses. At that time, the mathematics diagnostic test is administered. Students are given information regarding course selection, career planning, program planning and academic advising during the orientation. Student handbooks and registration materials are distributed at this time. A more extended Saturday orientation introduces students to the library, the computer system, and the many recreational facilities available at RIT.

Non-matriculated students
Students may apply to take a limited number of courses on a non-matriculated basis. If these courses are passed with an acceptable grade, and if the student later matriculates, these credits may be applied to the student's degree program. The regular admissions process should be followed by non-matriculated students who wish to be admitted to the MBA program.

Students may find it convenient to begin MBA courses on a non-matriculated basis while they are waiting for their GMAT scores to be reported.

Financial aid
Several forms of financial support are available to U.S. and International graduate students. For the most highly qualified full-time students, full research assistantships supplemented by scholarship support are available. Such exceptional candidates may expect 100% tuition remission and a quarterly scholarship to help cover books, housing, food and other cost-of-living expenses. For promising full-time candidates, research assistantships are also available. Typically, such awards cover 100% of a student's tuition costs. All assistants work with faculty on research projects, thus enhancing their education, and in turn receive tuition remission. Minority candidates may also apply for merit-based fellowships. Interested individuals should write to the Graduate Business Programs Office, requesting consideration for any of these merit-based financial aid programs.

While assistantships and fellowships are limited to full-time students, scholarships are available to outstanding full-time and part-time graduate students. Scholarships are administered through the dean of graduate studies, Dr. Paul Bernstein, who should be contacted by interested prospective students.

Other forms of financial aid such as loans and grants should be investigated through the Graduate Business Office and the director of financial aid in the Office of Financial Aid.

Placement service
Students seeking employment after graduation should register with RIT's Center for Cooperative Education and Career Services approximately one year prior to graduation. This lead time will enable the student to take full advantage of resume preparation aid and offers the opportunity to interview with a wide variety of local and national firms as they visit the campus.

Credit hour requirement
Credit hour requirements vary depending on the particular program and a student's prior academic achievements. Normally, 80 quarter credit hours are required in the traditional master of business administration program. Each course carries four quarter credit hours. In certain cases, total credit hour requirements may be reduced by the use of waiver credit and/or transfer credit. Students have the responsibility of applying for transfer credit and waiver credit.

Waiver Policy
For applicants who demonstrated a high likelihood of success as indicated from their GMAT scores and undergraduate record, up to eight foundation courses may be waived. In order to waive a foundation course, such students must have recently completed undergraduate course work in the relevant discipline and obtained good to excellent grades.

Applicants who do not satisfy the above requirements may still be granted waiver credit for a foundation course, provided they successfully complete an examination in the subject.

Transfer credit
A maximum of 12 quarter credit hours may be awarded as transfer credit from other graduate programs provided the courses in question carry a grade of "B" or better. Any questions concerning waiver or transfer credit should be referred to the Graduate Business Programs Office.

Academic standards
The average of the grades for all courses taken in the College of Business and credited toward the master's degree must be at least a "B" (3.0). Transfer credits from other colleges or institutions, waiver credits, or undergraduate course credits are not counted in the grade point computation. The policy on probation and suspension is explained in the section "Steps Toward Degree" (page 12) in this Bulletin. Students are urged to pay careful attention to that policy.

Program scheduling
Classes are scheduled weekday mornings and afternoons and weekday evenings. Classes meet once a week, 11 times during the quarter, for sessions of 3 ½ hours. Traditional full-time students take the 15 required classes in the daytime while choosing their electives from the evening offerings. Generally full-time students complete the traditional program in six quarters, or one and a half years. However, if students elect to go on a co-op, completion of the program may take two full years. A feasible course load for the part-time student is one to two courses per quarter, permitting program completion in approximately three to four years. Course requirements, faculty, and admission procedures correspond to the full-time program.

Program completion requirement
Institute policy requires that a graduate program be completed within seven years of the student's initial registration.

The co-op program
Cooperative education affords graduate students the opportunity to gain work experience with an organization. Co-ops are paid positions lasting 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 final, written report analyzing the company and the experience. Graduate students must apply for the co-op program early in their graduate studies. Students accepted into the co-op program will be eligible to interview with organizations once they complete the foundation courses in the MBA program. RIT will attempt to provide co-ops for qualified students but is unable to guarantee that all students will be placed.

Course offerings
Information concerning courses to be offered in a given quarter will be available through the Graduate Business Programs Office. The Institute reserves the right to make any necessary changes in course schedules or instructors, including the right to cancel courses, without prior notice. Day and evening courses meet once a week. The Institute 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.

The Traditional Master of Business Administration Curriculum*

The following sequence is recommended. Students who find it necessary to vary this sequence should seek counseling from the Graduate Office.

Quarter 1
BBUA-703 Accounting Concepts for Managers
BBUB-740 Organizational Behavior
BBUQ-781 Introduction to Statistics

Quarter 2
BBUQ-782 Applied Statistical Analysis
BBUE-711 Microeconomics
BBUM-761 Marketing Concepts

Quarter 3
BBUF-721 Financial Management I
BBUB-741 Organization & Management
BBUQ-780 Management Science
BBUE-712 Macroeconomics

Quarter 4
Elective(s)
BBUF-722 Financial Management II
BBUQ-743 Operations Management

Quarter 5
Elective(s)
BBUB-745 Business and Public Policy

Quarter 6
Elective(s)
BBUQ-790 Information Systems
BBUB-759 Strategy and Policy

•Students completing the Master of Business Administration degree with a Public Accounting Concentration, follow a modified form of the above course schedule. Such students should consult an advisor in the Graduate Business Office.

Master of Business Administration (MBA) Traditional Curriculum
Foundation Courses: Required courses which provide a depth and breadth of knowledge in business concepts, tools and functions.

Course Number and Title	Credit Hours
*BBUA-703 Accounting Concepts for Managers	4
*BBUB-740 Organizational Behavior	4
*BBUQ-780 Management Science	4
*BBUQ-781 Introduction to Statistics	4
*BBUE-7ll Microeconomics	4
*BBUF-721 Financial Management I	4
*BBUM-761 Marketing Concepts	4
*BBUQ-743 Operations Management	4
*BBUQ-790 Information Systems	4
BBUE-712 Macroeconomics	4
BBUQ-782 Applied Statistical Analysis	4
BBUB-741 Organization & Management	4
BBUF-722 Financial Management II	4
*BBUB-745 Business & Public Policy	4
BBUB-759 Strategy and Policy	4
Total hours-foundation courses	60

**Can be waived, reducing the number of courses required to graduate (no more than eight courses may be waived)*

Concentration courses: Concentrations are offered in public and corporate accounting, finance, marketing, management, the management of technology, manufacturing management, and international business. Concentration courses are on the following page.

Free elective courses: Free electives must be taken in discipline areas outside of a student's concentration. Students may choose no more than one free elective from economics, quantitative methods, finance and management and no more than two free electives from accounting, marketing, computers/information systems, production/operations management, personnel/human resources, and the social, legal, political environment of business. Graduate level courses from other Institute colleges also may be taken with prior approval of the chairman of Graduate Business Programs.

Concentration hours (8 or 12) and free elective hours (8 or 12)	20
Total hours	80*

**public accounting totals 96*

CORPORATE ACCOUNTING CONCENTRATION

Course Number and Title	
BBUA-704 Accounting Theory I	4
BBUA-705 Accounting Theory II	4
BBUA-706 Cost Accounting	4
Two free electives	8
Total Credits	20

Suggested free electives:
BBUF-723 Theory of Finance
Approved computer information systems courses

PUBLIC ACCOUNTING CONCENTRATION

Course Number and Title	
BBUA-704 Accounting Theory I	4
BBUA-705 Accounting Theory II	4
BBUA-706 Cost Accounting	4
BBUA-707 Advanced Accounting	4
BBUA-708 Auditing	4
BBUA-709 Basic Tax Accounting	4
BBUA-810 Advanced Tax Accounting	4
BBUA-730 Business Law I	4
BBUA-731 Business Law II	4
Total Credits	36

This concentration meets the educational requirements for the Uniform Certified Public Accounting Examination and the Certified Management Accountant examination.

FINANCE CONCENTRATION

Course Number and Title	
BBUF-723 Theory of Finance	4
One course from Group A	4
Three free electives	12
Total Credits	20

Group A
BBUF-724 Problems in Finance
BBUF-725 Securities & Investment Analysis
BBUF-726 Capital Markets
BBUF-729 Seminar in Finance

Suggested free electives:
BBUE-713 Advanced Microeconomics
BBUE-714 Advanced Macroeconomics
BBUA-706 Cost Accounting
BBUA-709 Basic Tax Accounting
Approved statistics, computer/information systems courses

MARKETING CONCENTRATION

Course Number and Title	
BBUM-762 Advanced Marketing Management	4
Two courses from Group A	8
Two free electives	8
Total Credits	20

Group A
- BBUM-763 Buyer Behavior
- BBUM-764 Marketing Logistics
- BBUM-765 Sales Management
- BBUM-766 International Marketing
- BBUM-767 Marketing Communications
- BBUM-758 Seminar in Marketing
- BBUM-769 Advanced Seminar in Marketing

Suggested free electives:
BBUB-770 Business Research Methods

MANAGEMENT CONCENTRATION

Course Number and Title	
Two courses from Group A	8
Three free electives	12
Total Credits	20

Group A
- BBUB-742 Introduction to Technology Management
- BBUB-746 Management & Career Development
- BBUB-750 Human Resource Management
- BBUB-753 Entrepreneurial Field Studies
- BBUB-757 Management & Leadership
- BBUB-758 Seminar in Management
- BBUB-763 Behavioral Skills
- BBUB-760 Comparative Management
- BBUB-768 Advanced Seminar in Management

THE MANAGEMENT OF TECHNOLOGY CONCENTRATION

Course Number and Title	
BBUB-742 Introduction to Technology Management	4
BBUB-761 Strategic and Global Factors in the Management of Technology	
OR	
BBUB-762 Managing the High-Tech Organization	4
Three free electives	12
Total Credits	20

Suggested free electives:
BBUQ-744 Project Management
BBUQ-745 Quality Control and Improvement
BBUQ-749 Manufacturing Strategy
BBUB-757 Management and Leadership

MANUFACTURING MANAGEMENT CONCENTRATION

Course Number and Title	
BBUQ-744 Project Management	4
BBUQ-745 Quality Control & Improvement	4
BBUQ-749 Manufacturing Strategy	4
Two free electives	8
Total Credits	20

Suggested free electives:
BBUA-706 Cost Accounting
BBUB-742 Introduction to Technology Management
BBUB-757 Management & Leadership
BBUB-760 Comparative Management
BBUB-770 Research Methods
EQAS-721 Statistical Quality Control I
EQAS-731 Statistical Quality Control II
EQAS-781 Quality Management
EQAS-782 Quality Engineering
EIEI-690 Seminar in Computer Integrated Manufacturing

INTERNATIONAL BUSINESS CONCENTRATION

Course Number and Title	
BBUB-780 Introduction to International Business	4
BBUM-766 International Marketing	4
BBUB-782 Seminar in International Business	4
Two free electives	8
Total Credits	20

Suggested free electives:
BBUB-760 Comparative Management
BBUF-760 International Finance

The Accelerated MBA (one year)

RIT now offers a One Year Master of Business Administration (MBA) program. Students enter the program in the summer and take four two-credit hour classes to prepare for the advanced level course work of the MBA program. In September, students join with other second-year MBA students and complete at least 12 more courses (7 required, 5 elective).

Admission
Admission to the One Year Program is awarded to recent outstanding graduates of AACSB (American Assembly of Collegiate Schools of Business)—accredited undergraduate business programs. Admission to the program is limited to candidates who have received an undergraduate degree within the past five years and who possess highly competitive undergraduate records and GMAT test scores.

To be considered for admission it is necessary to file an application with two letters of recommendation, submit transcripts of all previous undergraduate work, submit results of the Graduate Management Admission Test, and provide an up-to-date resume. The deadline for receipt of all application materials is May 10.

Orientation
Students accepted into the One Year Program must attend an orientation session prior to enrolling in summer classes. Students are given information on program planning, registration procedures, and career planning at orientation. A separate, more extended Saturday orientation introduces students to the library, the computer system, and the many recreational facilities available at RIT.

Financial Aid
Significant financial support is available for students admitted to the One Year Program. Due to the rigorous entrance requirements for the One Year program, accepted students tend to be very competitive for merit-based assistantships. Typically, such awards cover 100% of a student's tuition costs. All assistants are assigned to work with faculty or administrators on research projects, thus enhancing their educations, and in turn receive tuition remission.

Credit Hour Requirement
Normally, 56 quarter credit hours are required to complete the accelerated (One Year) MBA program. The summer quarter review courses each carry two credit hours, thus totalling eight hours. The second-year foundation courses carry four credit hours each, thus comprising 28 hours of study. Concentration courses and electives, which also carry four credit hours each, must total 20 hours.

Concentration Courses
Concentrations are offered in corporate accounting, finance, marketing, management, the management of technology, manufacturing management, and international business. Descriptions of the concentrations start on page 45.

MBA 4 + 1 Programs with SUNY Geneseo and Ithaca College
The College of Business has established agreements with SUNY Geneseo and Ithaca College that allow qualified students to accelerate their progress through the RIT MBA program. These agreements enable students to plan their undergraduate programs to include courses providing a foundation for graduate study. Specific, GMAT, program and CPA criteria must be met to qualify for waiver of selected MBA courses. For more information, call (716) 475-6183.

Graduate Faculty College of Business

Richard N. Rosett, Ph.D,, MA, Yale University—Dean; Professor, Economics

Gary Bonvillian, MS, Rochester Institute of Technology—Associate Dean

Mary B. Hope, MS, Rochester Institute of Technology—Director, Graduate Business Programs

Named Chairs and Named Professorships

Riad A. Ajami, Ph.D., Pennsylvania State University; MBA, Portland State University—Benjamin Forman Chair in International Business; Director, Center for International Business; Professor

Eugene F. Fram, Ed.D., SUNY at Buffalo—McClure Chair, Professorship

Walter F. **McCanna,** Ph.D., University of Wisconsin-Madison—Bertch Professor of Business Ethics; Director, Frank D. Bertch Center for Business Ethics

Karen Paul, Ph.D., Emory University-Dean's Professorship

Special Programs Directors

Robert J. Barbato, Ph.D., Michigan State; Director of Small Business Institute-Associate Professor

Donald O. Wilson, Ph.D., University of California at Irvine; MPA, University of Southern California—Director of Management of Technology Program; Assistant Professor

Department of Marketing & Management

Robert Pearse, Ph.D., University of Chicago—Distinguished Lecturer and Chairman

Management Faculty

Janet C. **Barnard,** Ed.D. University of Rochester—Assistant Professor

Andrew J. DuBrin, Ph.D., Michigan State; MS, Purdue—Professor

Ramesh Gehani, Ph.D., Tokyo Institute of Technology—Assistant Professor

William A. Nowlin, Ph.D., SUNY Buffalo; MPA SUNY Brockport—Associate Professor

Marketing Faculty

Dean C. **Siewers,** Ph.D., North Carolina-Chapel Hill; MBA, Duke University-Assistant Professor

Patricia A. Sorce, Ph.D., MS, University of Massachusetts—Associate Professor

Philip R. Tyler, DBA, MBA, Michigan State—Associate Professor

Stanley M. Widrick, Ph.D., Syracuse University; MBA, SUNY at Buffalo—Associate Professor

Julian E. Yudelson, Ph.D., Northwestern; MBA, Emory—Associate Professor

Department of Decision Sciences

George A.Johnson, DBA, MBA, Indiana University—Professor and Chairman

Decision Science Faculty

Kathleen Bentley, Ph.D. in progress, Syracuse University; MBA, BA, SUNY Albany—Assistant Professor

Terry L. Dennis, Ph.D., MSIA, Purdue-Professor

Delvin Grant, Ph.D., MBA, SUNY at Binghamton—Assistant Professor

Bernard J. Isselhardt, Ph.D., University of Iowa—Assistant Professor

Daniel A.Joseph, Ph.D., SUNY Buffalo; MBA, McMaster—Associate Professor

A. Erhan Mergen, Ph.D., MSIA, Union College—Associate Professor

Thomas F. Pray, Ph.D., Rensselaer Polytechnic Institute—Professor

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

Thomas A. Williams, Ph.D., Rensselaer Polytechnic Institute—Professor

Department of Accounting & Finance

Walter J. Woerheide, Ph.D., MBA, Washington University—Professor and Chairman

Accounting Faculty

Kenneth D. Gartrell, Ph.D., MS, BA, Kent State University; CPA—Assistant Professor

Francis E. Kearns, Ph.D., MBA, SUNY Buffalo; BD, Harvard University; CPA-Assistant Professor

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

Jose A. Rullan, MS, Rochester Institute of Technology; CPA—Assistant Professor

Franklin T. Russell, JD, Syracuse University; MBA, Johnson School of Management, Cornell University; BA, Cornell University—Assistant Professor

Judyth A. Swingen, Ph.D., MS, University of Wisconsin—Associate Professor

Daniel D. Tessoni, Ph.D., Syracuse University; MS, Clarkson; CPA—Assistant Professor

Robert J. Warth, MBA, Simon School of University of Rochester; CPA—Assistant Professor

Finance and Economics Faculty

James C. **Galloway,** Ph.D., University of Virginia; MBA, Pennsylvania—Assistant Professor

Steven C. **Gold,** Ph.D., SUNY at Binghamton—Associate Professor

John A. Helmuth H, Ph.D., South Carolina—Associate Professor

Jeffrey P. Lessard, Ph.D., University of Arkansas—Assistant Professor

Kyle Logan Mattson, DBA, University of Kentucky; MBA, Utah State University; MPA, Syracuse University—Assistant Professor

AshokJ. Robin, Ph.D., MBA, SUNY Buffalo—Assistant Professor

Special Appointments

Paul Bernstein, Ph.D., University of Pennsylvania; Ed.M., Temple University—Dean, Graduate Studies; Professor

Paul E. Petersen, Ph.D., Michigan State University—Dean, College of Engineering; Professor

M. Richard Rose, Ph.D., University of Pittsburg, MS, Westminster College; BS, Slippery Rock—Professor

Accounting

BBUA-703 Accounting Concepts for Managers
Registration #0101-703
An introduction to financial and managerial accounting concepts, with particular emphasis placed on their use for decision making. Topics covered will include: financial statements, transaction analysis, measuring economic values, responsibility accounting, budgeting, decentralized and divisional performance measurement.

Credit 4

BBUA-704 Accounting Theory I
Registration #0101-704
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. (BBUA-703)

Credit 4

BBUA-705 Accounting Theory II
Registration #0101-705
Continuation of Accounting Theory I with emphasis on liabilities, equity, long-term debt and special measurement and reporting problems. Included here is the Statement of Cash Flows, pensions, leases, and accounting for changes in prices. (BBUA-704)

Credit 4

BBUA-706 Cost Accounting
Registration #0101-706
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 distribution and control. (BBUA-703)

Credit 4

BBUA-707 Advanced Accounting and Theory
Registration #0101-707
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. (BBUA-705)

Credit 4

BBUA-708 Auditing
Registration #0101-708
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. (BBUA-705)

Credit 4

BBUA-709 Basic Taxation Accounting
Registration #0101-709
Study of federal income taxation, emphasizing tax planning for individuals and unincorporated businesses. (BBUA-703)

Credit 4

BBUA-794 Cost Accounting in the
Registration #0101-794 Manufacturing Environment
A first course in accounting for students specializing in computer integrated manufacturing systems (CIMS). 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

BBUA-810 Advanced Taxation Accounting
Registration #0101-810
Study of federal income taxation, emphasizing tax planning for corporations and partnerships. Includes U.S. taxation of international transactions. (BBUA-709)

Credit 4

Management

BBUB-740 Organizational Behavior
Registration #0102-740
The importance of human behavior in reaching organizational goals. Course emphasis: managing individual and interpersonal relations; group and intergroup dynamics; leadership, communication and motivation skills in managing organizational performance and change.

Credit 4

BBUB-741 Organization and Management
Registration #0102-741
A study of organizations as systems, including their subsystems and interrelationships with other organizations and the external environment. Focus is placed on the role of managers as those responsible for understanding and integrating the needs of the organization, its members, and its external environment. Major topics studied include organization structure and design, organizational performance, organizational change, organizational analysis, and bureaucracy.

Credit 4

BBUB-742 Introduction to Technology Management
Registration #0102-742
This course is an introduction to the technological process in organizations and the factors, both internal and external, which influence the rate, timing and success of industrial innovations. The interrelationship between science and technology and the importance of these two disciplines on the process of technological innovation is examined. Also discussed is the process of **R&D** management, the dynamics of technology life cycles, and organizational influences on engineering and manufacturing process. (BBUB-740 for business majors; permission of instructor for students in other colleges)

Credit 4

BBUB-753 Entrepreneurial Field Studies
Registration #0102-753
Students enrolled in this course are provided the opportunity to serve as consultants to a specific small business firm within this geographic area. Under an arrangement with the Small Business Administration, and working under the supervision of a senior faculty member, teams of students provide management consulting about a variety of problems to small businesses. As a practicum this course does not have regularly scheduled class hours. Instead students confer with their faculty member on an as-needed basis. (BBUA-703, BBUF-721, BBUM-761)

Credit 4

BBUB-756 Conflict Management and
Registration #0102-756 Negotiating Skills for Managers
A study of current theories and techniques related to constructive management of organizational conflicts and negotiations. Current theories on interpersonal, group and intergroup conflict management are reviewed. (BBUB-740)

Credit 4

BBUB-757 Management and Leadership
Registration #0102-757
Manager-oriented skills related to the 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. (BBUB-740)

Credit 4

BBUB-758 **Seminar in Management**
Registration #0102-758
A presentation of current specialty topics within the broad field of management. Seminar topics have included organizational power and politics, improving individual and managerial effectiveness, managerial control systems, employee and labor relations, organization development, compensation and reward systems, macro and micro aspects of technology management, and small business information systems. The course topic for a specific quarter will be announced prior to the course offering. Although a seminar, the course may include some lectures and examinations. (BBUB-740, varies with instructor)

Credit 4

BBUB-759 **Strategy and Policy**
Registration #0102-759
This course provides experience in combining theory and practice gained in other course work. This integrative exposure is achieved by solving complex and interrelated business policy problems that cut across the functional areas of marketing, production, finance, and personnel. This course is aimed at the formulation and implementation of business policy as viewed by top management. The case method and computer simulation are used extensively. Since this is a capstone course, the workload is considerably above average. (All other required courses)

Credit 4

BBUB-761 **Strategic and Global Factors in the**
Registration #0102-761 **Management of Technology**
This course deals with the relationship of technology to the strategic positioning of a company in a global competitive environment. The technology-strategy relationship is examined from the perspective of the individual firm, an entire industry, and the industrial policy of a nation. Various organizational arrangements, strategies and the role of government in technological developments and technology transfer will be studied by cross-country comparisons. (BBUB-742)
Credit 4

BBUB-762 **Managing the High-Tech Organization**
Registration #0102-762
The course deals with the internal organizational problems faced by managers of technology-intensive companies. Particular attention is given to motivating and managing creative professionals, overcoming barriers to innovation, managing technical groups and project teams, and organization design alternatives such as matrix management and skunk works. Management techniques for successfully developing and introducing into the marketplace new products and services will be examined. (BBUB-742)
Credit 4

BBUB-763 **Behavioral Skills for Managers**
Registration #0102-763
This course is designed to acquaint the student with behavioral skills needed for effective management. A variety of instructional methods will be used, including lectures, discussion, case analysis exercises, and videotaping.

Credit 4

BBUB-768 **Advanced Seminar in Management**
Registration **#0102-768**
Study and discussion of strategic issues in management and technology management for the advanced student. Topics will vary with the instructor. (BBUF-721, 722, BBUM-761, and BBUB-740 or 741, permission of instructor)

Credit 4

BBUB-770 **Research Methods**
Registration **#0102-770**
This course concerns the development, presentation, and use of research in managerial decision-making. Included are the processes by which meaningful research problems are generated, identification of the relevant literature, operationalizing the research design, and interpretation of findings. Students typically work in small groups to execute a research project in one of the functional areas of management for the profit or not-for-profit sector. (BBUQ-782)
Credit 4

BBUB-799 **Independent Study**
Registration #0102-799
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 career objectives and ability of faculty will be included in the review and considerations for acceptance. (Permission of instructor and graduate department)

Credit 14

International Business

BBUB-760 **Comparative Management**
Registration #0102-760
An analysis of business behavior and organization in the European Community, Eastern Block 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. In all cases, the differential effect of culture on management will be carefully appraised. (BBUB-740)

Credit 4

BBUB-780 **Introduction to International Business**
Registration #0102-780
This is a survey course designed to expose students to the complexities 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. (BBUB-740, BBUE-712)

Credit 4

BBUB-782 **Seminar in International Business**
Registration #0102-782
This capstone course will focus on either contemporary issues and problems in international business or regional studies analysis (e.g., Europe, Eastern Block, Pacific Basin). It will emphasize faculty-directed student research projects. (BBUB-780)

Credit 4

BBUM-766 **International Marketing**
Registration #0105-766
Global implications of marketing functions. Analysis of specific marketing environments for the development of competitive advantages in marketing strategies. Effect of national/cultural forces on product adoption and use. Political, legal, technological, financial, and geographic aspects of international marketing. (BBUM-761, BBUB-780)

Credit 4

BBUF-760 **International Finance**
Registration #0104-760
This course is concerned with the monetary aspects of international economic relations. It deals with the following topics: the balance of payments, foreign exchange rates and markets, plant location, capital asset allocation, flexible exchange rates system, international capital movements, exchange, restrictions, and international monetary experience. (BBUA-703, BBUE-711, BBUF-721)

Credit 4

Personnel/Human Resources

BBUB-746 **Management and Career Development**
Registration #0102-746
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. Student is required to develop a career plan (career pathing). 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. (BBUB-740)

Credit 4

BBUB-750 **Human Resource Management**
Registration #0102-750
A study of personnel systems and methods of human resource management in organizations. The major personnel topics studied include organizational staffing (selection and recruitment), training and development, compensation, equal employee opportunity, human resource forecasting, and performance appraisal. The human resource techniques of line managers also will be studied. (BBUB-740, BBUQ-782)

Credit 4

Social *8c* Political Environment of Business

BBUA-730 **Business Law I**
Registration #0101-730
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

BBUA-731 **Business Law II**
Registration #0101-731
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. (BBUA-730)

Credit 4

BBUB-745 **Business and Public Policy**
Registration #0102-745
The processes and mechanisms whereby public policy issues are generated, negotiated, and resolved with particular attention to business-government relations, corporate governance, public opinion processes, business ethics, and issues involving international trade and multinational corporations. The course includes ongoing discussion of relevant court decisions and legislative actions.

Credit 4

BBUB-751 **Legal Environment of Business**
Registration #0102-751
An introduction to legal principles and their relationship to business practices. Business ethics and the environmental impact of the federal administrative agencies are stressed. Among the agencies considered will be the EPA EEOC, FDA OSHA FTC and the NLRB. (BBUA-703, BBUB-740)

Credit 4

Economics

BBUE-701 **Review Course, Microeconomics**
Registration #0103-701
A study of the theory of the firm under different market structures. Demand, production, and cost functions are developed and utilized to model the firm. Emphasis is on both theory and application. Four market structures are examined: competition, monopoly, oligopoly, and monopolistic competition. Each market structure yields a different set of implications regarding economic efficiency, economic stability, pricing policy, profits, and technological change. (Admission to the one-year MBA)

Credit 2

BBUE-711 **Microeconomics**
Registration #0103-711
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

BBUE-712 **Macroeconomics**
Registration #0103-712
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. (BBUE-711)

Credit 4

BBUE-713 **Advanced Microeconomic Theory**
Registration #0103-713
An advanced study of the fundamental economic principles underlying the nature of a business firm. Topics include: theories of demand and revenue; theory of costs and production analysis in both the short-run and the long-run; equilibrium of demand and supply and efficiency of competition; market structures and their characteristics; pricing and output under perfect competition, pure monopoly; imperfect competition, and oligopoly; resource allocation and product distribution. Business applications are given along with the exposition of the theory. (BBUE-711)

Credit 4

BBUE-714 **Advanced Macroeconomic Theory**
Registration #0103-714
An advanced study of the fluctuations and growth of economic activity in a modern complex society. Topics include measuring macroeconomic activity; modeling economic activity; microeconomic foundations in macroeconomic theory (the labor, the commodity, the money and the bond markets); a parallel discussion of the complete classical and Keynesian macroeconomic models; recent criticism of the two models; the general equilibrium; the phenomena of inflation and unemployment and the way business can forecast them; the impact of fiscal and monetary growth; reality and macroeconomic disequilibrium; and wage price policies. (BBUE-712)

Credit 4

BBUE-715 **Managerial Economics**
Registration #0103-715
Analysis of the economic conditions facing the firm. Topics include: demand and cost analyses, resource utilization, pricing, market structure, and other selected topics. (BBUA-703, BBUE-711, BBUQ782)

Credit 4

BBUE-716 **Seminar in Economics**
Registration #0103-716
Content will differ depending on the quarter and instructor. Topics that may be covered include international finance, monetary theory, labor economics and market structure. (Permission of instructor)

Credit 4

Finance

BBUF-701 **Review Course, Financial Management I**
Registration #0104-701
A review 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. This course will proceed at an accelerated pace as all enrollees must have completed a basic-level college corporate finance course. (Admission to the one-year MBA)

Credit 2

BBUF-721 **Financial Management I**
Registration #0104-721
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. (BBUQ782, BBUA-703, BBUE-711)

Credit 4

BBUF-722 **Financial Management II**
Registration #0104-722
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. (BBUF-721)

Credit 4

BBUF-723 **Theory of Finance**
Registration #0104-723
This course involves a study of the current literature and most recent developments relating to the theories of valuation, risk, investment analysis, cost of capital, capital structure and dividend policy. Topics will be studied within the framework of the capital asset pricing model and the option pricing model. Also considered are specific areas of application and the policy implications of the theories studied. (BBUF-721, 722)

Credit 4

BBUF-724 **Problems in Finance**
Registration #0104-724
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. (BBUF-721, 722)

Credit 4

BBUF-725 **Securities and Investment Analysis**
Registration #0104-725
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. Factors such as return, growth, risk, accounting procedures, tax considerations, and the impact of various institutional arrangements on value determination. (BBUF-721, 722)

Credit 4

BBUF-726 **Capital Markets**
Registration #0104-726
This course will review the statistical tools employed in financial analysis and examine the descriptive evidence on the behavior of security prices. The course will consider theory and evidence of capital market efficiency, portfolio theory, and the theory and evidence on the relationship between expected return and risk. The implications of the theory for applied practice will also be considered. Other topics will include: the evaluation of portfolio performance, international capital markets and efficient markets for other assets. (BBUF-721, 722)

Credit 4

BBUF-729 **Seminar in Finance**
Registration #0104-729
This course will take on different content depending on the instructor and quarter when offered. Topics that may be covered are: financial models, financial analysis techniques, financial institutions and capital markets. Specific content for a particular quarter will be announced prior to course offering. (BBUF-721, 722, and permission of instructor)

Credit 4

BBUF-795 **Financial Management in the**
Registration #0104-795 **Manufacturing Environment**
A broad coverage of business finance in the manufacturing environment with emphasis on the analytical techniques of resource allocation and asset management. Covers risk assessment, capital structures, analysis of financial statements, financing business operations, cost of capital, theories of leverage, capital budgeting, and working capital management. (BBUA-794)

Credit 4

Marketing

BBUM-758 **Seminar in Marketing**
Registration #0105-758
This course will take on different content depending on the instructor and quarter when offered. Topics that may be covered are: marketing models, marketing channels, articulation with top marketing executives, marketing positioning, and world-class marketing strategies. Specific content for a particular quarter will be announced prior to course offering. (Permission of instructor and BBUM-761)

Credit **4**

BBUM-761 **Marketing Concepts**
Registration #0105-761
Critical examination of the marketing system as a whole; functional relationships performed by various institutions such as manufacturers, brokers, wholesalers, and retailers. Analysis of costs, strategies and techniques related to the marketing system. Both behavioral and quantitative aspects of marketing are considered.

Credit **4**

BBUM-762 **Advanced Marketing Management**
Registration #0105-762
Advanced study of selected problems that face marketing managers concerned with promotion, place, price, and product. Material centers on staff marketing functions. Research topics unique to the field of marketing are covered. (BBUM-761)

Credit **4**

BBUM-763 **Buyer Behavior**
Registration #0105-763
A study of the market in terms of the psychological and socio-economic determinations of buying behaviors, including current trends in purchasing power and population movements. (BBUM-761)

Credit **4**

BBUM-764 **Marketing Logistics**
Registration #0105-764
The study of an integrated system for the distribution of products from producer to consumer. The emphasis is on the physical flow of goods both between and within marketing institutions. Specific topics covered are unit geographic location, internal product flow, inter-unit transportation, and warehousing. (BBUM-761)

Credit **4**

BBUM-765 **Sales Management**
Registration #0105-765
An examination of selling and sales management as they pervade both the marketing process and the management communications process. Topics include building and managing an effective sales force and selling philosophy and techniques creating managerial "win-win" situations with both superiors and subordinates. (BBUM-761)

Credit **4**

BBUM-767 **Marketing Communications**
Registration #0105-767
A study of interrelationships of three communications mix functions: public relations, advertising, and sales promotion. Topics covered will center on the use of these functions in the development of models for persuasive communications and their interrelationships with other elements of the marketing mix. (BBUM-761)

Credit **4**

BBUM-769 **Advanced Seminar in Marketing**
Registration #0105-769
Course draws heavily on experiences of senior executives in the marketing field. Topics will vary with the instructor. (Permission of instructor and BBUM-761)

Decision Sciences Quantitative Methods

BBUQ-701 **Review Course, Management Science**
Registration #0106-701
A short course in management science, including decision analysis, linear programming, project management, waiting line models, and a demonstration of computer simulation. (Admission to the one-year MBA)

Credit 2

BBUQ-702 **Review Course, Statistical Methods**
Registration #0106-702
A short course in applied statistics, including estimation and hypothesis testing, simple linear regression, multiple regression analysis, and an introduction to experimental design. (Admission to the one-year MBA)

Credit 2

BBUQ-780 **Management Science**
Registration #0106-780
An introduction to quantitative approaches to decision making. Topics covered include linear programming, goal programming, integer programming, simulation and decision analysis. The emphasis is not on the techniques per se, but rather on modeling, problem solving and showing how quantitative approaches can be used to contribute to a better decision-making process. Extensive use of computers. (BBUQ-781 or equivalent)

Credit 4

BBUQ-781 **Introduction to Statistics**
Registration #0106-781
An introduction to the use of statistics in business. Topics covered include descriptive statistics, probability concepts, probability distributions, sampling methods, and sampling distributions. Includes the use of computerized data analysis and fundamentals of inference.

Credit 4

BBUQ-782 **Applied Statistical Analysis**
Registration #0106-782
The course emphasizes the use of statistical tools in decision making. Topics include statistical inference; simple and multiple regression analysis, and ANOVA. (BBUQ-781 or equivalent)

Credit 4

BBUQ-784 **Decision Analysis**
Registration #0106-784
An in-depth study of the decision-making process. Emphasis will be on how to structure a complex problem into manageable form, methods for improving creative-problem solving, and the use of decision support systems in decision making. (BBUQ-780, BBUQ781 or equivalent)

Credit 4

BBUQ-785 **Applied Regression Analysis**
Registration #0106-785
The primary objective of this course is to teach the student how to effectively utilize a variety of data analysis techniques commonly referred to as regression analysis. Emphasis will be placed on model formulation and analysis. All students will be required to analyze several large data sets using a standard statistical package. Relevant theory will be introduced to enable the student to pursue further study in data analysis. (BBUQ-782 or equivalent)

Credit 4

BBUQ-793 **Business Forecasting Methods**
Registration #0106-793
An introduction to quantitative and qualitative forecasting methods and their use in business forecasting. The student will be taught how to recognize which forecasting procedures to use based upon an analysis of problem characteristics. Includes the use of interactive forecasting techniques. (BBUQ-782 or equivalent)

Credit 4

BBUQ-795 **Seminar in Decision Sciences**
Registration #0106-795
This course will take on different content depending on the instructor and quarter when offered. Specific content for a particular quarter will be announced prior to course offering. (Permission of instructor)

Credit 4

Computers/Information Systems

BBUQ-789 **Simulation**
Registration #0106-789
An introductory course in the use of computer simulation in the solution of complex business problems. A simulation language is introduced and applied in the solution of a term project. Particular attention is focused on the types of problems for which computer simulation is a viable solution technique as well as methods for establishing the validity of the simulation. (BBUQ780, 782 or equivalent)

Credit 4

BBUQ-790 **Information Systems**
Registration #0106-790
The types of computer applications which are used in business organizations are studied. Basic systems concepts and the responsibilities of the participants in systems development projects also are covered. Hands-on application of personal computer software is an integral and substantial part of the course. (BBUA-703, BBUF-721, BBUB-740, 741)

Credit 4

BBUQ-795 **Seminar in Decision Sciences**
Registration #0106-795
This course will take on different content depending on the instructor and quarter when offered. Specific content for a particular quarter will be announced prior to course offering. (Permission of instructor)

Credit 4

BBUQ796 **Information Systems Management**
Registration #0106-796
Study of the management of information systems. This course will focus on the responsibilities of a manager of information systems, including the selection of hardware, software, and staff; the establishment of IS standards; the development of effective relationships within the organization; and the general application of management principles to the IS function, including policy and strategy formulation. Case analysis will be utilized. (BBUQ790 or equivalent)

Credit 4

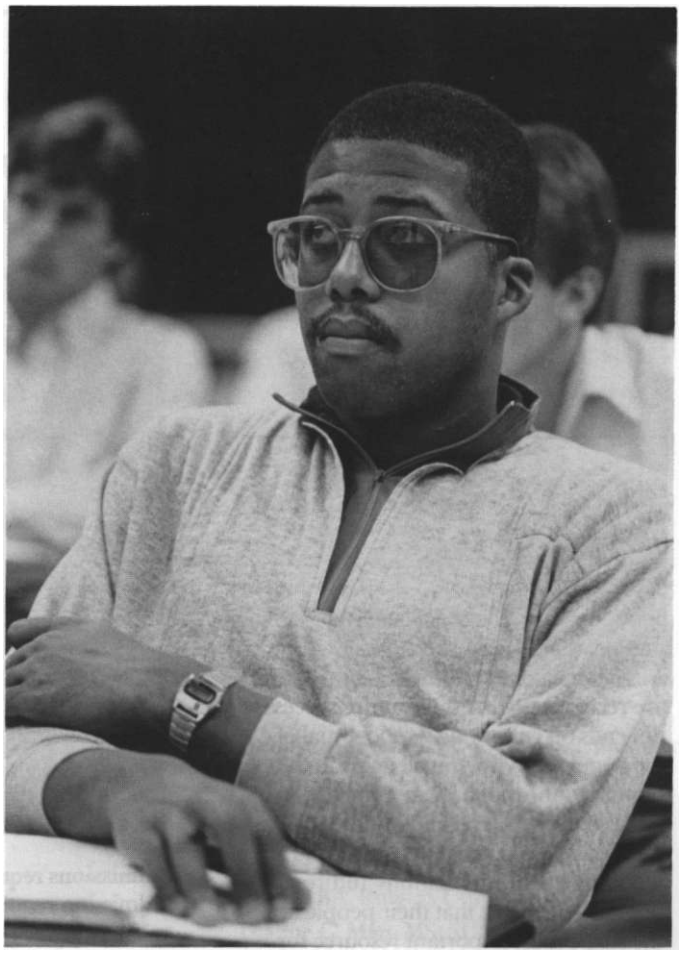
Production/Operations Management

BBUQ-743 **Operations Management**
Registration #0106-743
Study of production operations management. Topics include quality assurance, forecasting, resource planning, scheduling, materials and capacity management, inventory management, project management, just-in-time/total quality control (JIT/TQC), international operations, strategic considerations and current topics. (BBUQ-780, 782 or equivalent)

Credit 4

BBUQ744 **Project Management**
Registration #0106-744
A study in the principles of project management. This course focuses on the leadership role of the project manager, roles and the responsibilities of the project management team members, and the 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. (This course is for matriculated and non-matriculated graduate students with approval from the graduate business office.)

Credit 4



BBUQ745 **Quality Control and Improvement**
Registration #0106-745
Study of total quality control (TQC) and management (including Deming's philosophy), quality planning, quality cost principles, problem-solving methods and tools, the use of statistical methods for quality control and improvement, vendor relations, reliability concepts, and recent developments in quality; for example, quality function deployment (QFD) and Taguchi methods. The course focus is on the management and continuous improvement of quality and productivity in manufacturing and service organizations. (BBUQ781 or equivalent)

Credit 4

BBUQ749 **Manufacturing Strategy and Tactics**
Registration #0106-749
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. Strategic and tactical comparisons are developed for selected, example firms. (BBUQ743 or equivalent)

Credit 4

College of Continuing Education

Department of Career and Human Resource Development

Stanley Bissell, Acting Director

Human resource development today
The field of human resource development continues to expand and gain stature as an independent field. Government, industrial, educational, and other organizations are recognizing that their future success depends on cultivating the potential of the people who work at all levels in the organization—not only in top positions, but also in entry-level and middle-level positions. Competent executives who are mapping their organizations' futures do not ignore the fact that their people are the single most important resource for ensuring future success.

These executives and their organizations are turning to individuals with the necessary skills and knowledge to assist in this important process. These individuals, identified by a variety of tides—trainers, counselors, internal and external consultants, personnel administrators, human resource planners—need very specific education, training and skills.

Graduates of RIT's program in Career and Human Resource Development meet this need.

The program
The Career and Human Resource Development Program is a 52 quarter credit hour program with three major curriculum components: career development, organizational development, and human resource development. Students are required to take a theory course and techniques courses in each area. Students have the option of concentrating in a specific area through their choice of additional techniques courses and electives.

Many work environments are open to graduates of the program. Students focus on the environment of their choice—education, business, industry, public agencies—through their selection of projects, research topics and the setting of their internship.

Admissions 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 recent writing sample.
- An oral presentation.
- An interview with program faculty.

All credentials 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 Studies, RIT Admissions, or the department. Call 475-5062 for further information.

Financial assistance
In addition to the assistance available through the RIT Financial Aid Office (716/475-2186) or the dean of Graduate Studies (716/475-6523), the department has scholarship and assistantship opportunities. The number and kind vary from year to year. For more information contact the CHRD Department (716/475-5062) for further information.

Degree requirements
The degree requires the completion of a minimum of 52 quarter hours at the graduate level. Of the 52 hours, 24 are in nine courses required of all students. In addition, all students are required to complete 15 credits in techniques courses and 13 credits of electives. The degree can usually be completed in five consecutive quarters if the student starts in the Fall Quarter. However, the majority of students attend part time and take from two to four years to complete the degree work. Students must maintain a B average, and complete the degree within seven years from the first course taken and applied to the degree. Almost all courses are offered in the evenings, giving students the freedom to work during the day while they take courses.

Students are relatively free to choose the electives they feel best meet their needs. The only restrictions are: all courses must be graduate-level courses; a maximum of 12 quarter hours (not counted toward another degree) may be transferred from another college or university; a maximum of 12 hours may be taken outside the department of Career and Human Resource Development

Upon matriculation, each student is assigned an academic advisor. At this time the student and advisor will develop a plan of study. For specific questions about courses and a plan of study, the advisor or department director should be consulted.

Required Courses	Credit
CHRD-700 Introduction to Career & Human Resource Development	3
CHRD-705 Empirical Methods in CHRD	3
CHRD-707 Applied Data Analysis for CHRD	3
CHRD-710 Theory of Organizational Development	3
CHRD-720 Theories of Career Development	3
CHRD-730 Theory of Human Resource Development	3
CHRD-877 Internship*	6

**For students with appropriate professional experience, special projects or additional course work may be substituted for the Internship. Departmental approval is required.*

Organizational Development Techniques Courses	
CHRD-711 Futures Research & Simulation	3
CHRD-712 Planning & Evaluation in Organizational Development	3
CHRD-713 Practice of Consultation in Organizational Development	3

Career Development Techniques Courses	
CHRD-721 Career Counseling Techniques I	3
CHRD-722 Career Counseling Techniques II	3
CHRD-723 Information Use in Career Planning	3

Human Resource Development Techniques Courses	
CHRD-731 Techniques of HRD	3
CHRD-732* Design & Delivery of Training	2
CHRD-733 Needs Assessment & Proposal Development	3

**CHRD-732 may be taken more than once.*

Electives	
CHRD-740 Group Leadership	3
CHRD-750 Microcomputer Applications in CHRD	3
CHRD-850 Special Projects	Variable
CHRD-891 Selected Topics	3

Electives May Include:

Techniques courses not applied to degree requirements

Courses in other graduate-level programs at the Institute with permission of advisor

Degree Requirements

24 Credits-Required Courses
15 Credits-Techniques Courses
13 Credits-Electives
52 Credits Total

Graduate Faculty College of Continuing Education

Graduate Career and Human Resource Faculty

Stanley Bissell, ABD, University of Rochester; MLS, SUNY Geneseo; MA, University of Auckland, New Zealand; AB, Ohio Wesleyan University—Assistant Professor, Acting Director

Gladys W. Abraham, MS, SUNY Brockport; BS, SUNY Albany

Thomas T. Balog, BS, Bucknell University

Gregory J. Connor, MS, Rochester Institute of Technology; BS, Syracuse University—Assistant Professor

Susan K. Heard, Ed. D., University of Rochester, MS, Duquesne University; BS, Edinboro State

C. Carl Hilsdorf, MS, Rochester Institute of Technology; BA, SUNY Oswego

Isaac L. Jordan, Sr., Master of Divinity, MS, SUNY Buffalo; BS, Bethune-Cookman College

Paul Kazmierski, Ph.D., Syracuse University; M.Ed., B.Ed., BA, Duquesne University-Professor

Julie Lane-Hailey, Ph.D., University of North Carolina; MSW, Hunter College CUNY; BA, Rutgers University

Dianne C. **Mau,** MS, SUNY Brockport; BS, Rochester Institute of Technology

Joyce Morley-Ball, Ed.D, University of Rochester, CAS, MS, SUNY Brockport; BS, SUNY Geneseo

Robert J. Nemes, MS, BS, Rochester Institute of Technology

Joseph W. **Ostrowski,** MS, BS, Rochester Institute of Technology

James M. Papero, Ed.M., BS, University of Rochester—Associate Director Personnel

Ronald E. **Perry,** MS, BT, Rochester Institute of Technology

Charles M. Plummer, Ph.D., MS, Indiana University; BA, DePauw—Associate Professor

Kathleen O'Brien Voelkel, MS, University of Wisconsin; MSW, Southern Connecticut State; BS, University of Wisconsin-Instructor

J. Wixson Smith, MS, Rochester Institute of Technology; BS, SUNY Geneseo—Associate Professor

Career and Human Resource Development

CHRD-700 Introduction to Career and Human Resource Development
Registration #0290-700
As a result of this course, students will better understand the CHRD program and its courses/options as well as related RIT and community resources; better understand the general concepts of human resource development, career development and organizational development as they apply to individuals and groups in a wide variety of settings and structures; and better understand the past, present and future significance of social, economic, technological factors influencing organizations and occupational categories as well as the corresponding role and activities of the human resource professional.
Credit 3

CHRD-705 Empirical Methods
Registration #0290-705
This course will enable professionals in the fields of career development, organizational development and human resource development to accurately describe groups of people and their characteristics of interest to career and human resource development (e.g., skills, performance, background, attitudes, etc.). Topics include techniques of empirical investigation, questionnaire and test design, interviewing, and evaluations of training, counseling and development.
Credit 3

CHRD-707 Applied Data Analysis for CHRD
Registration #0290-707
Students will learn concepts and procedures for descriptive and inferential analysis of quantitative data typically found in human resource and career counseling situations. Through classes, assignments and use of statistical software, students will attain proficiency with descriptive statistics, probability, and estimation, hypothesis testing, cross-classification of data, correlation, and will be introduced to regression and analysis of variance. CHRD-707 will satisfy the data analysis requirement for the MS degree in CHRD.

Credit 3

CHRD-710 Theory of Organizational Development
Registration #0290-710
This course introduces the student to organizational development theories and their application in an organizational setting. Consideration will be given to the 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 the theorists upon which their philosophies are based. This course also will demonstrate how the theories of organizational development can be applied in organizations to foster change, innovation, and the revitalization of the organization.

Credit 3

CHRD-711 Futures Research and Simulation
Registration #0290-711
In this course students will learn to understand the techniques, theories, and advantages/limitations of simulation and futures research methods, and the application of simulation and futures research methods for facilitating individual and organizational decision making. (CHRD-710)

Credit 3

CHRD-712 Planning & Evaluation in Organizational Development
Registration #0290-712
In this course students will learn to understand the techniques, theories, and advantages/limitations of systematic planning strategies and the application of methods for strategic and tactical planning, and the decision making that assure accountability. (CHRD-710)
Credit 3

CHRD-713 The Practice of Consultation in OD
Registration #0290-713
Students will develop an understanding of the various roles that organizational development practitioners play in applying their knowledge and skill in organizational settings, e.g., serving as internal consultants, process consultants, and change agents. Students will learn those skills and practices that pertain to the field of organizational development including: organizational performance analysis, group dynamics, problem solving, intervention techniques, dealing with resistance to change, implementing change, stress management, and approaches that foster employees' acceptance of change and organizational transformation, revitalization and renewal. (CHRD-710)

Credit 3

CHRD-720 Theories of Career Development
Registration #0290-720
Career Development Theories provide mechanisms to examine and define the needs of the work place in relationship to the needs and abilities of the worker. This course will emphasize the structure of selected theories and explore their relationship to the individual's decision-making process.

Credit 3

CHRD-721 Career Counseling Techniques I
Registration #0290-721
This course will introduce selected theories and techniques that may be used in individual career counseling situations. Students will practice techniques and develop their own style of career counseling. This course is not meant for individuals seeking to develop clinical therapeutic skills. (CHRD-720)

Credits

CHRD-722 Career Counseling Techniques II
Registration #0290-722
This course is a continuation of CHRD-721, Career Counseling Techniques I. Students will practice career counseling techniques in dyads, triads with the use of video and audio tape to establish and demonstrate competence. Emphasis in this course will be on the practical application theories and techniques learned in CHRD-721 (CHRD-721)
Credit 3

CHRD-723 Information Use in Career Planning
Registration #0290-723
This course will explore the role of information in the educational, work, and leisure aspects of individuals' lifelong career and personal development. Students will be introduced to the following areas that may be useful in the development of career development and planning services: career planning models, selection and use of standardized tests and personal assessment instruments, career information data resources, research issues, and community resources. (CHRD-707, CHRD-720)

Credit 3

CHRD-730 Theories of Human Resource Development
Registration #0290-730
Professionals in the fields of career counseling and organizational development require an organized plan of human learning and development. This course presents recent investigations, both theoretical and empirical, into human learning research, and will emphasize the information-processing model of learning and memory. Students will acquire, through readings and group activities, an intellectually consistent basis for the practical procedures of human resource development

Credit 3

CHRD-731 Techniques of Human Resource Development
Registration #0290-731
This course is designed for future trainers in industrial settings and educators in college and university environments. The course is based on the theory that future trainers and educators must first identify and clarify the value systems within themselves and others prior to organizing a content to be learned. There then must be a self-need assessment by exploring what one knows and must know about learning, curriculum design, information delivery and the assessment of that learning. With this data, the future trainer/educator will seek out the resources to satisfy those needs by mastery of the management of learning principles and skills. With these needs satisfied, the next phase is to create a demonstration of this mastery by developing, facilitating, and evaluating a real course or training experience. The course will provide participants with a model experience that can serve as the basis for developing additional learning/training packages in future work and educational settings.
(CHRD-730)

Credit 3

CHRD-732 Design & Development of Training
Registration #0290-732
Students will gain practical experience in human resource development by designing, producing, teaching and evaluating a workshop, seminar or training session. Students will select a needed training module from the broad areas of personal and professional development, skills training and career development and carry out the necessary design, production and delivery steps. Students may take this course more than once in order to gain practical HRD experience and to add competencies to their resumes. (CHRD-730, 731)

Credit 2

CHRD-733 Needs Assessment and Proposal Development
Registration #0290-733
Students will learn and practice methodologies for the needs assessment, problem solving, and proposal development within organizations. Needs assessment will help individuals decide if they have a problem, what kind of problem it is, and how important it is to solve the problem. Problem solving techniques assist individuals and groups to analyze problems, identify resources and constraints and make recommendations and decisions. Proposal development enables individuals to formulate and promote specific solutions to organizational problems or objectives.
Credit 3

CHRD-740 Group Leadership Skills
Registration #0290-740
This course introduces students to small group theory and the concepts of group dynamics and group norms. Students will participate in a small group as they learn and practice group leadership and membership tasks. They will practice good communication skills as they learn and understand participant behaviors and examine strategies for dealing with conflict in groups.
Credit 3

CHRD-750 Microcomputer Applications in CHRD
Registration #0290-750
Professionals in the fields of human resource development and career development make frequent use of computer technology to write proposals, track clients, design training, monitor budgets, evaluate services and produce reports. In this course, students will learn to utilize MS-DOS software for word processing, file management, spreadsheets and communications. After completing this course, students will have a general understanding of these classes of software, be moderately competent using such software and be experienced using this software to produce products appropriate to their intended professions.
Credit 3

CHRD-850 Special Projects
Registration #0290-850
This course provides for independent study, investigation, 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 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

CHRD-890 Independent Study
Registration #0290-890
This course provides for independent study or research activity in subject matter areas not included in any existing course in the degree program, but having specialized value to students. Proposals approved by a supervising faculty member and the 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 **1-3**

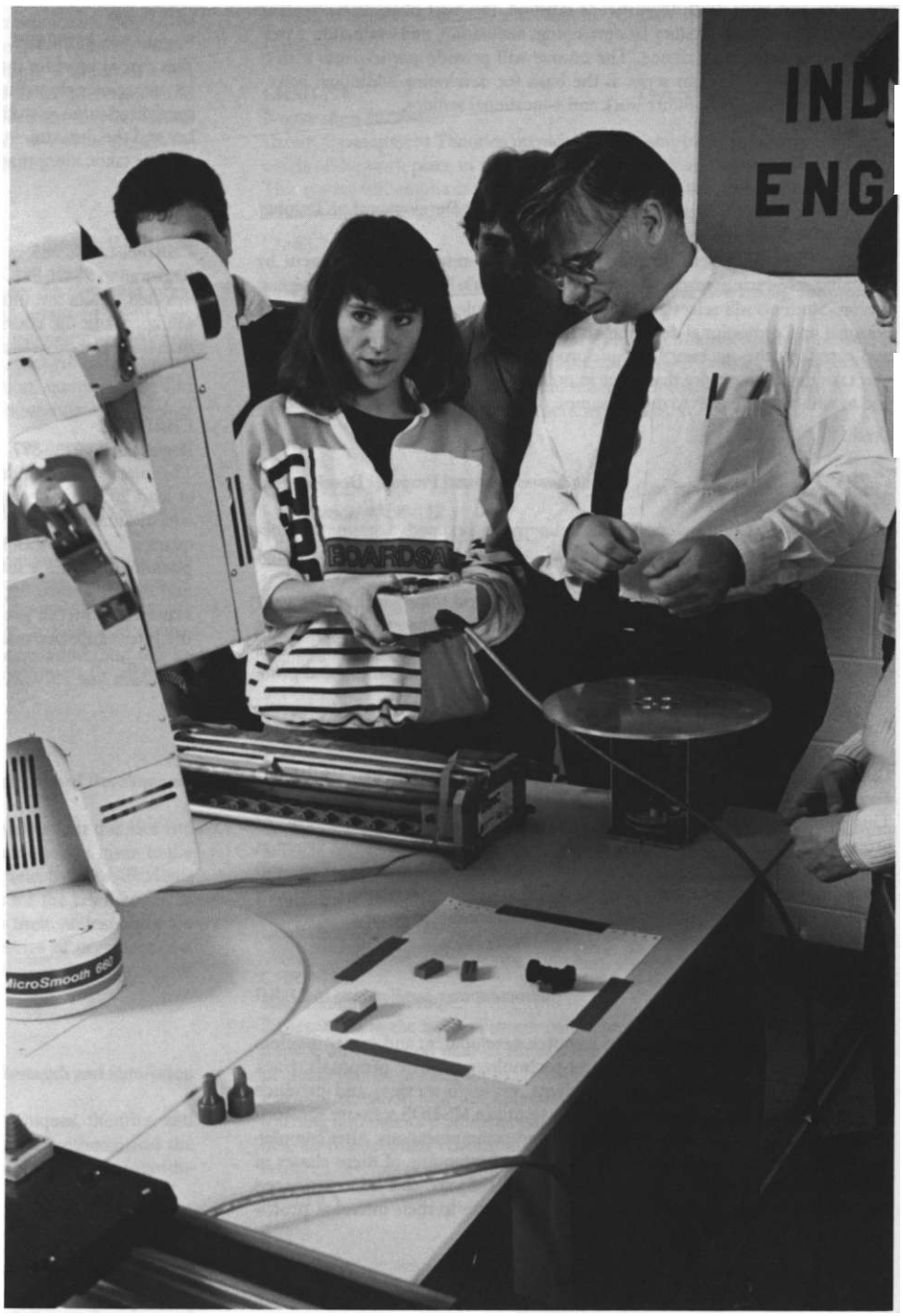
CHRD-891, 892, 893 Selected Topics
Registration #0290-891,892,893
Selected Topics are innovative courses not reflected in the curriculum. Titles will appear in the course listing each quarter. The course may be taken more than once as topics change, but for no more than a total of 6 credit hours.
Credit **3**

CHRD-877 Internship
Registration #0290-877
The internship is required of all students.* The course consists of two parts: a) at least 20 hours per week of professional experience in appropriate setting, and b) attendance at a seminar that will meet at various times throughout the quarter. Students should 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. *For students with appropriate professional experience, special projects or additional course work may be substituted for the Internship. Departmental approval is required.

Credit 6

College of Engineering

Paul E. Petersen, Dean



The College of Engineering offers programs leading to both the traditional master of science degree as well as the master of engineering degree. The MS degree is offered in electrical engineering, mechanical engineering, and computer engineering and requires successful completion of no less than 45 quarter credits beyond the baccalaureate and preparation of a master's thesis (or departmentally acceptable alternative). The MS program, which may be pursued on either a full- or part-time basis, leads to employment in engineering in an industrial environment or to further graduate study at the doctoral level. The College of Engineering also offers, jointly with the College of Science, a program leading to the MS degree in materials science and engineering.

For details on the MS program in applied and mathematical statistics, please refer to the appropriate description provided later in this section.

The master of engineering degree, with programs in mechanical engineering, industrial engineering, systems engineering, engineering management, manufacturing engineering, and microelectronic manufacturing engineering, is essentially a terminal master's program leading to industrial employment and substituting an industrial internship or an engineering case study for the traditional thesis. It requires completion of no less than 48 quarter credits (including credit for the internship or case study) in a program that is highly flexible to meet the needs of a variety of student backgrounds and projected employment fields. The master of engineering program also may be pursued on either a full- or part-time basis.

Specific details of several master of science and master of engineering programs offered by the college are covered in the following sections. Details of the MS degree in materials science and engineering are to be found in the section of the catalog devoted to the College of Science. Further information, such as course schedules, availability of assistantships, research activities and thesis requirements can be obtained from the department in question by telephone, mail, or personal visit.

Part-time study
The College of Engineering encourages practicing engineers in the greater Rochester industrial community to pursue a program toward the master of science 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 eight credits each quarter. A student who wishes to register for more than eight credits while employed in full-time industry must obtain the permission of his or her advisor and the approval of the department head.

It is possible for a student to obtain the MS degree in two academic years (or six academic quarters) by taking courses in late afternoons or early evening only.

A student in the master of engineering degree program may earn academic credits for industrial experience which will be treated as internship experience while the student is enrolled in the program.

Full-time study
Even though graduate programs in engineering serve the need of a large number of practicing engineers who wish to pursue a part-time program, the different programs may also enroll full-time graduate students. A full-time student may take up to 18 credits per quarter.

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

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.

In-plant graduate courses
In order 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.

Admission

Admission
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 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 additional undergraduate 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.

Non-matriculated status
An applicant is permitted to take graduate courses as a non-matriculated 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 non-matriculated student will be limited to an absolute maximum of 12 credits.

An applicant who wishes to enroll in a graduate course as a non-matriculated 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.

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 9 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 non-matriculated 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 insure transferability, prior approval should be obtained. The student should contact the individual department office about the procedure for obtaining transfer credits.

Faculty advisor
A member of the graduate faculty is appointed as a faculty advisor for each graduate student. The faculty advisor supervises the progress of the student towards the master's degree. Non-matriculated students should direct their questions to either the department head or the chairperson of the department's Graduate Committee.

Course descriptions
For a complete outline of courses, refer to the course description section.

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 advisor may recommend to the dean that the student's performance be reviewed and appropriate action taken.

Thesis
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 regulations:

The thesis must be completed and accepted at least 30 days before the last day of scheduled classes of the quarter in which the student expects to receive a degree. Three copies of the thesis must be submitted to the departmental office before the above deadline. These copies are for transmittal to the Institute library, the departmental office, and the student's thesis advisor. For detailed instructions about the organization of the thesis, the student should consult the brochure "Thesis Format," available at the departmental office.

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 non-matriculated student.

Courses of instruction
Information about the courses that will be offered in a particular quarter will be available from the departmental 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.

Master of engineering degree program
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, substituting a well organized industrial internship for the conventional thesis or equivalent requirement for an MS degree.

Special features of the program
An industrial internship of duration equivalent to two academic quarters in a full-time engineering position is an integral part of the program. A minimum of eight and a maximum of 16 credits may be earned by 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 and the director of graduate programs.

The program, although rooted in engineering, will be significandy interdisciplinary. By design, a student's program may range over several colleges of the Institute in assembling courses which will best help the student meet professional objectives. A maximum of 16 credits can be taken by the student in courses outside the traditional area of engineering and the sciences, subject to advisor approval.

Admission requirements
The requirements and general standards for admission and the selection procedure will be essentially similar to those for the MS degree programs.

Degree requirements
A minimum of 48 credits, including the academic credits awarded for the internship experience, are required for the master of engineering degree.

Faculty advisor
Each student will be assigned a faculty advisor as soon as he or she is formally admitted to the program.

In cases where the student's background warrants it, a committee of two advisors will be assigned. The faculty advisor will assist the student in preparing a meaningful plan of study. The advisor will also monitor and evaluate the student's internship experience (in cooperation with the student's industrial supervisor) and recommend to the Graduate Committee of the College of Engineering the number of academic credits to be awarded for the internship experience.

For information

For specific questions on the individual department programs contact:
- Computer Engineering 475-2987 (Dr. Czernikowski)
- Electrical Engineering 475-2164 (Dr. Unnikrishnan)
- Industrial Engineering 475-2147 (Dr. Reeve)
- Mechanical Engineering 475-2153 (Dr. Budynas)
- Microelectronic Engineering 475-2035 (Dr. Fuller)
- Applied and Mathematical Statistics 475-2033 (Dr. Schilling)

Questions on course schedules and registration:
- Computer Engineering 475-2987
- Electrical Engineering 475-2165
- Industrial Engineering 475-2598
- Mechanical Engineering 475-2163
- Microelectronic Engineering 475-2035
- Applied and Mathematical Statistics 475-2033

Computer Engineering Department

Roy Czernikowski, 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 six-course core curriculum. The requirements also include an area of concentration, graduate electives subject to faculty advisor's approval, and five 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 chairman of the student's graduate committee will normally serve as the student's faculty advisor. The intent is to allow students reasonable creativity in articulation in an area of concentration.

Master's degree in computer engineering core courses:
EECC-722 Advanced Computer Architecture (Winter)
EECC-740 Analytical Topics for Computer Engineers (Fall)
EECC-759 Principles of Digital Interfacing (Fall)
EECC-756 Multiple Processor Systems (Spring)
ICSG-700 Foundation of Computing Theory (Fall, Winter)
ICSG-710 Programming Language Theory (Winter, Spring)

The graduate curriculum will require the following courses above a BS degree in computer engineering:
6 courses in core (24 quarter credits)
2 courses in graduate electives (8 quarter credits)
2 courses in concentration (8 quarter credits)
5 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/her faculty advisor. The total of all graduate courses transferred from other appropriate institutions of higher learning may not exceed 12 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

R. Unnikrishnan, Department Head

Admission requirements
Admission into the graduate studies 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.) may be considered for admission provided the student agrees to complete a certain number of undergraduate courses in electrical engineering with at least a B average. For further information, please contact the EE Department.

Master of science degree program
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.

Core courses
These courses are required of all candidates for the MS degree in electrical engineering: EEEE-754,755,756, Analytical Techniques I, II, and III. A waiver of any of the above courses can only be granted if the student has taken credit-bearing graduate courses covering the appropriate topics.

A graduate student will be expected to take the required core courses during the first year of his or her program, since these courses are prerequisites for many of the other graduate courses.

Elective courses
Students are allowed to choose courses of his or her preference from the available graduate courses in electrical engineering to make up the necessary course credits.

Transfer credits
A maximum of 12 credit hours can be earned from courses available from other departments within RIT with *the prior approval* of the faculty/department advisor. For students transferring credits from other universities, the total number of credits transferred from outside the Electrical Engineering Department from all sources shall not exceed 12.

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

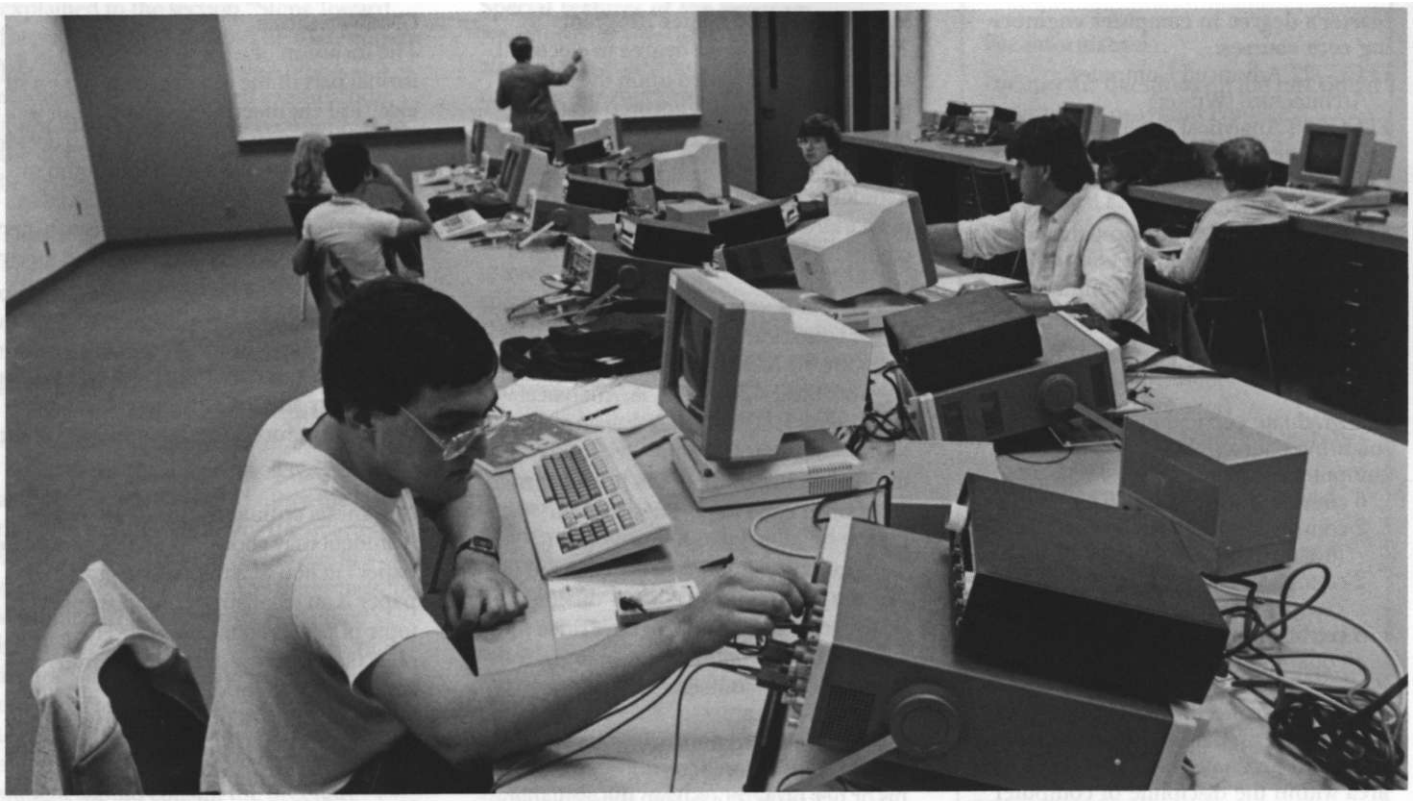
Those electrical engineering students who have an interest in computer science as a minor area are encouraged to pay special attention to certain specific policies. The bridge courses ICSA-701,702, 703,704, and 705 will be treated as advanced undergraduate courses and therefore, the total number of credit 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 thesis
The inclusion of a thesis (EEEE-890) as a formal part of the MS degree program in electrical engineering is optional but is strongly encouraged. Students who decide to write a thesis can earn a minimum of six credits and a maximum of 12 credits toward their degree from the thesis, nine being the most common number of credits earned. Typically, they take nine approved courses for 36 credits to meet the course requirements.

A thesis is written under the supervision of a faculty advisor and presented and defended before a thesis committee when complete.

Non-thesis option: the graduate paper
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 topic of the paper 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 number EEEE-800 Graduate Paper is used in registering for the paper. The student choosing this option will earn the remainder of the required credits for the degree by means of course work.

Graduate Student Advising
A committee of three EE faculty members is available for graduate students in helping them with the planning of their programs and monitoring their progress. A graduate student may obtain the list of the committee members from the departmental office and approach any member for help. When a graduate student has started work on a thesis or graduate paper, the professor supervising his or her work will become the advisor.



Schedule of graduate courses in electrical engineering

Offered Every Fall:
EEEE-723 Semiconductor Physics
EILEE-754 Analytical Techniques **I**
EEEE-764 Digital Control Systems
EEEE-775 Optical Engineering I
EEEE-790 Random Signals and Noise

Offered Alternate Fall Quarters:
EEEE-762 Nonlinear Control Systems (F 1991-92)
EEEE-741 Design for Testability (F 1992-93)
EEEE-763 Stochastic Estimation & Control (F 1992-93)

Offered Every Winter:
EEEE-724 Physics of Semiconductor Devices I
EEEE-726 Analog IC Circuits
EEEE-755 Analytical Techniques II
EEEE-758 Multidimensional Digital Signal Processing
EEEE-765 Optimal Control
EEEE-779 Digital Image Processing

Offered Alternate Winter Quarters:
EEEE-759 Waveform Coding for Speech and Images (W 1991-92)
EEEE-778 Fiber Optics (W 1991-92)
EEEE-794 Information Theory (W 1992-93)
EEEE-795 Optical Engineering II (W 1992-93)

Offered Every Spring:
EEEE-725 Physics of Semiconductor Devices II
EEEE-730 Advanced Analog IC Design
EEEE-756 Analytical Techniques III
EEEE-761 Modern Control Theory
EEEE-776 Electro-optics
EEEE-793 Error Detection and Error Correction

Offered Alternate Spring Quarters:
EEEE-768 Adaptive Signal Processing (Sp 1991-92)
EEEE-788 Advanced Topics in Digital Signal Processing (Sp 1991-92)

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 departmental office about a month before the beginning of each academic quarter.

Industrial and Manufacturing Engineering Department

N. Richard Reeve, Department Head

Although there is no master of science degree in industrial engineering at present, the master of engineering degree can be earned with specialization in the following fields: industrial engineering; systems engineering; engineering management; and manufacturing engineering. Close cooperation with the College of Business assures the master of engineering candidate of a wide selection of courses and a unique opportunity to build a program tailored to her or his professional interests and goals. The practice of emphasizing computer methods to realistic problem solving is employed in all the above specialties.

Graduate Course Offerings
Department of Industrial & Manufacturing Engineering

Even Years (e.g., 90/91, 92/93, etc.)

FALL	WINTER	SPRING
EIEI715 Statistical Analysis	EIEI-716 Registration	EIEI-630 Comp. Aided Mfg II
•EIEI-625 Comp. Aided Mfg. I	EIEI-730 Human Factors I	EIEI-734 Safety Engrg.
EIEI-7XX Special Topics/ Reliability	EIEI-7XX Special Topics/ SLAM	EIEI-720 Production Control
EIEI7XX Special Topics/ Decision Analysis	EIEI-7XX Special Topics/ Multiobjective Analysis	EIEI-7XX Special Topics/ Case Studies
		EIEI-725 Technological Forecasting

Id Years (e.g., 91/92, 93/94, etc.)

FALL	WINTER	SPRING
EIEI715 Statistical Analysis	EIEI-716 Regression	EIEI-630 Comp. Aided Mfg II
•EIEI-625 Comp. Aided Mfg. I	EIEI-620 Engrg. Economy	EIEI-734 Safety Engrg.
EIEI-701 Linear Programming	EIEI-731 Human Factors II	EIEI-702 Non-Linear Prog
EIEI-7XX Special Topics/ Design of Experiments	EIEI-710 Simulation (CPSS)	EIEI-601 Value Analysis
		FJEI7XX Special Topics/ Advanced Engrg. Economy

The following courses are offered upon demand:

EIEI-732, 733	Human Factors III, IV
EIEI-723	Facilities Planning
EIEI-718	Inventory Design

*If the 5th year is a B block, this course is shifted to the Winter Quarter (91/92), etc.)

Admission requirements

Admission into the graduate ME program within industrial engineering requires a BS degree in an engineering discipline. 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 (FORTRAN), and Probability/Statistics.

Program of study

The student, in conjunction with his/her advisor, formulates a program of study based on the individual's academic background, professional goals, master of engineering degree requirements, and the schedule of course offerings.

Mechanical Engineering Department

Charles W. **Haines,** Department Head

The graduate faculty of the Mechanical Engineering Department is dynamic and committed to professional growth. Some of the current research interests of the faculty in the Mechanical Engineering Department include finite elements, robotics, programmable automation, and computer-aided design and manufacturing. Research also is conducted in areas such as thermal stresses, response of structures to laser heating, analysis and optimization of vehicular systems subject to impulsive and random excitations, and mechanism of fracture in materials. Also, there is interest in software design and development for engineering applications; analysis of satellite data to derive information on the physical oceanography of the southern ocean using time series techniques; minimax optimal control and the problem of space glider re-entry using a multiple sub-arc approach; developing techniques of airfoil optimization to solve the inverse problem; flow in time-varying boundaries; two-phase heat transfer, three-dimensional reconstruction of two-dimensional echocardiographic images; soft-tissue biomechanics; and finite element investigation of blood vessel collapse phenomena in the heart wall.

The department has access to three general purpose VAX/VMS systems. The systems include a VAX 8650 and VAX 8700 which can each support up to 150 interactive users and VAX 8550, VAX 8810 and VAX 8350 units that can support approximately 50 interactive users each. Students also have access to ten VAX workstations, model station 2000. The general purpose systems provide a wide variety of programming languages including APAL, BASIC, COBOL, FORTRAN, MACRO (DEC Assembler), PASCAL, PLI, MODULA-2, and C. Engineering software such as NASTRAN, A PATRAN-G, ANSYS, CTRLC, ROMANS II, SPICE, PADL, GIFTS, ADS, ACSL, FLUENT, DADS, ADAMS, and SUPERSAP is available for research and development work on Finite Elements, CAD/CAM, Modal Analysis, Vibrations, and Heat Transfer. The department has a dedicated micro-VAX computer and a 15-station PC Lab. The department laboratories include a low-velocity wind tunnel, PUMA robots, spectrum analyzers, a holographic camera, and a laser doppler anemometer.

Master of science degree program

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 33 credits are to be earned in course work, while independent work carries a minimum of five credits and a maximum of 12 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 the chairman of the departmental Graduate Committee.

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 department head will recommend which undergraduate courses must be taken in order to acquire an acceptable background.
3. If an applicant has a BS degree, but not in mechanical engineering, he must receive at least a 3.0 grade point average in the recommended undergraduate courses before admission is granted to the mechanical engineering graduate program.

Core courses

All graduate students in the MS program are required to complete the following core courses which are offered every year:

EMEM-870 Mathematics for Engineers 1(F)
EMEM-871 Mathematics for Engineers II (F, W)
EMEM-872 Mechanics (S)
EMEM-874 Numerical Analysis (W)
EMEM-878 Fluid Dynamics (W)

In cases where students have had the equivalent in graduate level courses of any of the core courses, the departmental Graduate Committee may permit substitution or award transfer credit for the appropriate course.

Elective courses

The following elective courses are available to the student for graduate credit:

EMEM-810 Introduction to Continuum Mechanics (even year, F)
EMEM-811 Theory of Elasticity (even year, W)
EMEM-812 Theory of Plates and Shells (odd year, S)
EMEM-813 Theory of Plasticity (odd year, W)
EMEM-815 Experimental Stress Analysis (even year, S)
EMEM-816 Finite Elements (every year, F)
EMEM-820 Advanced Optimal Design (odd year, S)
EMEM-821 Vibration Theory and Applications (every year, S)
EMEM-823 Applied Systems Dynamics (every year, F)
EMEM-827 Computer Graphics in Design (even year, S)
EMEM-833 Heat Exchanger Design (odd year, W)
EMEM-838 Ideal Flows (odd year, S)
EMEM-864 Production Tool Design (even year, F)
EMEM-865 Computer Implementation of Finite Elements (odd year, W)
EMEM-873 Convective Heat Transfer (odd year, F)
EENG-801 Design for Manufacture (every year, W)
SESM-701 Introduction to Materials Science (every year, F)
SESM-705 Experimental Techniques (every year)
SESM-710 Materials Properties I (odd year, TBA)
CQAS-712 Fundamentals of Statistics II

Students with a background deficient in engineering materials are strongly advised to take SESM-701 as an elective.

When the needs of a particular program require additional courses, the student may, with department approval, elect to take up to 12 credits from other departments in the Institute. Graduate students are allowed to take those upper-level undergraduate electives in mechanical engineering specified in the course description catalog as EMEM-6XX. Some examples are:

EMEM-605 Applications in Fluid Mechanics (F, W)
EMEM-615 Robotics (F,W)
EMEM-618 Computer-Aided Engineering (S)
EMEM-635 Heat Transfer II (S, SR)
EMEM-652 Fluid Mechanics of Turbomachinery (S, SR)
EMEM-658 Engineering Vibrations (F,W)
EMEM-660 Refrigeration and Air Conditioning (S)
EMEM-672 Dynamics of Machinery (S, SR)
EMEM-685 Advanced Strength of Materials (TBA)
EMEM-694 Stress Analysis (S, SR)

A maximum of two such courses is allowed for graduate credit 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, lubrication, convective and radiative heat transfer, fluid mechanics, thermodynamics, wind and solar energy, control systems, optimal control, thermal stresses, composite materials, biomechanics, and viscoelasticity.

Thesis and other options

Once a student has completed about 20 quarter credit hours of graduate work, he or she ought to consider selecting one of the four options offered by the department with regard to completing the requirements of the master of science degree. These are a research thesis, a literature search, a design project, or additional course work with a comprehensive examination that is usually given in the Spring Quarter. A student selecting one of the first three options has to earn a minimum of five credits in the option chosen, and has to make a successful oral presentation of the work.

Master of engineering degree program
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, substituting a well organized and carefully chosen cooperative, industrial internship for the conventional thesis requirement of an MS degree.

An industrial internship of duration equivalent to two academic quarters in a specially developed full-time engineering position is an integral part of the program. A minimum of eight and a maximum of sixteen credits may be earned by the student from his/her internship experience. The internship position is selected to reflect each individual student's primary professional interest and is integrated with his/her curriculum.

The program, although rooted in engineering, will be significantly interdisciplinary. By design, a student's program may range over several colleges of the university in assembling courses which will best help him/her meet his/her professional objectives. The minimum number of credits for this program are distributed as follows:

Core Courses	8 credits
Concentration Courses	16 credits
Elective Courses	8-16 credits
Internship	16-8 credits

At least 20 credit hours of graduate-level course work, including the core (EMEM-870 and EMEM-874), must be taken in the Mechanical Engineering Department. Some possible concentration areas are in business, controls, manufacturing, and design engineering. A minimum of 48 credits are required for the Master of Engineering degree.

Admission requirements for the master of engineering degree
The admission requirements, general standards and selection procedures for admission to the engineering program are similar to those for the MS degree program.

The manufacturing engineering program for the master of engineering degree
This program is offered jointly by the departments of mechanical engineering and industrial 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: EENG-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 FORTRAN programming, engineering materials, manufacturing processes, and probability and statistics.

Course descriptions
For a complete outline of graduate courses offered, please consult the course description section.

Assistantships and scholarships
Some assistantships and scholarships may be available for full-time students. Appointment as a teaching assistant carries a 12-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 Dr. Paul Bernstein, dean of Graduate Studies (716-475-6523).

Course calendar
The core 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 (716475-5788 or 475-2163).

Schedule of Graduate Courses in Mechanical Engineering

Even Years (e.g., 90/91, 92/93, etc.)

FALL	WINTER	SPRING
EMEM-810 Introduction to Continuum Mechanics	EMEM-811 Theory of Elasticity	EMEM-815 Experimental Stress Analysis
EMEM-816 Finite Elements	EMEM-871 Math for Engineers II	EMEM-821 Vibration Theory and Applications
EMEM-823 Applied System Dynamics	EMEM-874 Numerical Analysis	EMEM-827 Computer Graphics in Design
EMEM-864 Production Tool Design	EMEM-878 Fluid Dynamics	EMEM-872 Mechanics
EMEM-870 Math for Engineers I	EENG-801 Design for Manufacture	
EMEM-871 Math for Engineers II		

Odd Years (e.g., 91/92, 93/94, etc.)

FALL	WINTER	SPRING
EMEM-816 Finite Elements	EMEM-813 Theory of Plasticity	EMEM-812 Theory of Plates and Shells
EMEM-823 Applied System Dynamics	EMEM-833 Heat Exchanger Design	EMEM-820 Advanced Optimal Design
EMEM-870 Math for Engineers 1	EMEM-865 Computer Implementation of Finite Elements	EMEM-821 Vibration Theory and Applications
EMEM-871 Math for Engineers II	EMEM-871 Math for Engineers II	EMEM-838 Ideal Flows
EMEM-873 Convective Heat Transfer	EMEM-874 Numerical Analysis	EMEM-872 Mechanics
	EMEM-878 Fluid Dynamics	
	EENG-801 Design for Manufacture	

Microelectronic Engineering Department

Lynn Fuller, Department Head

The College of Engineering is proud to offer a master of engineering degree program in microelectronic manufacturing engineering. This one-year program emphasizes all aspects of microelectronic engineering and provides a broad interdisciplinary background in optics, chemistry, device physics, computer science, electrical engineering, photographic science, and statistics, which are necessary for entry into the semiconductor industry.

Students in the program 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 program, are among the best in the nation.

As the shortage of microelectronic engineers continues to grow, RIT graduates will provide a valuable resource to the microelectronic industry. This program offers an unparalleled opportunity for students to prepare for professional challenge and success in one of the leading areas of engineering of our time.

The program

The master of engineering degree in microelectronic manufacturing engineering is awarded upon the successful completion of an approved graduate program consisting of a minimum of 48 credit hours: 10 courses and an internship. Under certain circumstances, a student may be required to complete more than the minimum number of credits.

The program consists of 10 courses including: one transition course; six core courses; and three elective courses. The transition course is in an area other than the area for which the BS degree is being earned. Up to four quarter credits will be given for completing the transition requirements. For example, a chemistry major may be required to take a two-course sequence in circuits and electronics; an electrical engineer may be required to take an organic chemistry course. The core courses are: Microelectronics I, II, III; Microlithography I, II; and Manufacturing Science I, II. Elective courses may be selected from a list including: CMOS, Defect Reduction and Yield Enhancement, Electronic Properties of Materials, Statistical Design of Experiments, and others.

The program also consists of an internship worth eight quarter credits, which may be completed at RIT or in industry. The internship will involve the investigation of some problem or process directly related to microelectronic manufacturing engineering. This is not a thesis, but does require a report and oral presentation.

Some 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 12 credits per quarter while the remaining time is devoted to the research effort. All appointments provide full tuition and stipend. Applicants for financial aid should write directly to the department head for details.

Schedule

Fall	Winter
Microelectronics I	Microelectronics II
Microlithography I	Manufacturing Science I
Transition Course	Microlithography II
	Elective
Spring	**Summer**
Microelectronics III	Internship
Manufacturing Science II	Elective
Internship	Elective

Microelectronics

The first two courses in the microelectronics sequence cover all aspects of integrated circuit processing. The courses are taught at the level of VLSI Technology by Sze. SUPREM and SUPRA are introduced to the students. Modeling programs for oxide growth and diffusion are studied in detail. The students study semiconductor devices, bipolar and MOS processing, specific processing steps, measurement and characterization. The students also go through several integrated circuit designs in different technologies, such as bipolar, NMOS and CMOS. They use SPICE to model the circuit operation, ICE integrated circuit layout editor and many other design tools. The students create a process, and manufacture and test their integrated circuits.

The Microelectronics III course covers chemical vapor deposition, plasma etching and deposition, and surface analysis techniques. Advance transistor design is studied including low doped drain structures, and poly emitter BJTs.

Microlithography

The microlithography courses are advanced courses in the chemistry of photoscience and lithography. Topics include negative and positive photoresist systems, developers, multilayer imaging systems, polyimides, electron beam and ion beam resist systems, contrast enhancement materials, adhesion promotion materials, lift-off and reversal processes.

Imbedded within these courses are topics which are important to the physical limitations of lithography, including a study of the characteristics of image-forming and image-recording elements and their matching for optimum performance. Topics include spread and transfer functions, partial coherence in image systems, and limitations imposed by the wave and particle nature of radiation. This course also compares optical, X-ray and electron beam imaging.

Laboratory experience includes e-beam and optical maskmaking, steppers, scanners, and contact aligners, radiometry, design of experiments, metrology, and lithographic processing demonstrating topics from the lecture.

Manufacturing

The manufacturing course includes topics such as scheduling, work in progress tracking, costing, inventory control, capital budgeting, productivity measures and personnel management. The laboratory for this course is the student-run factory. Measurement of yield, defect density, wafer mapping, control charts and other tools are introduced to the student.

Applied and Mathematical Statistics Department

John D. Hromi, Frederick H. Minett Distinguished Professor; Executive Director, Center for Quality and Applied Statistics: 475-2002

Edward G. Schilling, Paul A. Miller Distinguished Professor; Chairman, Graduate Statistics; Associate Director, Center for Quality and Applied Statistics: 475-6129

Statistics today is sometimes defined as the science of making decisions in the face of uncertainty. To aid those needing the basic statistical tools to collect and analyze data, and to aid those needing to update their present statistical skills, the master of science degree in applied and mathematical

statistics is offered by the College of Engineering at RIT through the Center for Quality and Applied Statistics. Several options, including thesis and non-thesis options, are available. Students electing a plan of study that includes a thesis must successfully complete at least 36 quarter hours of course work in addition to an acceptable thesis. Non-thesis options require the candidate for the MS to successfully complete 45 quarter hours of course work.

The faculty and staff of the Center for Quality and Applied Statistics is a distinguished group that includes two members who are fellows of both the American Statistical Association and the American Society for Quality Control. A third member of the faculty is a fellow of the American Society for Quality Control. The center's faculty includes 2 past presidents of the American Society for Quality Control and the only person ever to win the prestigious ASQC Shewhart Medal and its Brumbaugh Award four times. Extensive industrial experience characterizes the center's faculty, and the graduate program prepares each student for a productive career in the fields of statistics and quality control.

Both teachers and students work to put job experience and class studies together. For example, theses and papers often have job supervisor's approval and result in being put into effect rather than into the library. Theory is used for understanding, but is not necessarily an end in itself. Here theory means gaining knowledge of the underlying mathematical principles and learning how to solve problems intelligendy.

Cooperative education program
A unique feature of the graduate statistics program at RIT is the cooperative education program. This program allows the qualified graduate student to attend school on a full-time basis one quarter, and to earn a substantial salary the next quarter as an employee in an industrial concern. This pattern can be repeated until the student completes the MS degree.

To qualify for the cooperative education program you must have completed at least one quarter of study and received department approval.

The full-time program
Students who wish to study on a full-time basis can complete the MS degree in one year if normal progress is made.

The evening program
The Center for Quality and Applied Statistics offers courses to full-time employees of industry and other interested individuals in the evenings. The master's degree can normally be completed in two years of evening study.

The Mason E. Wescott Statistics Laboratory
The Center for Quality and Applied Statistics houses the Mason E. Wescott Statistics Laboratory, which provides computer access, assistance with problem solving, and interpretation of results for students enrolled in courses offered by the center. In addition, RIT maintains an extensive computer center with VAX/VMS and IBM equipment available for instruction and research. Additional resource facilities include the Wallace Memorial Library and Media Resource Center that provide access to all technical references vital to the professional growth in the areas of applied statistics and quality control.

Financial assistance
A variety of financial assistance possibilities exist and are available on a competitive basis to qualified applicants. These possibilities include graduate assistantships, tuition scholarships, grants, and cooperative education opportunities.

No entrance exam
Courses are offered on an open enrollment basis which is supportive of the RIT commitment to recurrent education. There are no entrance exams, and the program is self-contained at RIT. Students are expected to take a written examination after completing the core courses or 30 hours of instruction and an oral exam at the end of the program.

Requirements
For the master of science in applied and mathematical statistics degree, the satisfactory completion of the following courses is required:

Two basic courses:
(These may be waived by the department chairperson upon evidence of equivalent learning, experience or competency.)
EQAS-711 and 712 Fundamentals of Statistics I & II

Six core courses:
EQAS-801 and 802 Design of Experiments I & **II**
EQAS-821 and 822 Theory of Statistics **I** &II
EQAS-841 Regression Analysis 1
EQAS-742 Statistical Computing

Four required career options courses:
A special feature of the MS program is a logical grouping of core requirements, existing and new courses, which will allow the student to specialize within his or her career endeavors. The five specialized career options are:

Quality Control in Industry course requirements
EQAS-721 Statistical Quality Control **I**
EQAS-731 Statistical Quality Control **II**
EQAS-781 Quality Management
EQAS-782 Quality Engineering

Industrial Statistics course requirements
EQAS-761 Reliability
EQAS-783 Quality Engineering by Design
EQAS-856 Interpretation of Data
EQAS-875 Empirical Modeling

Administrative Applications of Quality Control course requirements
EQAS-781 Quality Management
EQAS-853 Managerial Decision Making
EQAS-873 Time Series Analysis
EQAS-721 Statistical Quality Control **I**

Statistical Theory and Methods course requirements
EQAS-824 Probability Models
EQAS-830 Multivariate Statistics I
EQAS-831 Multivariate Statistics II
EQAS-842 Regression Analysis II

Quality Control in the Health Sciences course requirements
EQAS-721 Statistical Quality Control I
EQAS-791 Statistical Methods in Health Sciences
EQAS-792 Biological Assays
EQAS-851 Nonparametric Statistics

Each career option has four required courses. A department advisor will work with each student in identifying the appropriate career option and in developing a total program structured to achieve individual professional objectives.

Five electives:
Taken from other courses listed under "Course Descriptions" in such areas as quality control, managerial decision making, multivariate analysis, sample surveys, reliability, and probability theory.

The total of 15 or 17 courses, each counting 3 quarter credits, comes to 45 or 51 credits depending on whether the basic courses (711-712) are waived. As indicated above, studies are normally completed in two to four years by attendance one or two nights a week.

The core courses are expected to be completed early in a student's program. Upon completion of the core courses or after 30 hours of instruction, a written examination is required. After successful completion of the examination, the remainder of the program is prepared with the advice and counsel of the department.

Levels of courses
There are 700 and 800 courses. The 700 level furnishes most of the standard methods currently used in industry; the 800 series covers theory and applications in special areas like the design of experiments. Generally, the 800 level is more advanced. From time to time, special courses are offered in topics of particular interest when requested by the students or as new fields of statistics open up. A minimum of 24 credits in the 800 series is required.

Faculty Advisor
A member of the graduate faculty is appointed as a faculty advisor for each graduate student. This advisor supervises the progress of the student toward the master's degree. Non-matriculated students should direct their questions to the department head.

Admission
Admission to the degree program will be granted to qualified holders of a baccalaureate degree from an accredited college or university who have acceptable mathematics credits including one academic year of calculus. Applicants who fail to meet the latter requirement may, at the discretion of the department chairperson, be required to complete two or three undergraduate mathematics courses before being able to matriculate in the regular graduate program.

Although students are encouraged to begin their graduate studies at any time, only four courses may be taken toward the MS degree as a non-matriculated student. This will assure proper selection of courses, adequate administrative time for transcripts, etc., and the scheduling of the mid-program examination to indicate the student's capability to attain the MS degree.

Procedure
To be considered for admission it is necessary to file an application, submit transcripts of all previous undergraduate and graduate work, obtain two letters of recommendation, and pay a $35 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 Admissions
Rochester Institute of Technology
Bausch & Lomb Center
P.O. Box 9887
Rochester, NY 14623-0887

Transfer and interdisciplinary credits
Credit for courses of graduate stature 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 chairperson with due regard to the candidate's objectives. However, to insure credit toward the degree, the candidate should write the chairperson indicating courses for which he or she would like transfer credit for work in the past and to obtain prior approval of courses for which transfer credit is sought. While these matters would be discussed with either the candidate's advisor or the department at various times during the advisement process, it is essential that all agreements be documented *in writing.* A letter to the departmental chairperson will assure proper recognition of outside work accomplished toward the degree.

Non-matriculated students
It is not necessary to be formally admitted or matriculated into the MS in statistics program in order to register for course offerings. However, for students who desire to enter the graduate program, only four courses may be taken toward the MS degree as a non-matriculated student. Those who are not matriculated may be admitted to courses in fields of their special interest by consent of the department chairperson.

Grades, exams and theses
The candidate must attain an overall average grade of 3.0 (B) for graduation. An oral examination is required when the student is enrolled in the last quarter of his or her program, to assure subject matter and verbal proficiency as well as ability to perform as a statistician in a working environment. Successful completion of each quarter course normally requires passing a final exam, submission of a written paper or thesis, or completion of a group project, as determined by the instructor. Students are encouraged to develop their writing and speaking skills as well as to use the computer as ways to improve their knowledge.

Plans of study
Students may, with the permission of the departmental chairperson, secure credits toward the master's degree in two ways:

First, a student may complete the required 45 or 51 quarter credits, depending on whether the basic "Fundamentals" courses are waived, by formal *classroom* attendance and receipt of satisfactory grades.

Second, three, six or nine of these credits may be obtained by submission of a satisfactory research project and *thesis.* The project and credits must be approved by the department chairperson prior to registration. A letter outlining the project and requesting this approval must be addressed to the chairperson by the candidate prior to the regular registration periods. The depth of the project will determine the number of credits received. Generally this type of credit should be sought at the end of the program after sufficient knowledge of the subject is available for use. EQAS-896 is the registration number used for thesis work.

Faculty
Nine full-time and 22 adjunct faculty normally teach in the master's program in applied and mathematical statistics. All instructors have an industrial background. This is reflected in their realistic approach to the subject matter. Many of the faculty hold jobs which require them to apply daily what they teach at night; e.g., the quality control instructor installs quality control systems for his company. As with many others dedicated to continuing education, faculty members have a commitment to give the students personal attention. This often involves career counseling.

Graduate Faculty College of Engineering

Paul E. Petersen, Ph.D., Michigan State-Dean; Professor

Computer Engineering Department

Roy Czernikowski, Ph.D., RPI—Professor and Department Head, Real-Time-Computation, Computer Architecture, and Distributed Systems

George Brown, MSEE, University of Rochester—Professor, VLSI Design, Systems and Control

Tong-han Chang, Ph.D., Chinese Academy of Science, Beijing—Professor, System Design Methodology, Communication and Computation

Kenneth Hsu, Ph.D., Marquette—Associate Professor, VLSI Design, Microcomputers and Control Systems

Ronald G. Matteson, Ph.D., Syracuse University—Associate Professor, Image Processing, Data Communications, Computer Architecture

Pratapa Reddy, Ph.D., Indian Institute of Technology—Associate Professor, Digital Systems

Electrical Engineering Department

Raman M. Unnikrishnan, Ph.D., Missouri—Professor and Department Head, control systems

Joseph D. DeLorenzo, Ph.D., Boston University—Associate Professor, electromagnetic scattering, image analysis, digital communication

Soheil A. **Dianat,** Ph.D., George Washington University—Associate Professor, control systems, signal processing

Roger Heintz, Ph.D., Syracuse—Professor, electronics, electromagnetics, laser integrated optics

Mark Hopkins, Ph.D., Virginia Polytechnic—Assistant Professor, control systems

Swaminathan Madhu, Ph.D., University of Washington—Professor, signal processing

A. V. **Mathew,** Ph.D., Queens University (Ontario)—Professor, control systems, robotic vision

Ponnathpur R. Mukund, Ph.D., University of Tennessee—Assistant Professor, VLSI design, electronic devices and circuit design.

James E. Palmer, Ph.D., Case Institute of Technology—Professor, control systems, digital design

David Perlman, MS, Cornell University-Associate Professor, electronics

Paul E. Petersen, Ph.D., Michigan State University—Professor, semiconductor devices

Mysore Raghuveer, Ph.D., Univ. of Connecticut—Associate Professor, image and signal processing

Sannasi Ramanan, Ph.D., I.I.T.-India—Assistant Professor, semi-conductor devices

V. C. V. Pratapa Reddy, Ph.D., IIT, India-Associate Professor, digital systems and microprocessors

Harvey E. Rhody, Ph.D., Syracuse—Professor, knowledge-based systems, image and signal processing

Edward R. Salem, Ph.D., Buffalo-Professor, image and signal processing

David Sumberg, Ph.D., Michigan State-Associate Professor, optics

Fung-I Tseng, Ph.D., Syracuse—Professor, electromagnetics, optics

Renan Turkman, Ph.D., Paris—Associate Professor, integrated circuits, semiconductor devices and processing

Jayanti Venkataraman, Ph.D., Indian Institute of Science—Associate Professor, electromagnetics

Adjunct Faculty in Electrical Engineering

K. H. Gurubhasavaraj, Ph.D., Nebraska—control systems

Majid Rabbani, Ph.D., Wisconsin—image processing, pattern recognition

Industrial & Manufacturing Engineering Department

Richard Reeve, Ph.D., Buffalo—Professor and Department Head, Applied Operations Research

S. **Cem Karacal,** Ph.D., Oklahoma State University—Visiting Assistant Professor, Manufacturing, CIM, Automation

Madhu Nair, BS, RIT; MS, Lehigh—Instructor, Computer-Aided Manufacturing

Nabil Z. Nasr, Ph**.D.,** Rutgers University—Assistant Professor, Robotics, NC Programming, Manufacturing

Sudhakar R. Paidy, Ph**.D.,** Kansas State University—Professor, Statistics, CIM, Reliability, and Operations Research

Jasper E. Shealy, Ph.D., SUNY at Buffalo—Professor, Human Factors

Paul H. Stiebitz, ME, RIT—Assistant Professor, Simulation and Operations Research

Brian K. Thorn, Ph.D., Georgia Tech—Assistant Professor, Applied Statistics, Behavior Science

Mechanical Engineering Department

Charles W. Haines, Ph.D., Rensselaer Polytechnic Institute—Professor and Department Head, Applied Mathematics

Nir Berzak, Ph.D., Columbia University—Associate Professor, Machine design, dynamic systems

Richard G. Budynas, Ph.D., P.E., Massachusetts—Gleason Professor, Applied Mechanics

Robert H. Ellson, Ph.D., University of Rochester—Professor, Fluid Mechanics, Thermodynamics

Jon E. Freckleton, MSED, Nazareth—Assistant Professor, Manufacturing engineering

Hany A. Ghoneim, Ph.D., Rutgers—Associate Professor, Finite elements

Amitabha Ghosh, Ph.D., Mississippi State University—Associate Professor, Computational Fluid Dynamics

Surendra K. Gupta, Ph.D., University of Rochester—Associate Professor, Materials Science and Computer Science, applied mechanics

Robert Hefner, Ph.D., Georgia Inst, of Tech.—Associate Professor, Systems Analysis, Heat Transfer

Richard B. Hetnarski, Dr. Tech. Sci., P.E., Polish Academy of Sciences—Professor, Thermoelasticity

Satish G. Kandlikar, Ph.D., Indian Institute of Technology—Professor, Thermal Systems and Energy

Bhalchandra V. Karlekar, Ph.D., P.E., University of Illinois—Professor, Heat Transfer, Energy

Mark Kempski, Ph.D., SUNY, Buffalo-Associate Professor, Biomechanics

Chris Nilsen, Ph.D., P.E., Michigan State-Associate Professor, Metallurgy and Materials Science

Alan H. Nye, Ph.D., University of Rochester—Professor, Fluid Mechanics

Ali Ogut, Ph.D., University of Maryland—Associate Professor, Fluid mixing, thermal fluid sciences

Frank Sciremammano, Jr., Ph.D., University of Rochester—Associate Professor, Geophysical Fluid Dynamics and Environmental Control

Robert L. Snyder, Ph.D., P.E., Iowa State-Professor, Materials Science, Chemistry

Joseph S. Torok, Ph.D., Ohio State University—Associate Professor, Theoretical and Applied Mechanics, Applied Mathematics

P. Venkataraman, Ph.D., Rice University—Assistant Professor, Optimal Control, Fluid Mechanics, Optimal Design

Wayne W. Walter, Ph.D., P.E., Rensselaer Polytechnic Institute—Professor, Applied Mechanics

Microelectronic Engineering Department

Lynn F. Fuller, Ph.D., SUNY Buffalo-Professor and Department Head, Analog I.C. Design, Manufacturing; Integrated Circuit Processing

Michael A.Jackson, MS, SUNY Buffalo-Assistant Professor, Surface Analysis, Integrated Circuit Metrology, Solid State Devices

S. Cem Karacal, Ph.D., Oklahoma State University—Visiting Assistant Professor, Manufacturing, CIM, Automation

Santosh Kurinec, Ph.D., University of Delhi—Associate Professor, Materials, Solid State Devices, Sensors

Richard L. Lane, Ph.D., SUNY Alfred-Professor, Materials, Chemical Vapor Deposition, Crystal Growth

Robert E. **Pearson,** MS, Rochester Institute of Technology—Assistant Professor, Digital **I**.C. Design, Testing, **I**.C. Processing

Bruce W. Smith, MS, Rochester Institute of Technology—Visiting Assistant Professor, Photolithography

Renan I. Turkman, Ph.D., Paris—Assistant Professor, Process Modeling, Solid State Devices, Plasma Processing

Center for Quality and Applied Statistics

John D. Hromi, M. Litt., University of Pittsburgh; D. Engr., University of Detroit—Frederick H. Minett Distinguished Professor, Executive Director, Center for Quality and Applied Statistics

Edward G. **Schilling,** MBA, University of Buffalo; MS, Ph.D., Rutgers University—Paul A. Miller Distinguished Professor, Associate Director and Chairman, Graduate Statistics; Associate Director, Center for Quality and Applied Statistics

Anne M. Barker, MS, Rochester Institute of Technology—Assistant Professor

Thomas B. Barker, MS, Rochester Institute of Technology—Associate Professor

John T. Burr, Ph.D., Purdue University-Assistant Professor

Daniel R. Lawrence, MA, Ball State University; MS, Rochester Institute of Technology; Ph.D., University of Toronto—Assistant Professor

Patrick J. S. McNenny, MS, Rochester Institute of Technology—Manager, External Programs

Joseph G. **Voelkel,** MS, Northwestern University; Ph.D., University of Wisconsin-Madison—Associate Professor

Mason E. Wescott, Ph.D., Northwestern University—Professor Emeritus, Graduate Statistics

Thomas K. Witt, MS, Rochester Institute of Technology—Manager, Mason E. Wescott Statistics Laboratory

Hubert D. Wood, MS, University of Rochester—Assistant Professor

Computer Engineering

EECC-720 **Electronic Design Automation**
Registration #0301-720
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. (EECC-561 or equivalent; EECC-630/730 also suggested)

Class 4, Credit 4

EECC-722 **Advanced Computer Architecture**
Registration #0306-722
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. (EECC-551 or ICSG-720)

Class 4, Credit 4 (W)

EECC-730 **VLSI Design**
Registration #0306-730
An introduction to the design and implementation of Very Large Scale (VLSI) systems. Basic NMOS devices and circuits are described. From this base, a variety of methods for designing both combinational logic and state machines is developed, with emphasis on the use of regular structures such as programmed logic arrays. System architecture and use of Computer Aided Design (CAD) tools will be stressed. Extensive laboratory projects will be required.
Class 4, Credit 4 (F,S,SR)

EECC-731 **VLSI Design Projects**
Registration #0306-731
A second course in the design and implementation of Very Large Scale (VLSI) systems. CMOS devices will be studied. System architecture and the use of Computer Aided Design (CAD) tools will be stressed. A major laboratory design project will be required. In addition the students will test chips fabricated in the first course. (EECC-730 or EECC-630)

Class 4, Credit 4 (W,S)

EECG740 **Analytical Topics for Computer Engineers**
Registration #0306-740
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. (SMAM-265 or ICSA-705 and preferably ICSG-700)
Class 4, Credit 4(F)

EECG741 **Design for Testability**
Registration #0306-741
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 trade-offs between built-in testing capacity and additional silicon structures are weighed. A small project, usually involving simulation, will be required. (EEEE-650 or EECC-561)

Credit 4

EECC-756 **Multiple Processor Systems**
Registration #0306-756
This course will cover the general guidelines, methodology, and approaches for the design, development, and use of single and multi- micro- or minicomputer systems. The 16- and 32-bit microprocessors have vast address spaces and virtual memory capability, incorporate complex I/O facilities, and permit rapid execution of cost-saving, high-level languages. The hardware and software support available for these microprocessors also makes them a cost-effective alternative to minicomputers. Distributed systems based on microcomputer technology will be investigated with emphasis on interconnect structures, intercommunications, software and hardware. The course will include a laboratory workshop in which each student will be required to design, implement, and test one or more parts of a practical system. Emphasis will be placed on engineering ability and management skill to meet proposed technical goals on time and within budget. (Graduate standing in Computer Engineering, ICSS-440 or ICSG-730, or permission of instructor)

Class 4, Credit 4 (S)

EECC-758 **Fault-Tolerant Digital Systems**
Registration #0306-758
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. (ICSS400 or EEEE-650 or EEEE-750 or EECC-561, EECC-550 or ICSS-720)

Class 4, Credit 4

EECC-759 **Principles of Digital Interfacing**
Registration #0306-759
Standard bus interface—parallel and serial. LSI interface devices. Interface design—peripherals and memory. Data acquisition—A/D and D/A converters, multiplexing. Remote control. Error detection and correction. (EECC-560 or permission of instructor)

Class 3, Lab 3, Credit 4 (F)

EECC-772 **Special Topics in Computer Engineering**
Registration #0306-772
Topics and subject areas that are not among the courses listed here are frequendy 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)

EECC-784 **Digital Image Processing Algorithms**
Registration #0306-784
This is a graduate-level course that emphasizes the computational and algorithmic techniques required for processing digitized pictorial images. The acquisition and quantization of digital images are described, followed by analysis and filtering techniques. Segmentation, projection, and reconstruction techniques are discussed. Finally, bi-level image processing is discussed, including contour filling and thinning techniques. Programming projects will be required. (Competence in calculus, engineering math, and structured programming is required)

Class 4, Credit 4

EECC-890 **Thesis**
Registration #0306-890
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

Electrical Engineering

EEEE-723 **Semiconductor Physics**
Registration #0301-723

An intermediate-level course on the physical properties of semiconductors for engineering students. The emphasis is on semiconductor materials and fundamental solid state physics. Topics include: electronic structure of atoms, crystal structures, direct and reciprocal lattices, Bragg diffraction, Bloch electrons, energy band theory, effective mass theory, energy-momentum relations in direct and indirect band gap semiconductors, intrinsic and extrinsic semiconductors, statistical physics applied to carriers in semiconductors, density of states, and lattice vibrations.
Credit 4

EEEE-724 **Physics of Semiconductor Devices I**
Registration #0301-724
An advanced-level course in electronic transport in semiconductors and the operation of bipolar devices (pn junction diodes, bipolar junction transistors). Topics include: electron drift and carrier-lattice interactions, carrier mobility, hot electron theory, diffusion, energy band diagrams, non-uniformly doped semiconductors, continuity equations, advanced static and dynamic analysis of pn junction diodes and bipolar junction transistors. (EEEE-723)

Credit 4

EEEE-725 **Physics of Semiconductor Devices II**
Registration #0301-725
An advanced-level course on majority carrier devices, MOS capacitors and charge-coupled devices. Topics include the static and dynamic analysis of the following devices: metal-semiconductor contacts (ohmic and Schottky barrier contacts), JFETs, MESFETs, HEMTs (MODFETs), MOS capacitors, MOSFETs (short and narrow channel effects, hot electron effects, ion implanted and buried channel devices, sub-threshold conduction), CMOS structures (advanced well structures, isolation techniques, and latch-up immunity), CCDs and memory devices. (EEEE-724)

Credit 4

EEEE-726 **Analog IC Circuits**
Registration #0301-726
A course in the analysis and design of bipolar analog integrated circuits. Topics include: device models, amplifiers, current sources and active loads, output stages, operational amplifiers, precision reference design, and analog circuit design in bipolar LSI. Course will involve circuit design and computer simulation projects.

Credit 4

EEEE-727 **VLSI Design**
Registration #0301-727
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. (EEEE-724, 670, and a course in computer architecture)
Credit 4

EEEE-730 **Advanced Analog I. C. Design**
Registration #0301-730
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 convenors, switched capacitor filters, and more. The students will participate in design projects including circuit design, layout, and SPICE simulation. (EEEE-726)
Credit 4

EEEE-741 **Design for Testability**
Registration #0301-741
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 trade-offs between built in testing capacity and additional silicon structures are weighed. A small project, usually involving simulation will be required. (EEEE-650)

Credit 4

EEEE-754 **Analytical Techniques I**
Registration #0301-754
This course is required of all graduate students and provides them with an understanding of complex variables and transform calculus. Topics include: theory of complex variables, transformations, analyticity, singularities,, complex integration, Cauchy's and residue theorems, series expansions, Taylor and Laurent series, conformal mapping, advanced topics in continuous time Fourier series and transforms, Laplace transforms, existence, inversion integral, branch points and applications.

Credit 4

EEEE-755 **Analytical Techniques II**
Registration #0301-755
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 polynomials 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. (EEEE-754)

Credit 4

EEEE-756 **Analytical Techniques III**
Registration #0301-756
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, autocorrelation, cross-correlation and power spectrum density, response of linear systems to stochastic inputs, introduction to linear prediction, Wiener filtering, elements of detection, matched filters. (Graduate standing)
Credit 4

EEEE-758 **Multidimensional Digital Signal Processing**
Registration #0301-758
This course deals with the digital processing of signals which are functions of more than one variable. Course outline: multidimensional (m-D) signals, definition, important differences between 1-D and m-D signals, examples, special m-D signals, multidimensional systems, linearity, shift-invariance, translation, rotation, convolution, frequency domain characterization, sampling theorem for m-D signals, multidimensional discrete fourier series and transforms, FIR filters, design and implementation, finite order difference equations, m-D-Z transforms, 2-D polynomials and root maps, IIR filters, transfer functions and stability, IIR filter design and implementation, applications, image processing, tomography, sensor array processing, inverse problems. Computer assignments are involved. (EEEE-754, 755. The latter can be taken concurrently with this course.)

Credit 4

EEEE-759 **Waveform Coding for Speech and Images**
Registration #0301-759
Modern compression techniques used in efficient digital transmission and storage of speech and image waveforms are dealt with in this course. 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. (EEEE-755, 756 or permission of instructor)

Credit 4

EEEE-761 **Modern Control Theory**
Registration #0301-761
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, multi-variage systems, preliminaries, systems of lease order, stability and control. (EEEE-754, 755,513)

Credit 4

EEEE-762 **Nonlinear Control Systems**
Registration #0301-762
This course is an introduction to the physical nature and mathematical theory of nonlinear control systems' behavior using phase plane techniques. Liapunov theory (including Aizerman's method, variable gradient methods, and the Lure forms), perturbation methods, describing function techniques, and Papov's criterion and analysis of switching and relays are discussed. These are applied to both piecewise-linear and analytical nonlinear systems. (EEEE-761)

Credit 4

EEEE-763 **Stochastic Estimation and Control**
Registration #0301-763
This course is concerned with the control of systems in the presence of uncertainties. Topics to be discussed: modeling of stochastic processes, estimation theory, least squares estimation, maximum-likelihood estimation, MAP estimation, optimum filtering and prediction, optimum smoothing and interpolation, the Wiener-Hopf equation, solution to casual and non-casual cases, state estimation, Kalman filtering, discrete and continuous time filters, Riccati equation, optimum feedback control in presence of noise, LQC problem and applications. (EEEE-756,761)
Credit 4

EEEE-764 **Digital Control Systems Design**
Registration #0301-764
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. (EEEE-755)
Credit 4

EEEE-765 **Optimal Control**
Registration #0301-765
An introduction to the calculus of variations. Topics covered include: conditions of optimality, optimizing transient performance by statistical and variational procedures, dynamic programming and by Pontryagin's maximum principle; and the design of optimal linear systems with quadratic criteria. (EEEE-761)
Credit 4

EEEE-767 **Power Semiconductor Circuits**
Registration #0301-767
The objective of this course is to provide an adequate, application-oriented knowledge to those interested in the areas of control, power, and power electronics. Topics to be discussed; preliminaries, basic principles of static switching thyristor theory, triggering, commutations; rectifiers; principles of controlled rectification, analysis of single and three-phase controlled rectifiers; inverters; series and parallel SCR inverters, design of inverters, sine wave filters; forced commutation inverter, McMurray inverter, DC systems, principles of AC-DC conversion, choppers, DC motor drives, dual converter; cyclo-converter, controls. Modeling and simulation of thyristor circuits; thyristor models approximations, digital simulation of choppers, inverters and cyclo-converters, areas of further research. Demonstration experiments will be set up. Also individual projects by interested students will be encouraged.

Credit **4**

EEEE-768 **Adaptive Signal Processing**
Registration #0301-768
An introduction to the fundamental concepts of adaptive systems; open and closed loop adaptive systems; adaptive linear combiner; performance function and minimization; decorrelation of error and input signal. Adaptation algorithms such as: steepest descent, LMS and LMS/Newton algorithm. Noise and misadjustments. Applications will include system identification, deconvolution and equalization, adaptive arrays and multipath communication channels. (EEEE-756 or permission of instructor.)

Credit **4**

EEEE-772, 773, 774 **Special Topics in Electrical Engineering**
Registration #0301-772,773,774
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. (No regular course schedule)
Credit **4**

EEEE-775 **Optical Engineering I**
Registration #0301-775
An introduction to the properties of optical components and their combination into systems, primarily from a geometrical optics point of view. The course develops paraxial matrix method with application to zoom lens design, and extends the matrix method to meridional rays and skew rays, and develops FORTRAN programs for the reduction of spherical aberration, coma, astigmatism and curvature of field. It also covers aspherical surfaces, Schmidt system, photometry, and the design of projection and achromatic systems.

Credit **4**

EEEE-776 **Electro-optics**
Registration #0301-776
This course deals with the principles of the laser and its operation. It covers ray tracing in an optical system, Gaussian beams, optical resonators, interaction of radiation and atomic systems, theory of laser ocscillation, Q-switching, and mode-locking. It also covers some specific laser systems and electrooptic modulation of laser beams. (EEEE472 or equivalent)

Credit **4**

EEEE-778 **Tiber Optics**
Registration #0301-778
This course introduces the basic concepts of wave propagation in fibers. It reviews basic waveguide equations and applies the theory to dielectric slab waveguide, step-index and graded-index fibers. It covers the techniques of source coupling and splicing, and discusses optical sources such as semiconductor lasers and LED. Applications to communication systems will also be discussed. (EEEE472 or equivalent)

Credit 3

EEEE-779 **Digital Image Processing**
Registration #0301-779
This is an introductory course in digital image processing. The course 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 and methods of image segmentation are degradation and methods of image restoration including deblurring. Several extensive computer and DSP lab assignments are required. (EEEE-755, 554 or permission of instructor)
Credit 4

EEEE-780 **Independent Study**
Registration #0301-780
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

EEEE-788 **Advanced Topics in Digital**
Registration #0301-788 **Signal Processing**
This course covers signal processing techniques which are widely used but not covered in fundamental signal processing courses. Topics include: review of random processes, spectral estimation, periodgram, Blackman-Tudey spectral estimation, rational transfer function models, AR, MA, and ARMA spectral estimators, maximum likelihood spectral estimation, two-dimensional spectral estimation, multirate DSP, sampling and signal reconstruction, decimators and interpolators, and quadrature mirror filters (QMF), homomorphic signal processing, multiplicative homomorphic systems, homomorphic systems for convolution, homomorphic image processing, and complex cepstrum, effects of finite register length in DSP, effect of number representation on quantization, quantization in sampling analog signals, finite-register-length effects in realizations of FIR and IIR filters, introduction to higher order spectra. (EEEE-756)

Credit 4

EEEE-790 **Random Signals and Noise**
Registration #0301-790
Topics covered in this course include: functions of two random variables, mean square estimation, orthogonality principles, sequences of random variables, central limit theorem, random processes, correlation functions, spectrum of periodic functions and periodic random processes, spectral densities, the Gaussian random process, noise through linear systems. (EEEE-755, 756)

Credit 4

EEEE-793 **Error Detecting and Error Correction**
Registration #0301-793
This course covers linear block codes and convolutional codes. The major linear block codes to be covered are Hamming, BCH, Golay, and Reed-Solomon codes. The fundamental structure of linear block codes will be developed and applied to performance calculations. The structure of cyclic codes will be developed and applied to encoders and decoders. The major error correction methods, including error trapping, majority logic decoding and the BCH algorithm will be developed and the Biterbi and sequential decoding algorithms will be studied. Questions of system performance, speed, and complexity will be examined. (EEEE-756)

Credit 4

EEEE-794 **Information Theory**
Registration #0301-794
This course introduces the student to the fundamental concepts and results of information theory. This is a very important course for students who want to specialize in signal processing, image processing, or digital communication. Topics include: definition of information, mutual information, average information or entropy, entropy as a measure of average uncertainty, information sources and source coding, Huffman codes, run-length constraints, discrete memoryless channels, channel coding theorem, channel capacity and Shannon's theorem, noisy channels, continuous sources and channels, coding in the presence of noise, performance bounds for data transmission, rate distortion theory. (EEEE-756)
Credit 4

EEEE-795 **Optical Engineering II**
Registration #0301-795
This course emphasizes the application of wave optics to optical systems. It covers various applications of wave optics to optical systems. Topics include: Michelson interferometer, Fourier transform spectroscopy, Fabry-Perot interferometer, thin films, methods of synthesis for dielectric multilayer filters, Fraunhofer and Fresnel diffraction, Fourier optics, spatial filtering and holography. (EEEE472 or equivalent)
Credit 4

EEEE-800 **Graduate Paper**
Registration #0301-800
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 5

EEEE-890 **Thesis**
Registration #0301-890
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

The following courses are recommended as part of the Master of Engineering program in Industrial Engineering and Engineering Management. They are offered on sufficient demand.

Industrial and Manufacturing Engineering

EIEI-620 **Engineering Economy**
Registration #030^620
Time value of money, methods of comparing alternatives, depreciation and depletion, income tax consideration, replacement, retirement and obsolescence, and capital budgeting.

Credit 4

EIEI-715, 716 **Statistical Analysis for Engineering I & II**
Registration #0303-715, 716
A basic two-quarter course in probability and statistics designed to give the student a foundation for further study in areas such as design of experiments, stochastic systems, and simulation.

Credit 4

The following courses can be used as part of the Master of Engineering program in Industrial Engineering and Engineering Management. The courses are generally offered in alternating years and/or as demand dictates.

EIEI-601 **Value Analysis**
Registration #030^601
This course examines the nature and measurement of value. The concept and construction of a value index representing average value is related. Numerical estimation methods such as ranking, pair comparison, magnitude estimation, and criteria analysis are explained and used to measure the value of diverse items. The methods used are applicable to the study of a wide variety of problems and have special utility in engineering design studies.

Credit 4

EIEI-701 **Principles of Operations Research I**
Registration #0303-701
Applied linear programming. Computational techniques for solving constrained optimization problems. Linear programming, the Simplex method and variations, duality and sensitivity testing.
Credit 4

EIEI-702 **Mathematical Programming**
Registration #0303-702
Application of non-linear programming techniques. Classical optimization techniques; quadratic, stochastic, integer programming and dynamic programming. Applications to industry. (EIEI-701)
Credit 4

EIEI-705 **Survey of Operations Research**
Registration #0303-705
A survey course designed to introduce the student to such topics as waiting line analysis, inventory, scheduling, replacement, and simulation. This course is intended to present an integrated view of the field of operations research to students who will take more specialized courses as well as those in other disciplines desiring only a limited exposure to the field. (EIEI-715)
Credit 4

EIEI-710 **Systems Simulation**
Registration #0303-710
Methods of modeling and simulating man-machine systems. Model validation, design of simulation experiments, variance reduction techniques, random number generation and distribution general are discussed. However, emphasis is placed on the G.P.S.S. simulation language. (EIEI-715)
Credit 4

EIEI-718 **Inventory Design**
Registration #0303-718
Overview of inventory problems. Single period models under risk and uncertainty, dynamic models under certainty, dynamic models under risk and uncertainty. Forecasting, inventory system analysis. (EIEI-715)
Credit 4

EIEI-720 **Production Control**
Registration #0303-720
A systems approach to the design of production control operations. Investigation of forecasting, operations planning, inventory control, and scheduling. Case studies and the design of actual production systems is encouraged. (EIEI-710, EIEI-716)
Credit 4

EIEI-723 **Facilities Planning**
Registration #0303-723
Principles of plant layout and material handling. Topics covered include criterion selection, cost elements, the layout design process, SLP, computerized plant layout and quantitative plant layout and material handling techniques relating to operations research.
Credit 4

EIEI-725 **Technological Forecasting**
Registration #0303-725
Technological forecasting is concerned with the Delphi method, SOON charts, tend extrapolation, relevancy trees, cross input analysis, internally consistent scenarios, and decision matrices. The course will provide a thorough introduction to the basic concepts and techniques of technological forecasting.
Credit 4

EIEI-730 **Biotechnology and Human Factors I**
Registration #0303-730
Basic functional anatomy and physiology. Human body systems. Anthropometry. Applications on the design for man and man-machine systems. Work physiology, industrial biomechanics.
Credit 4

EIEI-731 **Biotechnology and Human Factors II**
Registration #0303-731
Effect of mechanical and physical environment on: physiology, behavior, performance of man. Design considerations to protect man against environment effects (thermal environment, noise, vibration, acceleration, light, altitude).
Credit 4

EIEI-732 **Biotechnology and Human Factors III**
Registration #0303-732
Theoretical fundamentals of human body mechanics. Development applications of biomechanics and biomechanical models. Kinematics of the link system of the body and extremity joints.
Credit 4

EIEI-733 **Biotechnology and Human Factors IV**
Registration #0303-733
Measurements of human performance. Functions that man performs in man-machine systems. Techniques to quantify man's behavior at work.
Credit 4

EIEI-734 **Systems Safety Engineering**
Registration #0303-734
Accident study of the human component in occupational systems. Product systems safety analysis. Approaches in accident prevention.
Credit 4

EIEI-740 **Numerical Control and Manufacturing**
Registration #0303-740
Numerical control is the technique of programming a machine (such as a mill) to manufacture a part with minimum operator interaction. Several levels of NC programming will be studied: manual programming, computer assisted programming and interactive graphics. Students will participate in extensive hands-on work using a mill and a lathe. In addition, the role that NC machines play in the factory of the past, present, and future will be discussed and analyzed.
Credit 4

EIEI-741 **Applications of Robotics in Manufacturing Systems**
Registration #0303-741
This course introduces the fundamentals of robotics and robotics applications in manufacturing systems. The course deals with analysis of robotic systems, robotic selection and feasibilities, integration of robots in manufacturing systems, design of robot work station, materials handling, programming, control and safety. (Permission of instructor)
Credit 4

EIEI-747 **Microprocessor Applications**
Registration #0303-747
Automated manufacturing processes demand effective computer-microprocessor interfacing. This course will provide the necessary knowledge of assembly language programming and digital hardware interfacing techniques. The role of macro-assemblies, high level languages and systems software aids to develop efficient modular programs will be discussed. One or more specific manufacturing related applications will be implemented. Microprocessor architectures and interfacing to several hardware elements such as VART, PIA, A/D, D/A and other LSI chips will be covered. A greater emphasis will be placed on software aspects such as modularity, data structure, interrupt handling, communication protocols to design efficient hierarchical control systems for Computer Integrated Manufacturing.
Credit 4

EIEI-750 **Management of Quality Control Systems**
Registration #0303-750
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, 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. Graduate standing or consent of the professor. (EIEI-715)
Credit 4

Special courses related to a particular student's interest can be arranged via the following courses:

EIEI-771, 772, 773, 774, 775 **Special Topics in Industrial Engineering**
Registration #0303-771, 772, 773, 774,775

This a variable credit, variable topics course which can be in the form of regular courses or independent study under faculty supervision.

Credit variable (maximum 4 per course number)

EIEI-799 **Independent Study**
Registration #0303-799

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

EENG-777 **Engineering Internship**
Registration #0302-777

This course number is used by students in the master of engineering degree program for earning internship credits. The actual number of credits is to be determined by the student's faculty advisor and is subject to the Graduate Committee of the College of Engineering.

Credit variable

EENG-801 **Design for Manufacture**
Registration #0302-801

This is a required course in the manufacturing option of the Master of Engineering degree program. The course is offered joindy by the departments of Industrial 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.

Class 4, Credit 4 (W)

Mechanical Engineering

The courses EMEM-870, EMEM-871, EMEM-872, EMEM-874 and EMEM-877 are offered every year. The other courses (except those listed as "offered on sufficient demand") are typically offered every other year.

EMEM-810 **Introduction to Continuum Mechanics**
Registration #0302-810

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 a continuous medium. Applications to theory of elasticity, thermoelasticity, viscoelasticity, and fluid mechanics. (EMEM-871)

Class 4, Credit 4 (even year, F)

EMEM-811 **Theory of Elasticity**
Registration #0304-811

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, eliptic, rectangular cross-sections. Stresses and displacements in thick cylinders, disks, and spheres. Contact stress problems. Energy principles. (Graduate standing)

Class 4, Credit 4 (even year, W)

EMEM-812 **Theory of Plates and Shells**
Registration #0304-812

Theory of thin plates for small deflections. Rectangular and circular plates with various boundary conditions, elliptic and triangular plates. Navier and Levy solutions. Thermal stress in plates. Membrane theory of shells. Cylindrical shells and shells of revolution. (EMEM-685 or equivalent)

Class 4, Credit 4 (odd year, S)

EMEM-813 **Theory of Plasticity**
Registration #0304-813

The analysis of stress and strain. Criteria for yielding. Stress-strain relations of the theory of plasticity. Elastoplastic problems of spheres and cylinders. Torsion, Creep. (Graduate standing)

Class 4, Credit 4 (odd year, W)

EMEM-815 **Experimental Stress Analysis**
Registration #0304-815

Experimental methods of analysis of structural machine members, including strain gages and instrumentation, photoelastic methods, brittle coating, Moire fringe method, holographic techniques; and the hydrodynamic, electrical, and membrane analogs. Different methods will be demonstrated. (EMEM-694 or equivalent)

Class 4, Credit 4 (even year, S)

EMEM-816 **Finite Elements**
Registration #0304-816

Boundary value problems in mechanical engineering are discussed and presented through the development of the government field equations of a continuum through the development of the governing field equations of a continuum in structural mechanics, heat transfer and fluid mechanics. The process of discretization of a continuum by the finite element method is presented using energy principles, and applied to the field equations outlined above. In the course of application, various line, surface, and solid elements are defined and developed. Numerical considerations presented include topics such as solution time, optimization, condensation methods, computer characteristics, etc. Commercial codes such as NASTRAN, ANSYS, GIFTS, and SAP will be discussed. However, the students will solve problems using fundamental approaches that will involve hand calculations and writing some individual computer programs. (EMEM-870, EMEM-871, EMEM-440 or equivalent)

Class 4, Credit 4, (every year, F)

EMEM-820 **Advanced Optimal Design**
Registration #0304-820

Topics from nonlinear programming as applied to automated optimal design. Use of penalty functions for the transformation of constrained nonlinear optimization problems. Multivariate patter and gradient based algorithms, such as the method of steepest descent, Newton's method, quasi-Newton methods and generalized conjugate gradient techniques. Direct methods for constrained nonlinear optimization. Applications to the solution of practical nonlinear optimization problems using the digital computer. (EMEM-871 and EMEM-874)

Class 4, Credit 4 (odd year, S)

EMEM-821 **Vibration Theory and Applications**
Registration #0304-821

Vibration of discrete multi-mass system 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. (EMEM-871, EMEM-874)

Class 4, Credit 4 (every year, S)

EMEM-**823** **Applied System Dynamics**

Registration #0304-823

Review of ordinary differential equations and the applications to the mathematical modeling of dynamic systems. The LaPlace and Fourier transforms and their applications to the modelling of dynamic systems both experimentally and analytically. The known input-known output concept and the transfer function concept for system identification. Overview of analytical and experimental methods to obtain the dynamic characteristics of mechanical systems. Deterministic versus Stochastic inputs. Auto-correlation and cross-correlation functions and their Fourier Transforms. Stationary and non-stationary processes. The Frequency Response Function (FRF) and its relationship with the Transfer Function. Instrumentation and seniors: accelerometers, velocity sensors, displacement sensors, shakers, vibration tables, power amplifiers, force sensors, signal generators, signal conditioning devices and data acquisition systems. Mid-term exam. Data reduction and analysis of results. Curve fitting techniques. Graphical techniques, Bode and Nyquist plots. Time domain versus frequency domain. The use of Model Analysis software and its advanced simulation features. Non-linear systems, feedback control applications, or other areas of interest for the students. Laboratory experience consisting of understanding and using frequency analyzers to determine the FRF, experimental setup, and data gathering procedure for the identification of the dynamic characteristics of a mechanical system or structure. Presentation of term projects. (Graduate standing)

Class 4, Credit 4 (every year, F)

EMEM-827 **Computer Graphics in Design**

Registration #0304-827

The course emphasizes the current role of computer graphics in computer-assisted design and design analysis. Subjects include: components of CAD systems, methods of geometric modeling, visualization methods, techniques of interactive communication, and design applications utilizing available software packages for multidimensional graphic display, pre- and post-processing modelers for finite element analyses, and three-dimensional solids modeling. (Graduate standing)

Class 4, Credit 4 (even year, S)

EMEM-828, 829 **Special Topics in Applied Mechanics**

Registration #0304-828,829

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. A listing of topics for special courses is found at the end of this section. (Graduate standing)

Credit variable (maximum of 4 credits/quarter) (TBA)

EMEM-833 **Heat Exchanger Design**

Registration #0304-833

This course covers analytical models for forced convection through tubes and over surfaces, experimental correlations for the Nusselt number and pressure drop, design of single and multiple pass shell and tube heat exchangers; compact baffled, direct contact, plate and fluidized bed heat exchangers; radiators, recuperators, and regenerators. (EMEM-514 and instructor's approval)

Class 4, Credit 4 (odd year, W)

EMEM-838 **Ideal Hows**

Registration #0304-838

This graduate course introduces the students to the analysis of ideal flows from an advanced mathematical as well as engineering viewpoint. Steady acyclic motion, superposition of lows, vorticity dynamics; the theory of complex variables; airfoil and wing theories. (EMEM-871, EMEM-516 or equivalent)

Class 4, Credit 4 (odd year, S)

EMEM-848, 849 **Special Topics in Thermo Fluid Systems**

Registration #0304-848, 849

In response to student and/or faculty interest, special courses which are of current interest and/or logical continuation of regular courses will be presented. These courses will be structured as ordinary courses with specified prerequisites, contact hours, and examination. A listing of topics for special courses is found at the end of this section. (Graduate standing)

Credit variable (maximum of 4 credits/quarter) (TBA)

EMEM-864 **Production Tool Design**

Registration #0304-864

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 (even year, F)

EMEM-865 **Computer Implementation of Finite Elements**

Registration #0304-865

This is a course in the core group, CAD, of the manufacturing engineering option in the master of engineering degree program. 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 formulations, and the element library; program sequencing; general modeling methods (loads, constraints, material factors, mesh generation, interactive graphics, model conditioning, etc.); covergence, error analysis and the "patch" test, vibration and heat transfer analysis, and analogous analysis such as acoustics, illumination, etc. (EMEM-816)

Class 4, Credit 4 (odd year, W)

EMEM-870 **Mathematics for Engineers I**

Registration #0304-870

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. Applications in Mechanical Engineering. (Graduate standing)

Class 4, Credit 4 (every year, F)

EMEM-871 **Mathematics for Engineers II**

Registration #0304-871

Topics covered are orthogonal functions including Fourier Series, Bessel functions, Legendre Polynomials; Sturm-Liouville problems and eigenfunction expansions; an introduction to calculus of variations, including problems with constraints; vector analysis including the directional derivative, the gradient, line integrals, Green's Theorem, the Divergence Theorem and Stokes' Theorem. Applications in Mechanical Engineering. (Graduate standing)

Class 4, Credit 4 (every year, F, W)

EMEM-872 **Mechanics**

Registration #0304-872

Variational principles are developed and applied to the area of solid mechanics. Exact and approximate solution techniques are applied to the solutions of static and dynamic structural problems. Although static analysis is emphasized, dynamic problems will be introduced. Topics presented include: Calculus of Variations, Virtual Work, minimum potential energy, Castigliano's method, the Rayleigh-Ritz method, Galerkin's method, Hamilton's principle, and Lagrange's equations. (EMEM-871 and EMEM-543 or equivalent)

Class 4, Credit 4 (every year, S)

EMEM-873 **Convective Heat Transfer**

Registration #0304-873

This course deals with mechanisms and applications of forced convection transfer. Governing equations are analyzed and applied to practical situations such as single phase heat transfer during flow inside tubes, cooling of electronic components, flow boiling, and augmentation of single phase and two phase heat transfer. (EMEM-877)

Class 4, Credit 4 (odd year, F)

EMEM-874 **Numerical Analysis**
Registration #0304-874
The course emphasizes both the development of the current numerical methods that are available to solve engineering problems and the use of the digital computer to implement these techniques. The methods are developed for: Algebraic and transcendental equations in single variable; system of linear algebraic equations by both direct and iterative techniques; system of non-linear equations, interpolation and approximation theory; numerical differentiation and integration, initial value problems for ordinary differential equations; boundary value problems for ordinary linear and nonlinear differential equations; and partial differential equations; discussion on covergence and stability of methods, effect of truncation and round off errors. Extensive use of the computer will be required. (Graduate standing; knowledge of FORTRAN, experience in the use of digital computers and EMEM-870)

Class 4, Credit 4 (every year, W)

EMEM-878 **Fluid Dynamics**
Registration #0304378
This is an introductory course at the graduate level in fluid dynamics intended to give the students a broad exposure to incompressible flows. This course lays the foundation, and is a prerequisite for a study of advanced topics in heat transfer, advanced aerodynamics, computational fluid dynamics, wave mechanics, and geophysical fluid dynamics. This course includes conservation laws and boundary conditions, potential flows, highly viscous flows, boundary layer theory, flow stability and transition to turbulence. (EMEM-871, Graduate standing)

Class 4, Credit 4 (every year, W)

EMEM-880 **Independent Study**
Registration #0304-880
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/quarter) (every year, F, W, S)

EMEM-890 **Thesis, Design Project, or Literature Search**
Registration #0304-890
In conference with an advisor, a topic is chosen. The work may involve a thesis, design project, or literature search. Periodic progress reports and a final written document with an oral examination are required. (Four of the five graduate core courses)

Credit variable (5 to 12 credits total) (F, W, S, SR)

SESM-701 **Introduction to Materials Sciences**
Registration #1028-701
The course provides an understanding of the relationship between structure and properties of materials. Topics include: atomic and crystal structure, crystalline defects, diffusion theories, strengthening mechanisms, steels, cast irons, ceramic and polymeric materials, and corrosion principles (SCHG-208 or equivalent)

Class 4, Credit 4 (every year, F)

SESM-705 **Introductory Experimental Techniques**
Registration #1028-705
This course introduces the student 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 will be conducted. (SESM-701 and 702 or equivalents)

Class variable, Lab variable, Credit 4 (offered every year)

SESM-710 **Properties and Selection of Engineering Materials**
Registration #1028-710
This course deals with effective material selection which requires that a designer be familiar with many material systems and be acquainted with a nominal number of specific materials in these systems. The course contains theory not found in handbooks and practical information not covered in materials science or metallurgy courses. Emphasis is placed upon the application of materials according to properties and principles of material behavior. Ferrous, nonferrous and nonmetallic materials are covered. (SESM-701 or equivalent)

Class 4, Credit 4 (TBA)

Special topic courses will be offered in the following areas if there is a sufficient demand:

Energy Methods in Mechanics
Advanced Vibration Theory
Lubrication
Advanced Heat Transfer
Advanced Thermodynamics
Control Systems
Thermal Stresses
Aerodynamics
Wave Mechanics
Computational Fluid Dynamics
Geophysical Fluid Dynamics

Microelectronic Engineering

EMCR-701 **Microelectronics Manufacturing I**
Registration #0305-701
An intermediate course in the study of integrated circuit processing. Topics include diffusion, ion implantation, bipolar and MOS processes. Extensive use of CAE tools such as SUPREM and SPICE. Laboratory work includes the fabrication of MOS integrated circuits providing an introduction to all I.C. fabrication processes and safety.

Class 3, Lab 3, Credit 4(F)

EMCR-702 **Microelectronics Manufacturing II**
Registration #0305-702
A continuation of Microelectronics I with emphasis on merging the details of individual processing steps into a complete manufacturing process. Special emphasis is given to measurement techniques for evaluation manufacturing performance. The laboratory portion includes the design and fabrication of integrated circuits and test devices.

Class 3, Lab 3, Credit 4 (W)

EMCR-703 **Microelectronics Manufacturing III**
Registration #0305-703
A selection of topics from physical and plasma chemistry important to the understanding of integrated circuit processing. Including plasma etching, chemical vapor deposition, and related technologies. Advanced transistor design is studied including low doped drain structures, polysilicon emitter BJTs, BiCMOS structures, etc. Safety considerations are emphasized.
Class 3, Lab 3, Credit 4 (S)

EMCR-710 **CMOS**
Registration #0305-710
A course in advanced CMOS processing. Topics include design issues such as latch-up, advanced processes such as low doped drain or SALICIDE, BiCMOS, test structures, manufacturing. The laboratory involves the student in the manufacture of CMOS integrated circuits and test structures. (EMCR-520, 640, 650 or 701,702)

Class 3, Lab 3, Credit 4 (S)

EMCR-711 **Defect Reduction and Yield Enhancement**
Registration #0305-711
This course looks at each step in the integrated circuit manufacturing process and investigates how to reduce defects and increase yield. Defect analysis, test structures for defects and yield will be studied. Laboratory will involve applying these ideas to the RIT student-run factory. (EMCR-640, 650 or 701, 702)

Class 3, Lab 3, Credit 4 (SR)

EMCR-712 **Maskmaking and Electron Beam Lithography**
Registration #0305-712
Students study maskmaking, including topics in data preparation, pattern generation, inspection, and related chemistry. Electron beam lithography will be studied in detail. The laboratory involves both optical and e-beam maskmaking. (EMCR-565 or EMCR-721)

Class 3, Lab 3, Credit 4 (S)

EMCR-713 **Electronic Properties of Materials**
Registration #0305-713
An in-depth study of materials emphasizing those used in the integrated circuit industry. Laboratory will focus on materials evaluation techniques and surface analysis, including SEM and EDAX.
Class 3, Lab 3, Credit 4 (W)

EMCR-721 **Microlithography I**
Registration #0305-721
Selected topics from organic, polymer, physical, and photographic chemistry important to the understanding of photoresists and optical lithography. Photoresist processes such as negative, positive, reversal, dyed, antireflective coatings, image stabilization, and modeling and simulation of photographic processes. Laboratory course topics emphasize photolithographic process characterization techniques and statistical design of experiments.
Class 3, Lab 3, Credit 4 (F)

EMCR-722 **Microlithography II**
Registration #0305-722
A continuation of EMCR-721. Topics include advanced processes such as multilayer, contrast enhancement, and chemically amplified. High energy lithographic techniques, including deep-UV, x-ray, and electron beam. Laboratory will demonstrate these topics.
Class 3, Lab 3, Credit 4 (W)

EMCR-731 **Manufacturing Science I**
Registration #0305-731
A manufacturing course. Topics include scheduling, work in progress tracking, costing, inventory control, capital budgeting, productivity measures and personnel management. The laboratory for this course is the student-run factory. Measurement of yield, defect density, wafer mapping, control charts and other tools are introduced to the student.
Class 3, Lab 3, Credit 4 (W)

EMCR-732 **Manufacturing Science II**
Registration #0305-732
A course in Computer Integrated Manufacturing as it applies to microelectronics manufacturing. 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 to the student. Laboratory experiences are related to the operation of the student-run integrated circuit factory.

Class 3, Lab 3, Credit 4 (S)

EMCR-770 **Independent Study**
Registration #0305-770
This course number should be used by students who plan to study a topic on an independent basis. The student must obtain the permission of the appropriate faculty member before registering for the course.
Credit variable

EMCR-777 **Internship**
Registration #0305-777
This course number is used to fulfill the internship requirement. The student must obtain the approval of an appropriate faculty member to supervise the paper before registering for this course.

Credit variable

Statistics

EQAS-701 **Statistical Concepts**
Registration #0307-701
A service course designed for non-concentrators which emphasizes statistical thinking instead of mathematical manipulations. This is an intuition-based introduction to the subject. Topics include: exploratory data analysis, methods for collecting data, statistical inference, regression analysis, and analysis of variance. This course does not count as credit for the MS degree in statistics. (None)

Credit 4

EQAS-711 **Fundamentals of Statistics I**
Registration #0307-711
For those taking statistics for the first time. Covers the statistical methods used most in industry, business, and research. Essential for all scientists, engineers, and administrators. Topics: organizing observed data for analysis and insight; 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.

Credit 3 or 4

EQAS-712 **Fundamentals of Statistics II**
Registration #0307-712
Continuation of EQAS-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; learning how to separate 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. (Fund, of Statistics I EQAS-711 or Consent of the Department)

Credit 3 or 4

EQAS-721 **Statistical Quality Control I**
Registration #0307-721
A practical course designed to give depth to practicing quality control personnel. Topics: statistical measures; theory, construction, and application of control charts for variables and attributes; computerization procedures for control charts; tolerances, specifications, and process capability studies; basic concepts of total quality control, and the management of the quality control function.

Credit 3

EQAS-731 **Statistical Quality Control H**
Registration #0307-731
Investigation of modern acceptance sampling techniques with emphasis on industrial applications. Topics: single, double multiple, and sequential techniques for attributes sampling; variables sampling; techniques for sampling continuous production. The course highlights Dodge-Romig plans, Military Standard plans, and recent contributions from the literature.

Credit 3

EQAS-742 **Statistical Computing**
Registration #0307-742
An advanced course in statistical computing using SAS statistical software. The course will cover basic SAS procedures; the creation, manipulation, and analysis of data bases; graphical display techniques; and the development and writing of custom numerical analysis procedures. (Fund, of Statistics I and II, EQAS-711 and EQAS-712, or consent of department)
Credit 3

EQAS-751 **Mathematics for Statistics**
Registration #0307-751
This course will survey various mathematical techniques useful in statistical analyses and present illustrations of their applicability. Emphasis will be on a variety of calculus techniques together with selected topics for linear algebra central to the understanding and application of various statistical methods. Reference will be made to relevant available software. (Fundamentals of Statistics I and II EQAS-711 and 712; prior coursework in both differential and integral calculus)

Credit 3

EQAS-761 **Reliability**
Registration #0307-761
A methods course in reliability practices: What a reliability engineer must know about reliability predictions, estimation, analysis, demonstration, and other reliability activities. Covers most methods presently being used in industry. Topics: applications of normal, binomial, exponential, and Weibull graphs to reliability problems; hazard plotting; reliability confidence limits and risks; strength and stress models; reliability safety margins; truncated and censored life tests; sequential test plans; Bayesian test programs. (Fund, of Statistics II EQAS-712)

Credit 3

EQAS-781 **Quality Management**
Registration #0307-781
A course designed to cover concepts and methods of quality management. Topics include: basic concepts, history of quality control, quality policy, economics of quality, quality costs, organization for quality, design for system effectiveness, manufacturing planning for quality, and quality data systems.

Credit 3

EQAS-782 **Quality Engineering**
Registration #0307-782
A course designed to cover important elements of quality engineering. Topics include: specifications, statistical tolerancing, measurement, vendor relations, process control, motivation, customer relations, diagnostic techniques, process improvement studies, and quality planning. (Consent of the Department)

Credit 3

EQAS-783 **Quality Engineering by Design**
Registration #0307-783
The Taguchi Method of off-line control including parameter design and tolerance design leading to improved products and processes at lower costs. (Design of Experiments II EQAS-802)

Credit 3

EQAS-791 **Statistical Methods in Health Sciences**
Registration #0307-791
A course designed as an introduction to statistical methods for those involved in the health sciences. Topics include: types of biological data, descriptive statistics, tests of significance, experimental design, tests of association, relative risk, diagnostic tests. (Fund, of Statistics II EQAS-712)
Credits

EQAS-792 **Biological Assays**
Registration #0307-792
An advanced course in biostatistics which deals with the important research concerns of identifying and verifying drug-dose response. Topics include: parallel-line assays, slope-ratio assays, quantal response assays. (Design of Experiments II EQAS-802)
Credit 3

EQAS-801 **Design of Experiments I**
Registration #0307-801
How you design and analyze experiments in any subject matter area; what you do and why. Topics: basic statistical concepts, scientific experimentation, completely randomized design, randomized complete block design, nested and split plot design. Practical applications to civil engineering, pharmacy, aircraft, agronomy, photo-science, genetics, psychology, and advertising. (Fund, of Statistics EQAS-712)
Credit 3

EQAS-802 **Design of Experiments II**
Registration #0307-802
Continuation of EQAS-801. Topics: factorial experiments; fractional, three-level, and mixed factorial designs; response surface exploration. Practical applications to: medical areas, alloys, highway engineering, plastics, metallurgy, animal nutrition, sociology, industrial and electrical engineering. (Design of Experiments I EQAS-801)

Credit 3

EQAS-821 **Theory of Statistics I**
Registration #0307-821
Provides a sound theoretical basis for continuing study and reading in statistics. Topics: constructs and applications of mathematical probability; discrete and continuous distribution functions for a single variable and for the multivariate case; expected value and moment generating functions; special continuous distributions. (Fund, of Statistics II EQAS-712 or consent of the Department)
Credit 3

EQAS-822 **Theory of Statistics II**
Registration #0307-822
Continuation of EQAS-821. Topics: supporting theory for and derivation of sampling distribution models; applications and related material; point estimation theory and applications; the multivariate normal probability model, its properties and applications; interval estimation theory and applications. (Theory of Statistics I EQAS-821)

Credit 3

EQAS-824 **Probability Models**
Registration #0307-824
An introduction to probability theory and stochastic processes. Topics include: random variables, conditional probability and expectation, Markov chains, renewal theory, queuing theory, and reliability. (Theory of Statistics I EQAS-821)

Credit 3

EQAS-830 **Multivariate Analysis I**
Registration #0307-830
This course deals with the summarization, representation, and interpretation of data sampled from populations where more than one characteristic is measured on each sample element. Usually the several measurements made on each individual experimental item are correlated and certainly one should riot apply univariate analysis to each measurement separately. This course covers the use of the basic multivariate techniques. Computer problems solving will be emphasized. Topics will include: multivariate t-tests, ANOVA, MANOVA, regression analysis, repeated measures, quality control, and profile analysis. (Design of Experiments II EQAS-802)

Credit 3

EQAS-831 **Multivariate Analysis II**
Registration #0307-831
A continuation of EQAS830, this course covers the use of advanced multivariate techniques. Topics include: principal component analysis, cluster analysis, multi-dimensional contingency tables, discrete discriminant analysis, multi-dimensional scaling, and regression with errors in the independent variable. Practical applications will be emphasized. (Multivariate Analysis I EQAS-830)
Credit 3

EQAS-841 **Regression Analysis I**
Registration #0307-841
A methods course dealing with the general relationship problem. Topics include: the matrix approach to simple and multiple linear regression; analysis of residuals; dummy variables; orthogonal models; and computational techniques. (Design of Experiments I EQAS-801 and statistical computing EQAS-742)

Credit 3

EQAS-842 **Regression Analysis II**
Registration #0307-842
A continuation of EQAS-841. Topics: selection of best linear models; regression applied to analysis of variance problems; non-linear estimation; and model building. (Regression Analysis I EQAS-841)
Credit 3

EQAS-851 **Nonparametric Statistics**
Registration #0307-851
Distribution-free testing and estimation techniques with emphasis on application. Topics: sign tests; Kolmogorov-Smirnov statistics; runs tests; Wilcoxon-Mann-Whitney test; chi-square tests; rank correlation; rank order tests; quick tests. (Fund, of Statistics II EQAS-712)
Credit 3

EQAS-853 **Managerial Decision Making**
Registration #0307-853
Statistical decision analysis for management. Topics: utilities; how to make the best decision (but not necessarily the right one); normal and beta distributions; Bayesian theory; many action problems; optimal sample size; decision diagrams. Applications to marketing; oil exploration; portfolio selection; quality control; production; and research programs. (Fundamentals of Statistics II EQAS-712)
Credit 3

EQAS-856 **Interpretation of Data**
Registration #0307-856
Advanced topics related to use of statistics in investigational analysis, including: narrow limit gauging, practical design of experiments, analysis of small sample data, analysis of means, identifying assignable causes, and other methods for troubleshooting with statistical methods. (Design of Experiments I EQAS-801)
Credit 3

EQAS-864 **Advanced Acceptance Sampling**
Registration #0307-864
An advanced course in acceptance control techniques including: basis of acceptance sampling; attributes plans; variables plans for process parameters; variables plans for proportion non-conforming; sampling schemes including MIL-STD-105D and MIL-STD-414; plans for special applications; rectification and continuous procedures; cumulative results plans; compliance sampling; reliability sampling; and administration of sampling plan. (Statistical Quality Control II, EQAS-731)
Credit 3

EQAS-871 **Sampling Theory and Applications**
Registration #0307-871
An introduction to sample surveys in many fields of applications with emphasis on practical aspects. Topics: review of basic concepts, sampling problem elements; sampling; random, stratified, ratio, cluster, systematic, two-stage cluster; wild life populations, questionnaires, sample sizes. (Fund, of Statistics II, EQAS-712)
Credit 3

EQAS-873 **Time Series Analysis**
Registration #0307-873
A methods course in modeling and forecasting of time series with emphasis on model identification, model fitting, and diagnostic checking. Topics: survey of forecasting methods, regression methods, moving averages, exponential smoothing, seasonality, analysis of forecast errors, Box-Jenkins models, transfer function models, case studies. (Regression Analysis I EQAS-841)
Credit 3

EQAS-875 **Empirical Modeling**
Registration #0307-875
A course in model building based on the application of empirical data gathered through appropriate experimental design and analyzed through regression techniques. Topics: response variable construction, experimental design methods, and related analysis techniques. (Design of Experiments II EQAS-802 and Regression Analysis I EQAS-841)
Credit 3

EQAS-881 **Bayesian Statistics**
Registration #0307-881
An introduction to Bayesian statistics and decision making which explores Bayes' Theorem in its relation to classical and Bayesian methodology. Topics: probability, Bayes' Theorem, assessment of prior probabilities and likelihoods, hypothesis testing, and the multivariate case. (Fund, of Statistics II EQAS- 712)
Credit 3

EQAS-886 **Sample Size Determination**
Registration #0307-886
The question most often asked of an industrial statistician is "What size sample should I take?" This course answers that question for a wide variety of practical investigational projects. Techniques for the full use of the optimal sample evidence are also offered. (Fund, of Statistics II EQAS-712 and Design of Experiments I EQAS-801)
Credit 3

EQAS-889 **Independent Study Project**
Registration #0307-889
Three or six but not more than nine credit hours. Credit will be assigned at the discretion of the candidate's advisor, 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 changed or augmented at the discretion of the candidate's advisor before approval is given for the candidate to proceed.
Credit 3, 6, or 9

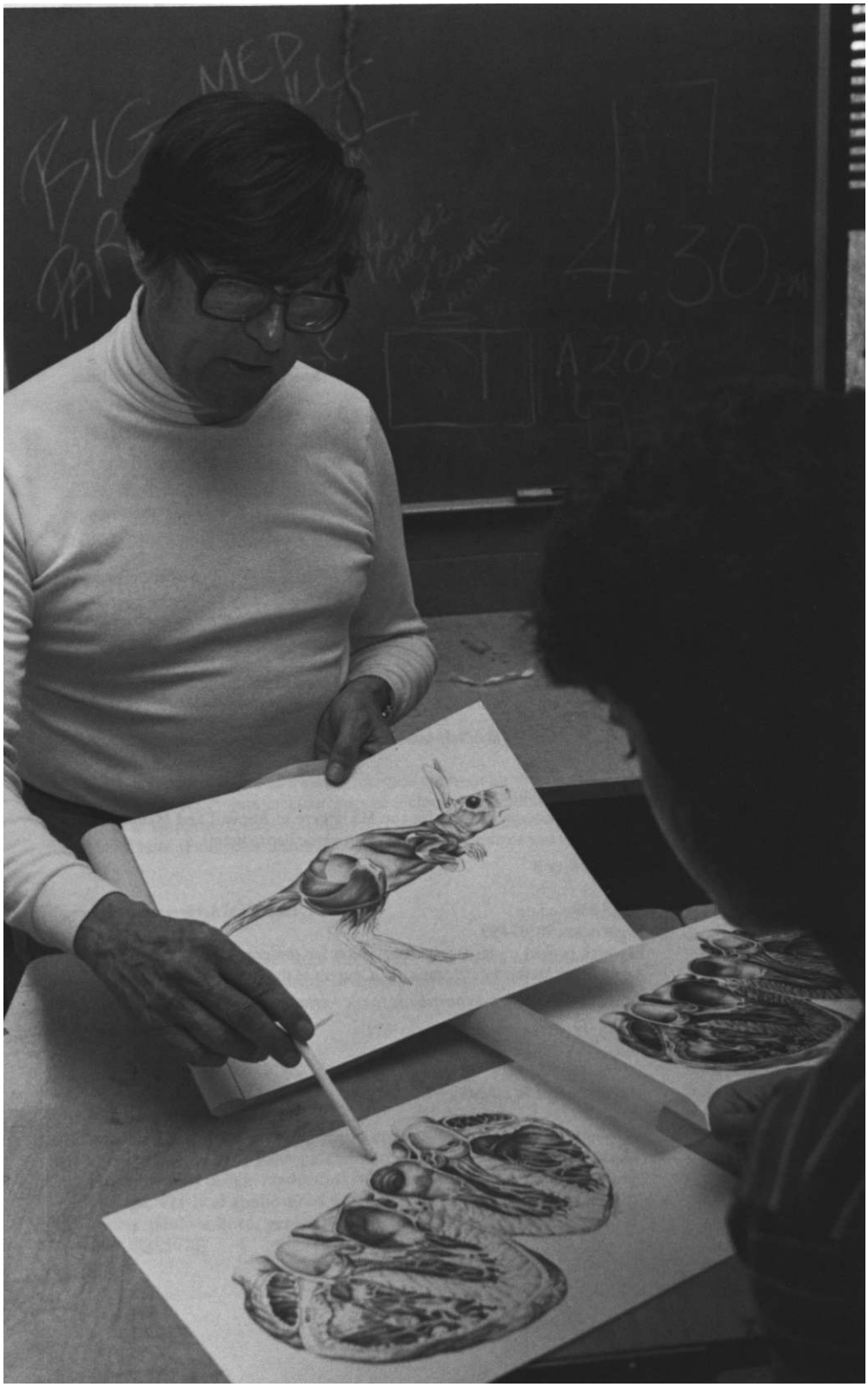
EQAS-891 **Special Topics in Applied Statistics**
Registration #0307-891
These courses provide for the presentation of subject matter of important specialized value in the field of applied and mathematical statistics not offered as a regular part of the statistics program. Section 02, Mixture Designs; Section 03, Scaling Methods; Section 04, Repairable Systems Reliability; Section 05, Time Series Analysis II. (Consent of the department)
Credit 3 each course

EQAS-895 **Statistics Seminar**
Registration #0307-895
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 or 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

EQAS-896 **Thesis**
Registration #0307-896
Thesis for students working for the MS degree in Applied and Mathematical Statistics for one to nine credits. (Consent of the department)
Credit 3,6, or 9

EQAS-899 **Individual Achievement Project**
Registration #0307-899
Research project under faculty supervision for students working for the MS in Applied and Mathematical Statistics. (Consent of the department)
Credit Variable 1-9

College of Fine and Applied Arts



Peter Giopulos, Acting Dean
Joanne Szabla, Acting Associate Dean
(475-2634)

Master of Fine Arts
Master of Science for Teachers

In the College of Fine and Applied Arts there are 13 possible concentrations of study for the artist, designer or craftsman. The School of Art and Design offers programs in industrial design, interior design, graphic design, medical illustration*, painting, printmaking, and computer graphics design*. Students are prepared to operate their own studios and shops, to be self-employed professionals, and to work in business and industry as artists and designers. It prepares graduates to teach at elementary and secondary levels through a concentration in art education. In the School for American Craftsmen, there are five studio concentrations for a professional career through the crafts: ceramics and ceramic sculpture, glass, metalcrafts and jewelry, weaving and textile design, woodworking and furniture design.

The College of Fine and Applied Arts provides a center for advanced study in the graphic, plastic and the fine arts in which the student has the opportunity to work in a professional environment; it stimulates and encourages work of the highest quality. Students of superior ability who possess a baccalaureate degree in art, crafts or design may increase their competence in the field of their major interest under the guidance of accomplished professional artists and craftsmen. For those students who have a background in graphic design, industrial design, interior design, painting, sculpture, printmaking, illustration, computers or one of the five craft areas, there is opportunity to develop new areas of competence. The master's programs are also designed to enable students to broaden their experience in the practice of art in areas other than their majors and to increase their understanding of the arts in the humanistic sense. Students are expected to participate in the planned non-credit program of assemblies, seminars, and exhibits as well as their formal class requirements.

**Only MFA in Medical illustration and Computer Graphics Design.*

Graduate degrees
The College of Fine and Applied Arts offers two graduate degrees. The master of science for teachers may be taken in nine studio areas and, in addition, in art education. The art education concentration leads toward permanent art N-12 certification to teach in the public schools of the State of New York and involves pedagogical studies and student teaching. The MST in Art Education is a September to May program. The master of science for teachers may also be pursued in the studio areas of graphic design, industrial design, interior design, painting, printmaking, ceramics and ceramic sculpture, glass, metalcrafts and jewelry, weaving and textile design and woodworking and furniture design. This MST in studio may also lead to certification if provisional or temporary certification has been previously earned as an undergraduate. Students may select the summer option or one year full-time study for this studio concentration.

The second graduate degree is the master of fine arts, considered the highest degree of study in the studio arts. This involves the presentation of a thesis and usually requires two years of full-time study.

Objectives
The MFA and MST programs are constituted to reflect the goals of Rochester Institute of Technology.

The programs are designed to graduate artists, designers, craftsmen and teachers who are cognizant of the contemporary situation and desire to better it by devotion to their work and high standards of personal discipline.

Requirements for admission to the MST degree programs
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. Applicants with different backgrounds should refer to the section on non-matriculated students. 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 included the studio course distribution required by the New York State Education Department. For those holding the BS degree in art education and the provisional certification, the graduate concentration should be in the studio area, and the program must include a minimum of 10 quarter credit hours in liberal studies or humanities.

A student is accepted into the program with the understanding of full-time status unless granted part-time status at admission.

Requirements for admission to the MFA degree programs
The applicant should hold the baccalaureate degree in a field of the arts, science or education from a regionally accredited college in the United States or Canada and demonstrate, in the quality of the undergraduate record and creative production, a genuine, professional potential. (See also non-matriculated students.) The undergraduate degree should include 75 quarter credit hours (50 semester hours) in studio courses.

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 students will receive prior to admission as a graduate student. Extended study may require additional time on campus.

Human Gross Anatomy and biology or equivalent content is necessary for the MFA in medical illustration. Human Gross Anatomy is taught by the University of Rochester, and a surcharge for tuition is required.

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.

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 or industrial arts in the State of New York can achieve permanent certification within the structuring of the master of science for teachers program (studio concentration) or the master of fine arts.

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

Those coming from foreign countries where the baccalaureate is not given for programs in the practice of art may be admitted to graduate study if the diploma or certificate received approximates the standards of the BFA, BA, or BS degrees, and their academic records and portfolios indicate an ability to meet graduate standards.

Studio residence program
The School for American Craftsmen offers a craft residence program. Residence will be accepted in ceramics and ceramic sculpture, weaving and textile design, metalcrafts and jewelry design, woodworking and furniture design and the glass studios. This is an opportunity for the development of craft skills and aesthetic concepts.

Residence positions are limited and will be awarded by portfolio, transcript, references and a statement of purpose. An interview is required. Accepted candidates are required to enroll for at least six credits of audit per quarter, be present in the studio during class hours and contribute up to six hours of work in the studio area. In exchange, the school will provide work space, excellent equipment and supportive tutorial instruction. The resident is invited to participate in visiting artists sessions, lectures and all other studio activities.

Participants may be graduates continuing preparation for graduate study, early career professionals developing techniques and designs for production in their own future studios, or teachers on leave who wish to work again in an academic environment.

Inquiries should be made to Residence Program, College of Fine and Applied Arts, Rochester Institute of Technology, James E. Booth Building, P.O. Box 9887, Rochester, N.Y. 14623-0887.

Admission procedure

To apply for admission to graduate study a student must submit evidence of his or her baccalaureate degree, a portfolio of 20-24 slides or other evidence of creative work, a statement of purpose, and references.

All correspondence concerning applications, catalogs and portfolios should be addressed to Director of Admissions, Rochester Institute of Technology. Program inquiries should be addressed to Graduate Programs, College of Fine and Applied Arts.

Transfer of credit

Graduate work pursued 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 College of Fine and Applied Arts reserves 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.

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, the Institute at large, and to inform and inspire the college's graduate body.

The Faculty Show, Graduate Thesis Shows, and Student Honors Show are annual events on the gallery calendar.

The MFA and MST degrees

The MFA degree is designed as a professional degree for the practicing artist, craftsman, or designer, and for those wishing to teach at the college or university level. This is earned normally in two years of full-time study and the completion of a minimum of 90 credit hours including the presentation of an acceptable thesis. Those who have entered the MST program and who may wish to change to the MFA program must petition the graduate faculty for permission to change the degree objective. In view of the pronounced difference in entrance requirements, students requesting a transfer from MST to the MFA program may be required to take additional undergraduate or graduate courses. Such students must also have demonstrated their professional potential by establishing a "B" average (3.0) in at least one quarter (or one summer session) of the MST course of study.

The MST degree may be earned normally in one academic year or in summer sessions through the satisfactory completion of a minimum of 48 credit hours in course work. It is arranged for the student holding the BFA degree (or a BA degree with an art major) who wishes to earn teacher certification, or who holds provisional certification (with a BS or BA degree in art or industrial arts education) and seeks permanent certification. The MST degree may also be taken as a concentration in the studio areas with supporting courses on the basis of need and interest from graduate offerings in other schools and departments of the Institute. This major in art education integrates public school teaching, social sciences and studio classes. In contrast, the studio MST candidate selects one of the nine art areas: graphic design, industrial design, interior design, painting, printmaking, ceramics, metals, textiles, wood or glass. Summer sessions can accommodate teachers seeking permanent certification through study in an art area. The art education concentration has a September start, and is earned in one academic year.

Attendance regulations

The programs of the college utilize the studios 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.

Peter Giopulos

Graduate art students 'usually know where they're going'

"Today's art student is notjust interested in courses, but in a program of study that's well planned," says Peter Giopulos, acting dean in the College of Fine and Applied Arts.

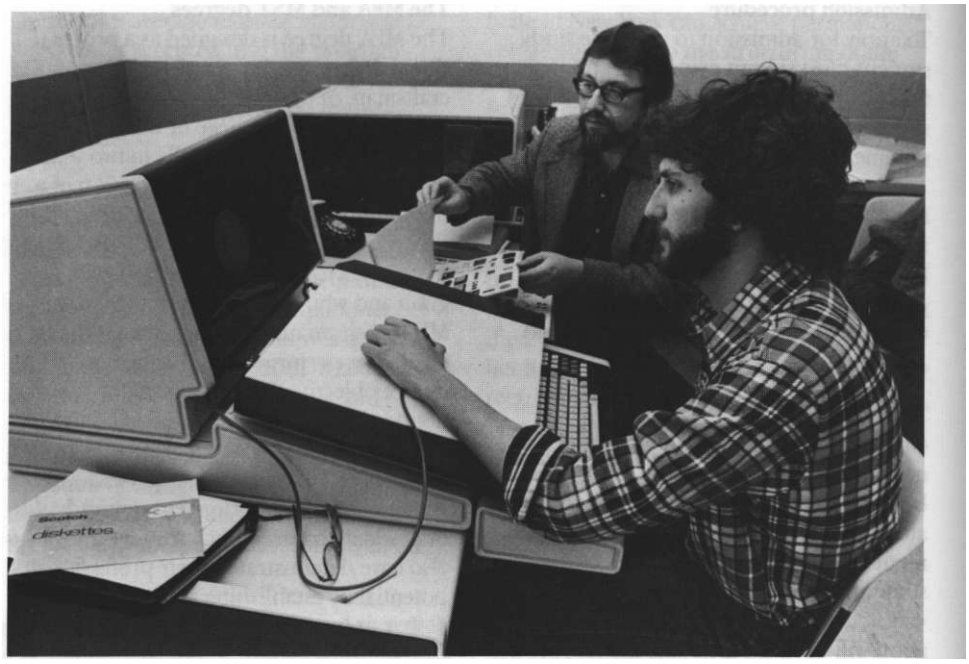
"Most of our graduate students have been through an experimental stage, both in their lives and in their creative work. They've learned how to bring that experimentation into focus, whether personally or artistically. And they usually know where they're going."

RIT offers a variety of graduate programs through the School for American Craftsmen and the School of Art and Design, but all of them, Giopulos says, have "depth within the major and allow for a minor sequence and electives, which are available from many other programs."

In the graduate program, study is geared to the person "who has gained a marketable skill as an undergraduate or in other previous experience," Giopulos says. "These are people with very definite ideas about where they're going artistically."

Giopulos is a graduate of Syracuse University (BFA), and Pennsylvania State University (M.Ed., Ph.D.). He has been on the faculty of the College of Fine and Applied Arts, and has been named acting dean of that college and coordinator of graduate programs.

The programs



The **Master of Fine Arts** program includes six categories of study:

1. Major concentration Designed to give depth of experience in the area of the student's major interest and chosen from one of the thirteen areas: ceramics and ceramic sculpture, metalcrafts and jewelry, woodworking and furniture design, weaving and textile design, glass, industrial design, interior design, graphic design, fine art (painting), fine art (printmaking), medical illustration, computer graphics design.	30 cr.
2. Minor Concentration* From the above, to consist of studio and related electives other than major.	15
3. Electives	18
4. Graduate Forum	3
5. Humanities, art history	10
6. Thesis	14
Total	90 cr.

Graphic Design graduates may consider a minor in the American Video Institute, where an advanced certificate in electronic and optical storage applications can be earned. Application to AVI's certificate is required, and upon acceptance the student will enroll in 22 quarter credits of study. This will have an impact on the minor and electives in the MST or MFA degree in graphic design. Students blend graphic design into videodisc systems, image-bank management, advanced video, optical disc storage, moving imagery and communication theory. See page 26 for further information.

The Master of Science for Teachers program requirements include two categories of studies:

MST ART EDUCATION

1. Master of Science for Teachers in *art education* for those holding the BFA or BA (art major) degree and seeking permanent certification for teaching in the public schools.

The degree offers a concentration consisting of background courses in Education, Psychology and Sociology	20 cr.
Art Education Concentration: Methods and Materials in Art Education, Seminar in Art Education, Practice Teaching	22
Studio electives	6
Total	48 cr.

MST STUDIO

2. Master of Science for Teachers in *studio art* (for those holding the BS degree in art education or industrial arts education, who desire permanent certificates, or for the BA or BFA student wishing advanced study).

The degree offers a major concentration of studies designed to meet the needs of individual students, and may include appropriate or relevant courses from other schools and departments of the Institute.

The following general pattern of studies covers requirements for the degree.

Major Concentration:	
Studio art, or crafts	24 cr.
Humanities, art history	10
Minor Concentration	9
Electives	5
Total	48 cr.

The City Center

The College of Fine and Applied Arts graduate painting is housed in downtown Rochester's historic area, within its cultural, education, and business center, at 50 West Main Street. This provides students who enroll in these programs with stimulating surroundings, city resources, and ample work space.

	MFA	MST STUDIO	MST ART EDUCATION
Major	30 credits	24 credits	22 credits
Minor	15	9	
Humanities	10	10	20 Social Sciences
Graduate Forum	3		
Electives	18	5	6
Thesis	14		
	90 credits	*48 credits	**48 credits

*Oneyear or summers
**September start only

*In certain cases the minor concentration or courses may be taken elsewhere in the Institute (photography, printing) when related to the objectives of the student. Such courses must be approved in advance, normally after arrival on campus, by the advisor and the deans of the colleges involved. The minor supports the spirit of the MFA degree.

Portfolio Guidelines For Graduate Applicants

The following guidelines are presented for all graduate students applying to the College of Fine and Applied Arts* Presentation of the portfolio is one of the requirements used in totally assessing the performance and academic capabilities of the applicant.

1. The portfolio should contain examples of at least 20-24 pieces of the applicant's best work—35mm slides are preferred, displayed in an 8 ½" x 11" vinyl slide protector page.

2. Slides will be returned by the College of Fine and Applied Arts only when return postage is enclosed.

3. While every precaution will be taken to insure proper care and handling, the Institute assumes no responsibility for loss or damage to slides.

4. Identify slides by name and address. Please send portfolio and all other application materials to:

Rochester Institute of Technology
Office of Admissions
Bausch & Lomb Center
Box 9887
Rochester, New York 14623-0887
Telephone: (716) 475-6631

**Major courses for art education, computer graphics design and medical illustration are offered only during Fall, Winter and Spring Quarters. Art education applicants should arrange a personal interview with Dr. Joanne Szabla, acting associate dean, College of Fine and Applied Arts, (716) 475-2634.*

Graduate Faculty College of Fine and Applied Arts

Peter Giopulos, Ph.D., Pennsylvania State University—Professor, Acting Dean

Joanne Szabla, Ph.D., Walden University—Professor, Acting Associate Dean

Philip W. **Bornarth,** MAE School of the Art Institute of Chicago—Professor, Painting, School of Art and Design

Donald G. Bujnowski, MA, University of Minnesota—Professor, Weaving and Textile Design, School for American Craftsmen

Wendell Castle, MFA, University of Kansas—Artist-in-Residence, Chair; School for American Craftsmen; Professor

Nancy A. **Chwiecko,** MFA, Rochester Institute of Technology—Visiting Assistant Professor, Interior Design, School of Art and Design

David Dickinson, MFA, Rochester Institute of Technology—Professor, Printmaking, School of Art and Design

Robert Heischman, U.C.F.A., Ruskin School of Drawing and Fine Art, Oxford University—Professor, Painting, School of Art and Design

Glen R. Hintz, MS, The Medical College of Georgia—Assistant Professor, Medical Illustration; School of Art and Design

Richard Hirsch, MFA, Rochester Institute of Technology—Associate Professor, Ceramics, School for American Craftsmen

Barbara Hodik, BS Ed., Benedictine College; MA, New York University; Ph.D., Pennsylvania State—Professor, Art Education, School of Art and Design

Robert H.Johnston, Ph.D., Pennsylvania State University—Professor

Robert K. Keough, MFA, Rochester Institute of Technology—Professor, Computer Graphics Design, School of Art and Design

William Keyser, MFA, Rochester Institute of Technology—Professor, Woodworking and Furniture Design, School for American Craftsmen

Max Lenderman, MFA, University of Kansas; MS, Indiana State University—Professor, Weaving and Textile Design, School for American Craftsmen

Craig McArt, MFA, Rochester Institute of Technology—Professor, Industrial Design, School of Art and Design

Edward C. Miller, BFA, SUNY at Buffalo; MFA, Illinois State—Associate Professor, Painting, School of Art and Design

Albert Paley, MFA, Tyler School of Art—Artist-in-Residence, The Charlotte Fredericks Mowris Chair in Contemporary Craft; School for American Craftsmen; Professor

R. Roger Remington, MS, University of Wisconsin—Professor, Graphic Design, School of Art and Design

Robert Schmitz, MFA, University of Wisconsin; MS, Alfred University—Professor, Ceramics, School for American Craftsmen

James H. Sias, MA, Michigan State University—Professor, Industrial Design, School of Art and Design

Douglas Sigler, MFA, Rochester Institute of Technology—Professor, Woodworking and Furniture Design, School for American Craftsmen

Mark Stanitz, MA, Kent State University-Assistant Professor, Metalcrafts and Jewelry, School for American Craftsmen

Michael Taylor, MFA, East Tennessee State University—Associate Professor, Glass, School for American Craftsmen

Toby Thompson, MFA, Rochester Institute of Technology—Professor, Industrial Design and Interior Design, School of Art and Design

Leonard A. **Urso,** MFA, State University of New York at New Paltz—Assistant Professor, Metalcrafts and Jewelry, School for American Craftsmen

James C. **Ver Hague, Jr.** MFA, State University of New York at Buffalo; MS, Rensselaer Polytechnic Institute—Professor, Computer Graphics Design, School of Art and Design

Robert Wabnitz, Diploma, Rochester Institute of Technology—Professor, Medical Illustration, School of Art and Design

Lawrence Williams, MFA, University of Illinois—Professor, Printmaking, School of Art and Design

Norman Williams, MS, Syracuse University—Professor, Art Education, School of Art and Design

School of Art and Design

Industrial Design and Interior Design name change pending approval of New York State Education Department.

Courses for the education concentration of the MST program are offered through the College of Liberal Arts, and course descriptions are given under that heading with a Liberal Arts call number.

Art Education

FADE-701, 702 (MST) **Methods and Materials in Art Education**
Registration #0401-701, 702 **(Major)**
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.

Class 2, Lab 9, Credit 5 (F, W) (offered on sufficient demand)

FADE-820 (MST) **Seminar in Art Education**
Registration #0401-820 **(Major)**
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.

Lab 25, Credit 3 (S) (offered on sufficient demand)

FADE-860 (MST) **Practice Teaching in Art**
Registration #0401-860 **(Major)**
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)

Graphic Design

FADG750 **Graphic Design**
Registration #0402-750 **(Minor, Elective)**
Advanced creative problem-solving experiences in a professional studio setting

Lab 6, Credit 3 (offered every quarter)

FADG780 **Graphic Design**
Registration #0402-780 **(Major)**
Advanced creative problem-solving experiences in a professional studio setting. This course places emphasis on graphic design history, theory, methodology, verbal skills, a formal approach to visual aesthetics, and a balanced approach to use of media. Problems are both theoretical and applied on an individual and group basis. Media Center and computer graphics studio available.

Lab 9-27, Credit 3-9 (offered every quarter)

Computer Graphics Design

FADG-780 **Introduction to Computer Graphics Design**
Registration #0432-780 **(MFA Major)**
An introduction to computer graphics. Basic familiarity with using the keyboard, CRT, disk drive, tablet, printer, plotter and image digitizer to create imagery.

Lab 9, Credit 3 (offered each year)

FADG-781 **Two-Dimensional Computer Graphics Design**
Registration #0432-781 **(MFA Major)**
Exposure to computer graphic algorithms, design heuristics, design methodology, and program structures for two-dimensional imagery. Projects involve programming in PostScript.

Lab 9, Credit 3 (offered each year)

FADG-782 **Three-Dimensional Computer Graphics Design**
Registration #0432-782 **(MFA Major)**
Extension of previous experience to include three-dimensional objects, hidden lines and surfaces, solid modelling, perspective. Projects involve complex programming in PostScript.

Lab 9, Credit 3 (offered each year)

FADG-783 **Visual Semiotics/Graphic Design**
Registration #0432-783 **(MFA Major)**
The application of syntactic, semantic and pragmatic levels of visual design activities. These concepts will be applied to creative projects utilizing the computer as the primary tool.

Lab 9, Credit 3 (offered each year)

FADG-784 **Digital Typography (MFA Major)**
Registration #0432-784
A study of the evolution of typography, typesetting and typesetting systems from metal type through photo typesetting to today's digital typesetting. Hands-on experiences in production typesetting, including digital typesetting, word processing and prepress planning for accurate typographic reproduction.

Lab 9, Credit 3 (offered each year)

FADG-785 **Computer-Generated Slide Design**
Registration #0432-785 **(MFA Major)**
The design of slides for business graphics and audio-visual presentations. Hands-on experience with a sophisticated computer graphics system for the generation of high resolution slides. Emphasis on both commercial production concerns and creative problem solving.

Lab 9, Credit 3 (offered each year)

FADG-786 **Computer-Generated Animation**
Registration #0432-786 **(MFA Major)**
Extension of computer generated slide design using keyframe animation techniques to automatically create frames for film, video or multi-image slide presentations.

Lab 9, Credit 3 (offered each year)

FADG-787 **Advanced Computer Graphics Design**
Registration #0432-787 **(MFA Major)**
Advanced explorations of computer graphic applications. Projects include such topics as computer generated layout, digital type development, computer-aided instruction lessons, TV and electronic mail promotions and computerized animation.

Lab 27, Credit 9 (offered each year)

Industrial and Interior Design

FADD-750 **Industrial and Interior Design**
Registration #0403-750 **(Minor, Elective)**
The reasoned application of theoretical and practical background to advanced projects in industrial and interior design.

Lab 6, Credit 3 (offered every quarter)

Industrial Design

FADU-780 **Industrial Design**
Registration #0442-780 **(Major)**
Selected projects in industrial design which allow individual application of design methodology and technical skills toward professional goals. Selection of the projects is directed at providing an adequate background for development of the master's thesis.

Lab 9-27, Credit 3-9 (offered every quarter)

Interior Design

FADI-780 **Interior Design**
Registration #0444-780 **(Major)**
Selected projects in interior design which allow individual application of design methodology and technical skills toward professional goals. Selection of the projects is directed at providing an adequate background for development of the master's thesis.

Lab 9-27, Credit 3-9 (offered every quarter)

Painting

FADP-750 **Painting**
Registration #0405-750 **(Minor, Elective)**
Study of present techniques and concepts in painting and the relation to the tradition of painting. Development of painting skills in a chosen medium.

Lab 6, Credit 3 (offered every quarter)

FADP-750 **Illustration**
Registration #0405-750 **(Painting Minor, Elective)**
An elective exploring the art of illustrators, their relation to audience, publishers, and media. Studio problems will develop and expand basic concepts of illustration.

Lab 6, Credit 3 (offered each year)

FADP-750 **Drawing Problems**
Registration #0405-750 **(Painting Minor, Elective)**
Individual drawing projects related to graduate students' major area of study. Opportunity to refine drawing skills on the graduate level.

Lab 6, Credit 3 (offered each year)

FADP-780 **Painting**
Registration #0405-780 **(Major)**
Development of mastery of a permanent painting medium and related preparatory study. Examination of ideas and relationships in the field of painting with emphasis upon individual creative solutions.

Lab 9-27, Credit 3-9 (offered every quarter)

Printmaking

FADR-750 **Printmaking**
Registration #0406-750 **(Minor, Elective)**
Advanced techniques in etching, lithography and woodcutting, as well as in many experimental areas including color processes, photoetching, photolithography, paper making and combination printing. Students are expected to develop along independent lines, and direction is offered in contemporary thought and concept. The emphasis is toward developing a complete respect for the printmaking craft and profession.

Lab 6, Credit 3 (offered every quarter)

FADR-780 **Printmaking**
Registration #0406-780 **(Major)**
Contemporary and historical printmaking concepts are presented as stimulant and provocation for the development of an individual approach to expression. Advanced techniques are demonstrated in intaglio, relief and lithography with resources available in non-silver photo processes, paper making and combinations. A complete understanding of the development and maintenance of the print studio is supportive for the professional artist. The work leads toward the master's thesis.

Lab 9-27, Credit 3-9 (offered every quarter)

Sculpture

FADS-750 **Sculpture**
Registration #0407-750 **(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.

Lab 6, Credit 3 (offered each year)

Medical Illustration

FADM-781 **Medical Illustration Topics I**
Registration #0408-781 **(MFA Major)**
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 audiovisual television supporting milieu in which the medical illustrator works.

Lab 6, Credit 3 (offered each year)

FADM-782 **Medical Illustration Graphics and Exhibits**
Registration #0408-782 **(MFA Majors)**
A course emphasizing the use of titles, animation, charts and graphs, schematics, and illustrative procedures as vehicles for meeting instructional and communicative needs. Students will learn the various techniques available and will apply those techniques while constructing three-dimensional illustrations for in-house presentation for traveling displays. In addition, students will learn to plan and cost analyze their illustrative exhibits.

Lab 6, Credit 3 (offered each year)

FADM-783 **Medical Illustration Anatomical Studies**
Registration #0408-783 **(MFA Major)**
A study of pathological specimens and human dissection using colored pencil, pen and ink, carbon dust, and airbrush. Emphasis will be on rapid but accurate sketching and observation in the laboratory with a representation of form and structure in living tissue for the preparation of surgical procedures.

Lab 6, Credit 3 (offered each year)

FADM-784 **Medical Illustration Topics II**
Registration #0408-784 **(MFA Major)**
A course emphasizing photographic techniques as employed in medical illustration. Students will learn to use the copystand and various films to reproduce continuous tone, black and white, and color artwork. The copystand and other lighting techniques will be introduced for photographing anatomical specimens, models, and surgical instruments. Combining photographic images and processes with illustrative techniques also will be explored.

Lab 6, Credit 3 (offered each year)

FADM-785 **Medical Illustration Surgical Procedures I**
Registration #0408-785 **(MFA Major)**
The application of illustrating and photographing in the operating room. The student will become familiar with the organization of operations with his or her role as a medical illustrator. Sketches are to be drawn directly from the observation of surgery, consulting with the surgeon for accuracy of detail and development. The final preparation of the art work will be submitted for publication or portfolio.

Lab 6, Credit 3 (offered each year)

FADM-786 **Medical Illustration Surgical Procedures II**
Registration #0408-786 **(MFA Majors)**
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 art work will meet the demands of reproduction.

Lab 6, Credit 3 (offered each year)

Thesis

FAD(C, P, R, M, G, I or U>-890 **Research and Thesis Guidance**
Registration #040(2, 5,6,8,32,42, or 44)390 **(MFA Major)**
The development of a thesis project initiated by the student and approved by a faculty committee and the special assistant to the dean for graduate affairs. Primary creative production, the thesis must also include a written report and participation in a graduate thesis show.

Lab 942, Credit 3-14 (offered every quarter)

FASA-785 **Forms of Inquiry**
Registration #0420-785 **(Required for MFA)**
The exploration and organization of forms of inquiry in the fields of art, craft and design.

Class 2, Credit 2 (offered each year)

FASA-790 **Graduate Forum**
Registration #0420-790 **(Required for MFA)**
The presentation and discussion of issues in aesthetics, criticism, creativity and perception as they relate to art, design and craft will be undertaken. Points of view to be clarified through critical writing. Required for MFA; to be taken prior to Thesis.

Class 2, Credits

School for American Craftsmen

Ceramics and Ceramic Sculpture

FSCC-750 **Ceramics and Ceramic Sculpture**
Registration #0409-750 **(Minor, 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.

Lab 6, Credit 3 (offered every quarter)

FSCG780 **Ceramics and Ceramic Sculpture**
Registration #0409-780 **(Major)**
A program structured on the basis of individual 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 ceramic expression. The student will be encouraged to evaluate new techniques, materials and concepts. This sequence leads to the master's thesis, suggested by the student and approved by the faculty.

Lab 9-27, Credit 3-9 (offered every quarter)

Glass

FSCG-720 **Stained Glass**
Registration #0411-720 **(Minor, Elective)**
An elective providing exploration of personal approaches to visual expression and techniques in flat glass. Technical processes may incorporate all hot and cold processes used in glass.

Lab 6, Credit 3 (offered each year)

FSCG-750 **Glass**
Registration #0411-750 **(Minor, 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, neon, engraving, sand carving, cutting, electroplating, lamp working and sculptural construction. Course emphasis on personal, independent development encouraging contemporary thought and concept.

Lab 6, Credit 3 (offered every quarter)

FSCG-780 **Glass**
Registration #0411-780 **(Major)**
A program structured on the basis of individual needs, interests and background preparation as they may be determined through faculty counseling. All technical processes and techniques are to be considered relevant. The course is structured to provide a foundation for professional creativity and to encourage exploration of personal concepts relating to the presentation of a body of visual work. This sequence leads to the master's thesis, suggested by the student and approved by the faculty.

Lab 9-27, Credit 3-9 (offered every quarter)

Metalcrafts and Jewelry

FSCM-750 **Metalcrafts and Jewelry**
Registration #0412-750 **(Minor, Elective)**
This is the study and manipulation of metals for hollowware/jewelry. Design sensitivity and concepts are approached through the raising, forming and planishing or casting, forging, and fabricating techniques.

Lab 6, Credit 3 (offered every quarter)

FSCM-780 **Metalcrafts and Jewelry**
Registration #0412-780 **(Major)**
A program structured on the basis of individual needs, interests and background preparation as they may be determined through faculty counseling. Both hollowware and jewelry areas will be explored. It is designed to give the student a broad exposure to metalworking techniques, expand the student's knowledge of applied design, strengthen perceptual and philosophical concepts and develop an individual mode of expression. This sequence leads to the master's thesis, suggested by the student and approved by the faculty.

Lab 9-27, Credit 3-9 (offered every quarter)

Weaving and Textile Design

FSCT-750 **Weaving and Textile Design**
Registration #0413-750 **(Minor, Elective)**
This is the study and appreciation of weaving and textile techniques, soft sculpture, off-loom weaving and printing. Design approaches are stressed.

Lab 6, Credit 3 (offered every quarter)

FSCT-780 **Weaving and Textile Design**
Registration #0413-780 **(Major)**
A program structured on the basis of individual needs, interests and background preparation as they may be determined through faculty counseling. Techniques offered are combination weaves and pattern design, double weave, embroidery and stitchery, finnweave, Ikat, multiple layer, dyeing, non-loom, pile rug, surface design, silk screen printing, computer design, silkscreen, tapestry, and soft sculpture. Design concepts are complements to the techniques. This sequence leads to the master's thesis, suggested by the student and approved by the faculty.

Lab 9-27, Credit 3-9 (offered every quarter)

Woodworking and Furniture Design

FSCW-750 **Woodworking and Furniture Design**
Registration #0414-750 **(Minor, 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.

Lab 6, Credit 3 (offered every quarter)

FSCW-780 **Woodworking and Furniture Design**
Registration #0414-780 **(Major)**
A program structured on the basis of individual needs, interests and background preparation as they may be determined through faculty counseling. This provides an opportunity for technical, aesthetic and design competency to grow through the exploration of hand and machine tools; solid wood theory, joinery and practice; veneer theory, and practice; production theory; chair, table and cabinet design and construction. This sequence leads to the master's thesis, suggested by the student and approved by the faculty.

Lab 9-27, Credit 3-9 (offered every quarter)

Thesis

FSC (C, G, M, T, or W)-890 **Research and Thesis Guidance**
Registration #04 (09,11,12,13 or 14>390 **(Major MFA only)**
Research and presentation of an acceptable thesis with a focus on technique, design, and/or production. The thesis subject will be chosen by the candidates with the approval of the faculty advisor. The thesis will include a written summation or report of the research and participation in the graduate thesis show.

Lab 9-42, Credit 3-14 (offered every quarter)

FSC(C, G, M, T, or W)-778 **Professional Studio Internship**
Registration #04(09,11,12,13,14>778
This internship is designed to give qualified students and professionals the opportunity to spend one quarter in the personal studio of a faculty member from the School for American Craftsmen in order to gain practical experience in the day-to-day operation of a professional studio. Selection of applicants will be based on background, portfolios, and interviews.

40-hour week, Credit 8 (offered by special approval)

College of Graphic Arts and Photography

Dr. Carole A. Sack, Acting Dean

The College of Graphic Arts and Photography represents what RIT is all about—an interdisciplinary institution. A broad range of disciplines is available to students including design, science, technology, engineering, and management, as well as world-class faculty, who are at the forefront of their disciplines.

Seven graduate programs are offered in the field of imaging arts and sciences: **master of science degree in graphic arts systems, master of science degree in graphic arts publishing,** and **master of science degree in printing technology** from the School of Printing Management and Sciences; **master of science degree in imaging science, Ph.D. degree in imaging science,** and a **master of science degree in color science** from the Center for Imaging Science. The School of Photographic Arts and Sciences offers a **master of fine arts degree in imaging arts.**

With millions of dollars of state-of-the-art and advanced equipment supporting course work and research, students have the opportunity to excel in their chosen areas of emphasis.

The advancement of our graduates upon employment is excellent; their successes are what our programs are all about—excellence through learning.

Master of Science Degree Programs in the School of Printing Management and Sciences

The School of Printing Management and Sciences offers three master of science degree programs: graphic arts publishing, graphic arts systems, and printing technology.

Admission requirements
Prior to being admitted to a master of science degree program, applicants must satisfy the Graduate Admission Committee of

the School of Printing Management and Sciences that their previous training, ability, **and** practical experience indicate a reasonable chance of success. Applicants may be admitted who hold a baccalaureate degree from an accredited institution. The School of Printing Management and Sciences encourages applicants with undergraduate records at the B (3.0) level or higher. Applicants are also encouraged to take the Graduate Record Examination (GRE) as an aid in counseling during the development of the individual's program of studies.

Requirements are:

- Written RIT application
- Earned baccalaureate degree
- Official undergraduate transcript
- Two recommendations
- An on-campus interview when possible
- Undergraduate GPA of 3.0 or higher
- Foundation course work 3.0 or higher, if required
- TOEFL score of at least 525 (international students)

Application deadlines

Candidates are encouraged to apply to the graduate program at any time during the year. However, those applicants who do not have a printing background should complete the admissions procedures before April 9,1992, to allow sufficient time to make arrangements to attend the Foundation Program. Applicants who hold an undergraduate degree in printing and meet all foundation course requirements should apply before July 26,1992. Students are permitted to begin their regular graduate classes only in September.

Foundation Program

The Foundation Program is common to all three graduate programs within the School of Printing Management and Sciences. It begins in April 1992 and provides students who have little or no printing background with the opportunity to gain the required background before commencing their regular courses in the Fall Quarter. During the admissions process, Graduate Coordinators evaluate the background of an applicant to their programs to determine whether a section of the Foundation Program might be waived because of the applicant's prior course work or work experience.

The Foundation Program involves the following course work:

- Accounting Systems—Grad
- Typography/Design—Grad
- Composition Technology—Grad
- Graphic Arts Imaging Techniques—Grad
- Printing Processes—Crad
- Planning/Finishing—Grad
- Science/Math—Grad
- Computers—Grad Study
- Technical Writing—Grad

In addition to the above Foundation Program courses, two courses, Organizational Behavior and Economics, must be completed by Graphic Arts Systems students. These two courses are required, but they are not taught in the Foundation Program. Consequently, Graphic Arts Systems students need to have completed these courses in their bachelor's degree work, or they will need to complete them, most appropriately, before beginning the Foundation Program. Because students may begin their graduate courses in the fall if they are lacking no more than two Foundation courses, it is possible for students to complete these two courses during the academic year.

Three Foundation courses are offered as evening courses late in the spring quarter: Accounting Systems, Technical Writing, and Computers. These courses can be taken at other universities that may be more convenient to the prospective student. However, the prospective student should obtain the graduate coordinator's approval before enrolling in the courses at another school.

The remaining six Foundation courses are scheduled during a 10-week period, beginning the first Monday in June. The courses are sequential—students complete one course before beginning the next one. Classes begin at 8:00 a.m. and end at 12:00 noon or 3:00 p.m., depending on the class. If an applicant has had a particular subject area waived, he/she will be excused from that section of the Foundation Program.

An applicant must complete the Foundation Program with an overall B average before he/she can begin the required courses in the particular graduate program to which he/she has been accepted.

Cary Library

The School of Printing Management and Sciences has the Melbert B. Cary, Jr. Graphic Arts Collection, composed of more than 14,000 volumes including many rare books and other materials detailing the history of printing and illustrating past and present fine printing, book design and illustrations, papermaking, binding, and other aspects of the graphic arts. The Frederic W. Goudy-Howard W. Coggeshall Memorial Workshop contains letters, papers and memorabilia of Mr. Goudy along with cases of Goudy types that can be seen only at RIT, because matrices for their manufacture were destroyed by fire in 1939.

Master of Science Degree in Graphic Arts Publishing

Marie Freckleton, Coordinator
(716)475-5871

Today's printing and publishing industry is the seventh largest industry in the country, producing more than $168 billion in products in 1990. Because the industry is undergoing massive technological change and increasing its production by about $10 billion annually, it is in need of increased numbers of employees who are better educated than in the past and who are highly flexible and innovative in decision making. Employment in printing and publishing is projected to grow at an annual rate of 1.5 percent from 1990 through the year 2000.

One of today's key areas in the printing and publishing industry is the production and publication of magazines and books, projected to produce $40 billion in products during 1991. The MS degree program is oriented toward educating individuals of high competency for technical production and management positions in the multifaceted publishing industry.

Program orientation

Most existing courses of study in publishing taught in the United States are concerned with the historical/editorial/advertising aspects of the industry. This new program addresses publishing from the technological/production viewpoint (including its management) and how it interrelates with the historical, advertising, circulation, and fulfillment functions. The program is open to students with a variety of undergraduate degree backgrounds. Therefore, the Foundation Program of courses has been made available for all applicants into the Graphic Arts Publishing Program.

The options

The Graphic Arts Publishing Program has four options.

Typography and Printing Design

This option prepares students to make responsible management-level decisions affecting printing design, typographic specifications, planning, scheduling, copy and film organization and budgeting/estimating functions. Graphic arts publishing concerns are an integral part of the option core and elective course work. Option content is concentrated in pre-press areas and is specifically structured to develop practical and theoretical skills which will enable the graduate to function successfully as art director, type

director, corporate printing buyer, production art director, or account executive.

The unique structure of the Typography and Printing Design Option allows professional-level development at an accelerated pace, thereby permitting a modest investment in student time. Interrelationships among the design and typography disciplines with all the major printing processes are thoroughly explored. The goal is to build within each student a firm foundation of printing technology on which sensitive, precise, and practical aesthetic judgment will rest.

Magazine Publishing

This option is specifically designed to prepare graduates for careers in magazine publishing. It includes all aspects of publishing from the editorial function to production and distribution, and concentrates particularly on decision making at the management level in the publishing production functions. An overview of contemporary publishing includes studies on publishing strategies for magazines with particular emphasis on the critical role played by the production manager. Graduates of the Magazine Publishing Option will fully qualify for positions in all areas of magazine production, including production manager, design production, technical sales, and systems management.

The Magazine Publishing Option gives students an aesthetic and practical appreciation of the large-scale development in composition, printing, binding, and distribution factors, which have made today's magazines so dynamic. In addition, the interrelationships among the major printing processes and production systems are thoroughly examined, and important interpersonal relationships among production, editorial, and design personnel are explored. As in the other options, both the core curriculum and elective course work in the Magazine Publishing Option will utilize the extensive graphic arts laboratories and classroom facilities, the Institute's Wallace Memorial Library, and two specialized libraries in the College of Graphic Arts and Photography.

Fine Printing

This option is specifically oriented toward the "book arts." The student will acquire a fundamental theoretical knowledge of graphic reproduction technology, make an in-depth investigation into the history of the book and typeface development, including a thorough acquaintance with paper, type, printing and binding through a series of lectures and integrated laboratory courses.

The option will appeal most to those students who eventually would like to establish a small press or fine printing firm, or who would like to work for a book publisher in a variety of positions. Some students may wish to develop the ability to select high-quality (and compatible) materials and acquire a familiarity with short-run printing technology.

Other students may be attracted by the chance to use historic printing equipment, or by exercising their creative and hands-on abilities to design and produce a small book, retaining absolute control over all aspects of production. To meet these needs, students in the Fine Printing Option will have ample opportunity to use the school's renowned hand composition laboratory, Monotype and Linotype equipment, and will learn to print on a wide variety of relief presses ranging from Washington hand presses to precision proofpresses. On the other hand, those students who wish to explore state-of-the-art technology in screen printing and lithographic processes will be given ample opportunity to register for courses in those disciplines.

Electronic Publishing

This option is systems oriented and focuses on the various segments of electronic publishing from the most elaborate segment of the high-volume production of prototypes of newspapers, catalogs and magazines to the single user, desktop systems for producing newsletters, office forms and short reports. The growth potential of the electronic publishing industry will be startling, escalating to an estimated $50 billion by the year 2000. Both corporate and commercial markets for electronic publishing will need experienced individuals to work as publishing systems architects, font and format managers, specialized programmers, and corporate publishers.

To prepare these individuals for industry, this option is made up of course work in the theoretical aspects of publishing and reproduction technologies, software and hardware considerations, and management strategies for electronic publishing centers. This option will utilize new electronic publishing laboratories equipped with the latest in electronic publishing computers, typesetters and printers. Like the other Graphic Arts Publishing options, a thesis, research paper, or project is required for graduation.

Thesis requirements

All four options in the Graphic Arts Publishing Program will require a thesis or a project of thesis equivalency. The primary purpose of the thesis is to demonstrate original thinking, creativity and research in areas decided upon by the students with the guidance and consent of their advisors. The thesis may take on different forms: printed specimens with written summary of purpose and procedure, written research report, or an electronic film or video presentation along with a written summary of purpose and procedure.

Required graduate degree courses

Typography and Printing Design

Fall

*0911-702	Graphic Reproduction Theory	4
*0911-713	Phototypography Procedures	4
*0911-723	Contemporary Publishing	3
0911-725	Typefaces, Their Development, Classification and Recognition	3
Elective		4
	Total Credits	18

Winter

0911-722	Ink, Color, and Substrates	4
0911-729	Computer-Aided Printing Design and Copy Preparation	4
0911-730	History of the Book	3
Elective		8
	Total Credits	19

Spring

*0911-727	Typographic Style Development	3
*0911-711	Tone and Color Analysis	4
0911-890	Thesis	5
Elective		3
	Total Credits	15

Magazine Publishing

Fall

*0911-702	Graphic Reproduction Theory	4
*0911-713	Phototypography Procedures	4
*0911-723	Contemporary Publishing	3
0911-725	Typefaces, Their Development, Classification and Recognition	3
Elective		4
	Total Credits	18

Winter

0910-708	Marketing & Economic Planning in Graphic Communications Production	4
0911-732	The Editorial Function	3
0911-733	Production Function	4
0911-734	Advertising, Circulation and Fulfillment	3
0911-722	Ink, Color, and Substrates	4
	Total Credits	18

Spring

Elective		4
*0911-711	Tone and Color Analysis	4
0911-890	Thesis	5
Elective		3
	Total Credits	16

Fine Printing

Fall

*0911-702	Graphic Reproduction Theory	4
*0911-713	Phototypography Procedures	4
*0911-723	Contemporary Publishing	3
0911-725	Typefaces, Their Development, Classification and Recognition	3
Elective		4
	Total Credits	18

Winter

0911-737	Book Production	3
0911-730	History of the Book	3
0911-738	Machine Typesetting	4
0911-722	Ink, Color, and Substrates	4
0911-740	Relief Printing	4
	Total Credits	18

Spring

0911-739	Paper and Binding for the Fine Printer	4
*0911-711	Tone and Color Analysis	4
0911-890	Thesis	5
Elective		3
	Total Credits	16

Electronic Publishing

Fall

*0911-702	Graphic Reproduction Theory	4
*0911-713	Phototypography Procedures	4
*0911-723	Contemporary Publishing	3
Elective		3
Elective		4
	Total Credits	18

Winter

0911-741	Image Processing Systems	4
0911-742	Document Processing Languages	4
0911-722	Ink, Color, and Substrates	4
0911-745	Management Strategies for Corporate and Commercial Publishing Enterprises	4
	Total Credits	16

Spring

*0911-743	Markets for Electronic Publishing	4
0911-850	Thesis	4
Elective		4
Elective		4
	Total Credits	16

**Core courses*

Elective courses are selected by the student to develop additional expertise in a particular area of interest. Elective courses must have the program coordinator's approval.

Program equipment

The School of Printing Management and Sciences has state-of-the-art printing equipment valued at $60 million. This equipment is available to all graduate students for industrial and research purposes.

Students in the Typography and Printing Design Option will receive optional laboratory work in the Typography, Design, Composition Systems, and other pre-press laboratories, utilizing both traditional and the latest computer-aided design equipment. Magazine Publishing majors have access to a broad spectrum of equipment to observe and utilize, from the latest in computer-based typesetting systems to a new Harris M-1000B publication press. The Scitex 350 digital image processing system will be of great value to this and other options as well as the 399 Hell DS 608, and Royal Zenith 210 scanners as well as the Crosfield Studio 800 system.

Students in the Fine Printing Option will use the school's traditional hand composition, Linotype and Monotype equipment, as well as letterpress, offset, bindery and other equipment normally used by the fine printer. In addition, students matriculated into the Electronic Publishing Option will work with the latest in electronic equipment, including, Macintosh and DOS platforms using the latest software, laser imagesetters, Xerox electronic publishing system (6085), and Compugraphic system with its companion flat-top scanner for integrating text and halftone illustrations.

The equipment is not only used to reinforce the theoretical aspects of the program, but also to give students at the graduate level first-hand knowledge of considerations in managing a state-of-the-art publishing operation.

Program requirements

In addition to general admission requirements for all graduate students in the School of Printing Management and Sciences, students selecting the Typography and Printing Design Option must demonstrate competence in aesthetic applications.

If the applicants have completed all admission requirements, they will be conditionally accepted as graduate students pending the successful completion of the Foundation Program.

Master of Science Degree in Graphic Arts Systems

Barbara A. Birkett, Coordinator
(716) 475-2889

Today's printing industry is technology driven, competitive, and rapidly changing. Because of the broad range of company size and structure, the printing industry provides graduates with many opportunities, from exercising the entrepreneurial spirit of ownership to becoming a part of a large multinational firm. But whatever the size, to be effective and to feel comfortable in this changing environment, graduates must have honed managerial skills and solid technical knowledge.

Today's graduates must be equipped with people skills and a knowledge of financial controls, cost allocation systems, pricing strategies, and long- and short-range planning. A printing leader must be vitally aware of how competitors are adapting to the environment: what markets are they going after, what specializations are they developing; and what pricing strategies are they using?

Graduates who have a solid technical background have a distinct advantage: they do not have to "learn on the job." They are ready to assume responsibility. As complex as the technology is, it must be applied in a specific plant, in a specific locale, with specific employees. Graduates need to be aware of technology's limits and to see opportunities for new research, new techniques, and new applications. In short, they must be in control.

Program objective

The MS degree program in Graphic Arts Systems seeks to meet the challenges of the printing industry. It provides graduates with the managerial and technical knowledge needed to be effective.

The program should be of particular interest to non printing undergraduates, such as journalism, English, business, history, psychology, and other liberal arts and technical majors. Abilities developed in undergraduate work, such as comprehending, analyzing, and communicating, become the foundation of graduate study. This program focuses students' skills on a variety of roles within the printing industry, whether administration, production, or sales. It provides students with the requisite knowledge to understand and control the processes for which they are responsible.

The program

The Graphic Arts System Program requires 48 credit hours of graduate work, 36 of which must be taken at RIT. Twelve of the 48 hours—essentially three courses—are electives selected by the student to develop expertise in an area of particular interest. Elective courses must have the coordinator's approval.

Project design (Course 850)

In the Spring Quarter, the student must complete a project related to graphic arts systems. The student is responsible for selecting the topic and type of project; however, the project must include a written report documenting the project work.

Required graduate degree courses

0911-702	Graphic Reproduction Theory	4
0910-705	Estimating and Analyzing in Graphic Arts Systems	4
0910-706	Operations Management in the Graphic Arts	
	or	
0106-743	Operations Management	4
0910-708	Marketing and Economic Applications in Graphic Communications	
	or	
0105-761	Marketing Concepts	4
0911-709	Trends in Printing Technology	4
0911-711	Tone and Color Analysis	4
0911-713	Phototypography Procedures	4
0911-722	Ink, Color and Substrates	4
Elective		12
0910-850	Project Design	4
	Total Credits	48

A **typical schedule of courses**

Fall

0911-702	Graphic Reproduction Theory	4
0911-709	Trends in Printing	4
0911-713	Phototypographic Procedures	4
Elective		4
	Total Credits	16

Winter

0910-706	Operations Management in Graphic Arts	
	or	
0106-743	Operations Management	4
0910-708	Marketing and Economic Applications in Graphic Communications	
	or	
0105-761	Marketing Concepts	4
0910-705	Estimating and Analyzing in Graphic Arts Systems	4
0911-722	Ink, Color, and Substrates	4
	Total Credits	16

Spring

0911-711	ToneandColor Analysis	4
Electives		8
0910-850	Project Design	4
	Total Credits	16

Master of Science Degree in Printing Technology

Joseph L. Noga, Coordinator
(716)475-2849

Technology in the printing industry continues to evolve rapidly with the incorporation of innovative materials and concepts from other disciplines. This evolution covers all aspects of graphic communication as well as such non-communicative graphics as circuit printing and textile decorating. The graduate program is designed to help the student remain current after leaving RIT.

This graduate program is specifically arranged for students so that completion prepares them for participation in a volatile industry whether in production, research or other functions, as well as for the possibility of a career in teaching. In this regard, the program rests on theory and the applications of basic theory along with training in the use of modern equipment. The student must complete a research thesis allowing him or her to bring to bear acquired knowledge on a specific problem. Thesis work affords the student the opportunity to contribute to the knowledge of the printing technologies. This work is done under the guidance of faculty experienced in that area of printing on which the student has chosen to focus.

This graduate program recognizes the value of aesthetics in the graphic arts and allows opportunity for the student to bring technology to bear on design and aesthetic forms. Those students whose interests run heavily in this aspect of printing, such as in book design, are encouraged to master the technology so that thesis work can apply technology to aesthetic goals. The program remains a technical one, however, with strongest attraction for the students primarily interested in technology.

The program

The printing technology curriculum leading to a master of science degree in the School of Printing Management and Sciences is a professional program designed to provide graduate education in printing for students whose undergraduate majors were in the arts, sciences, education, or other non-printing areas, as well as for graduates with a major in printing. Candidates who do not have adequate undergraduate work in printing must take the Foundation Program prior to starting the required core program.

The printing technology major provides graduate level study in printing technology and in research methods. The program is not intended to give a broad exposure to the printing field, but to provide the student an opportunity to specialize in a particular area, and to develop research skills useful to the graphic arts. This objective is accomplished through the program's core courses, selection of electives, and the development of the thesis. The goal of the program is to educate students who will have, in addition to an understanding of the procedures and theoretical concepts in printing processes, an appreciation of particular problems in special areas at an advanced level. The students wishing to explore areas beyond the course requirements of the program are encouraged to take additional course work to broaden their experience in the printing field.

The printing technology major is a full-time master's degree program. The length of time required to earn a degree varies according to the student's undergraduate preparation in printing, mathematics, and science. All students must earn 48 credits as a graduate student, 36 of which must be taken at RIT, to earn the master of science degree. The program generally requires one academic year at the graduate level. Candidates who wish to enter the program, but lack adequate preparation, must take the Foundation Program. With Foundation course work completed, the candidate will start the core graduate program sequence with the Fall Quarter.

Program objectives

The goal of the technology major is to graduate well-educated students in both the theoretical and practical aspects of graphic arts technology. The program provides graduates with the necessary education to approach solutions to printing problems by an orientation to processes and materials based on systematic analysis.

Preparation in the technology major provides entry as a professional into the printing field in areas such as production management, research and development, technical sales representative, quality assurance, administration, marketing, etc. Because the printing industry is large and extremely varied, the student's overall preparation, interest and background would allow for entry level positions in these and in a number of other areas in the printing industry.

Program requirements

The master of science degree program in printing technology requires the completion of 48 quarter credit hours of study including eight hours for the thesis. If foundation courses are not required, the program can be completed in one academic year. The program's length is based on each individual's program of study and the length of time each student chooses to complete his or her thesis work. Students who are qualified in one or more of the required courses may substitute other course work with the permission of the program coordinator.

Technology major

Required courses

0911-701	Research Methods	4
0911-709	Trends in Printing Technology	4
0911-702	Graphic Reproduction Theory	4
0911-703	Statistical Inference	4
0911-713	Phototypography Procedures	4
0911-711	Tone and Color Analysis	4
0911-722	Ink, Color and Substrates	4
Electives		12
0911-890	Thesis	8
	Total Credits	48

A typical schedule of courses

Fall

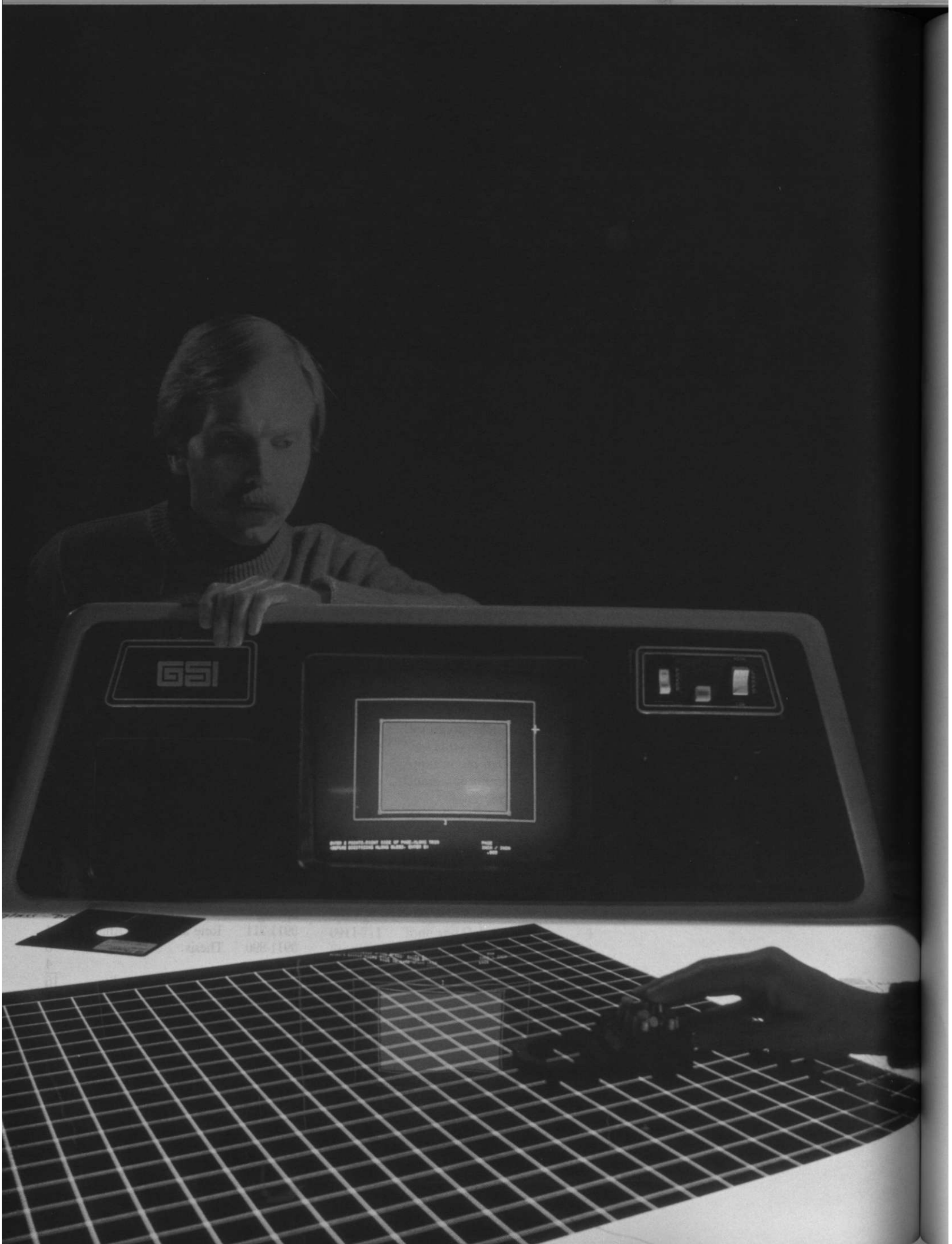
0911-702	Graphic Reproduction Theory	4
0911-709	Trends in Printing Technology	4
0911-713	Phototypography Procedures	4
Elective		4
	Total Credits	16

Winter

0911-701	Research Methods	4
0911-703	Statistical Inference	4
Elective		4
0911-722	Ink, Color, and Substrates	4
	Total Credits	16

Spring

0911-711	Tone and Color Analysis	4
0911-890	Thesis	8
Elective		4
	Total Credits	16


GSI

School of Printing Management and Sciences

PPRM-702 **Computers in Management**
Registration #0910-702
An applications workshop which covers printing requirements in relation to computer systems configurations; applications of computers to management and production control problems; investigation of computer-oriented production control techniques.

Credit 4

PPRM-705 **Estimating and Analyzing in Graphic Communications**
Registration #0910-705
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.

Class 4, Credit 4

PPRM-706 **Operations Management in Graphic Arts**
Registration #0910-706
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.

Class 4, Credit 4

PPRM-708 **Marketing and Economic Applications in Graphic Communications**
Registration #0910-708
The role, importance, and principles of marketing are combined with selected topics from microeconomics that relate to a printing company's plans for the future. Extensive outside reading is required to facilitate the use of class time for practice and discussion of the materials.

Class 4, Credit 4

PPRM-850 **Project Design**
Registration #0910-850
The student selects, plans, organizes, and investigates a topic in the field of graphic arts systems and produces a suitably documented, tangible report of thesis quality. The student is responsible not only for originating and doing the project, but also for obtaining a faculty sponsor for the project.

Class 4, Credit 4

PPRT-701 **Research Methods in the Graphic Arts**
Registration #0911-701
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, research design and measurement. The study of problems in the graphic arts including ink and paper, reproduction methods, and quality control.

Class 4, Credit 4

PPRT-702 **Graphic Reproduction Theory**
Registration #0911-702
Analysis of the basic theories of graphic reproduction and study of the principles underlying prevalent and proposed printing processes; special topics such as classification and description of the various light-sensitive systems as applied to the graphic arts, ink transfer theory, present and proposed systems of printing based on electrostatics; electrolysis, magnetism and lasers; study of hybrid systems and the significance and application of interdisciplinary methods. The Neugebauer and color correction equations.

Class 4, Credit 4

PPRT-703 **Statistical Inference**
Registration #0911-703
The purpose of this course is to provide graduate students in the School of Printing Management and Sciences with an introduction to the field of statistics and its application to graduate research projects. In addition, current uses of statistics in the printing industry are examined.

Class 4, Credit 4

PPRT-708 **Introduction to Systems Analysis**
Registration #0911-708
Problems of systems analysis in printing operations for the highest quality product at the minimal cost including optimal floor designs and methods of study. (PPRM-301)

Class 4, Credit 4

PPRT-709 **Trends in Printing Technology**
Registration #0911-709
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.

Class 4, Credit 4

PPRT-711 **Tone and Color Analysis**
Registration #0911-711
A study of the methods and instrumentation necessary for the evaluation of printed materials for product quality assurance. The ultimate objective: the optimization and control of the production processes.

Class 4, Credit 4

PPRT-713 **Phototypography Procedures**
Registration #0911-713
Utilizing phototypesetting equipment, the student shall learn to develop typographic skills necessary to plan and mark-up typesetting jobs so that the end results will closely match the original concept. Coding, format planning and development shall be taught so that the student will feel at ease in the creation and completion of the projects. The lectures include the aesthetics and the technical information on phototypesetting equipment. Mark-up; systems analysis of equipment; and front-end systems.

Class 4, Credit 4

PPRT-722 **Ink, Color and Substrates**
Registration #0911-722
A study of the physics of light and color, basic color theory, color measurements and color systems. Included are applications of color theory to the graphic arts. The chemistry and physics of ink and substrates, and their interaction, are covered. Emphasis is given to the problem of ink, color and substrates in each printing process.

Class 4, Credit 4

PPRT-723 **Contemporary Publishing**
Registration #0911-723
An overview of contemporary book, magazine and newspaper publishing with emphasis on comparative editorial, production, circulation and marketing strategies. Advantages and disadvantages of the various kinds of publishing are discussed relevant to meeting the needs of society. Cost structures of the various publishing industries are explored as are strategies of new acquisitions.

Class 3, Credit 3

PPRT-725 **Typefaces: Their Development,**
Registration #0911-725 **Classification and Recognition**

This in-depth course deals with the historical development of typefaces to the present time. Proposed classification systems are discussed. Students will be encouraged to develop a system to suit their own needs. A system for substitution typefaces also will be a major consideration of this course. Factors that aid in the identifying of typefaces are shown through the extensive use of slides. Students will be expected to write two papers. (PPRT-713)

Class 3, Credit 3

PPRT-727 **Typographic Style Development**
Registration #0911-727

A course created with the idea that students will develop a corporate style manual. At the end of the course students will make a presentation of their style manuals and show examples of their implementation.

Categories will include, but need not be limited to: "looks," editorial style, terminology, typefaces, illustrations, and document structures. Extensive library research will be expected. Examples of style manual implementation will be produced during the lab time. (PPRT-713, PPRT-729)

Class 3, Credit 3

PPRT-729 **Computer-Aided Printing**
Registration #0911-729 **Design and Copy Preparation**

An in-depth study of the applications of desktop software to the preparation of camera-ready copy. Page makeup software, black-and-white scanning software, and drawing and painting software will be incorporated into copy assembly, facilitating multipage, flat color reproduction and special effects. The corporate designs generated in this course are the basis for development of a style manual in 0911-727. Extensive utilization of slides and other visual aids and demonstrations of various software and equipment will be included in lectures and labs.

Class 4, Credit 4

PPRT-730 **History of the Book**
Registration #0911-730

The "book" or codex, in manuscript and printed form, has served for over a thousand years as the principal record of human imagination and achievement. This course will begin with a discussion of early methods of preservation of information, but will concentrate on post-15th century developments in the techniques and technology of printing and illustrating books. An important printer will be selected from each century (beginning with the 15th and concluding with the 20th) and thoroughly discussed, including an analysis of the cultural and technological influences which shaped the products of his press, as well as those of his contemporaries.

Class 3, Credit 3

PPRT-732 **The Editorial Function**
Registration #0911-732

An examination of the historic forces that have helped to shape the structure of magazines today, and how this structure has affected the administrative and editorial functions of these magazines. The future of magazines also will be considered. Course conducted by lecture and discussion.

Class 3, Credit 3

PPRT-733 **Production Function**
Registration #0911-733

An examination of the various operations involved in the production of a magazine along with designing the optimum system of production for a given magazine. The interrelatedness of the various production operations also will be studied. Course conducted by lecture and discussion.

Class 4, Credit 4

PPRT-734 **Advertising, Circulation and Fulfillment**
Registration #0911-734

An examination of magazine advertising, circulation, fulfillment, and distribution functions as they affect the marketing of magazines. The impact of the legal aspects of publishing upon advertising and distribution will be examined. Course conducted by lecture and discussion.

Class 3, Credit 3

PPRT-737 **Book Production**
Registration #0911-737

The many-faceted role of production is explored in the examination of the publishing cycle from manuscript to bound books. Emphasis is placed on an understanding of the production and editorial systems and the interaction between them. Production and cost requirements for composition, printing, binding and distribution for trade boolu, textbooks, journals and special editions are thoroughly discussed.

Class 3, Credit 3

PPRT-738 **Machine Typesetting**
Registration #0911-738

An introduction to hot metal typesetting in which students will become familiar with the mechanisms of the Linotype, Monotype and Ludlow systems. Emphasis on developing a good background in machine operation and ability to select proper equipment for private press use.

Class 4, Credit 4

PPRT-739 **Paper and Binding for the fine Printer**
Registration #0911-739

The first half of this course is a study of the papers—handmade, fine mould or machine-made—suitable for fine printing with an emphasis on those which may be used in relief processes, through papers suitable for offset printing.

The second half of the course will cover contemporary binding techniques used for limited editions. Sewn and adhesive bound structures with various endpaper constructions will be studied and practiced. Full-, half-, and quarter-case bindings, including slipcase making will allow a student to become competent in making those important decisions on bindings used in book manufacture.

Class 4, Credit 4

PPRT-740 **Relief Printing**
Registration #0911-740

An introduction to the techniques for relief printing as applied to type and illustration. Basic operational procedures and individual make-ready and lockup techniques will be demonstrated and practiced for printing presses that will include Washington handpress, Heidelberg platen press and the Vandercook proof press.

Class 4, Credit 4

PPRT-741 **Image Processing Systems**
Registration #0911-741

This course will introduce the student to the concepts underlying the digital representation and manipulation of images. Students will be evaluated based on examinations and a term project.

Class 4, Credit 4

PPRT-742 **Document Processing languages**
Registration #0911-742

This course will introduce the student to the concepts underlying modern document processing systems. Students will be evaluated by examination and will be required to complete a term research project

Class 4, Credit 4

PPRT-743 **Markets for Electronic Publishing**
Registration #0911-743

An examination of the various product and market segments of the electronic publishing industry from corporate, commercial and vendor viewpoints, along with the effects of market forces upon the various segments. Course conducted by lecture and discussion.

Class 4, Credit 4

PPRT-745 **Management Strategies for Corporate**
Registration #0911-745 **and Commercial Publishing Enterprises**

An examination of the strategies in the operation and management of both corporate and commercial publishing enterprises, including organization and administration, employee considerations, work flow, marketing and sales, and financial matters including chargeback systems. Course conducted by lecture and discussion.

Class 4, Credit 4

PPRT-760 **Advertising**
Registration #0911-760
This course will examine the origins of advertising and its development into the major force it exerts on our lives today. An inquiry of the various media will be pursued with primary attention focused on print advertising. The role of the advertising agency will be explored. The different types of advertising and the various stages of advertising will be examined. The course will include several weekly quizzes and both a mid-term and final examination.

Class 3, Credit 3

PPRT-765 **Corporate/Electronic Composition Systems**
Registration #0911-765
A combination lecture and laboratory course dealing with the image processing systems and electronic publishing. A comparative study from a technical as well as aesthetic perspective. Specialized hardware and software are analyzed in three class projects.

Class 4, Credit 4

PPRT-767 **History of Letters**
Registration #0911-767
This course will examine the origins of man's desire to record graphically events that were important in his life. It will trace man's first crude attempts scratched on bone and rock to the sophisticated sound/symbol alphabets of the present. The main evolutionary steps in this process will be emphasized. The tools used and how they influenced the forms will be stressed. Technology's influence also will be part of this process. Periodic quizzes and both a mid-term and final examination will be utilized.

Class 3, Credit 3

PPRT-850 **Research Projects**
Registration #0911-850
Individual research projects in which independent data are collected by the student, followed by analysis and evaluation. A comprehensive written report is required. Consent of advisor is required.
Credit variable **14**

PPRT-890 **Research and Thesis Guidance**
Registration #0911-890
An experimental survey of a problem area in the graphic arts.

Credit 8

Graduate Faculty School of Printing Management and Sciences

Sven Ahrenkilde, MS, Polytechnic University, Denmark—Research Associate, Technical and Education Center of the Graphic Arts

Barbara Birkett, MBA, University of Michigan—Assistant Professor, Technical Writing/Financial Controls, Graduate Program Coordinator of Graphic Arts Systems

William H. Birkett, MBA, University of Michigan, C.MA.—Associate Professor, Printing Management

Robert Y. Chung, MS, Rochester Institute of Technology—Associate Professor, Computer Technology

John Compton, MS, Rochester Institute of Technology—Professor, Quality Control

Frank Cost, MS, Rochester Institute of Technology—Assistant Professor, Coordinator, Printing and Applied Computer Science

Chester J. Daniels, MS, Rochester Institute of Technology—Senior Technologist, Technical and Education Center of the Graphic Arts

Hugh R. Fox, JD, Rutgers University—Associate Professor, Printing Management

Clifton T. **Frazier,** M. Ed., University of Rochester—Associate Professor, Photo-Lithography Technology

Marie Freckleton, MST, Rochester Institute of Technology—Assistant Professor, Printing Design

Edward Granger, Ph.D., University of Rochester—Graduate Printing Faculty, Professor, Center for Imaging Science, Sr. Staff, Graphic Imaging, Div. of Eastman Kodak Company

Robert G. Hacker, Ph.D., University of Iowa—Professor, Newspaper Management, Computer Applications

Sam Hoff, MS, California State University—Assistant Professor, Screen Printing/Image Assembly

Charles Layne, Ph.D., The Ohio State University—Adjunct Professor, Statistical Inference

Joseph L. Noga, MS, University of Bridgeport—Professor, Electronic Color Imaging, Graduate Program Coordinator of Printing Technology

David Pankow, MLS, Columbia University, New York City—Curator, Melbert B. Cary, Jr. Graphics Arts Collection

Archibald D. Provan, M. Ed., University of Rochester—Professor, Typography

Emery E. Schneider, M. Ed., University of Rochester—Associate Professor, Phototypesetting

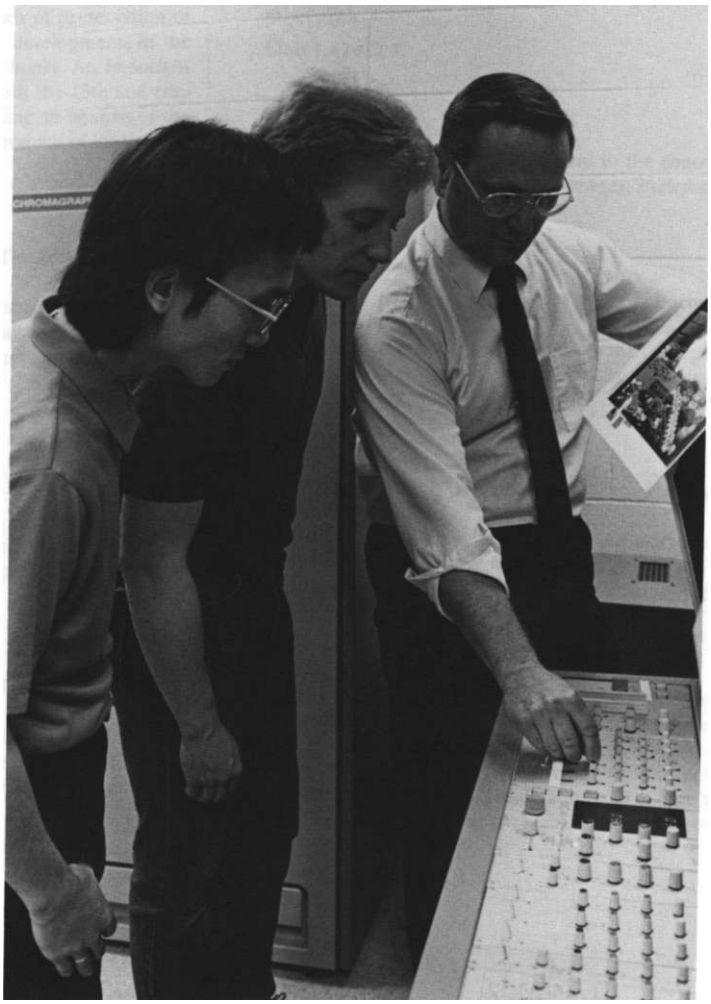
Franz Sigg, MS, Rochester Institute of Technology—Research Associate, Technical and Education Center of the Graphic Arts

Miles F. Southworth, M. Ed., University of Rochester—Professor, Director, School of Printing Management and Sciences

Associates of the Graduate Faculty

Herbert H.Johnson, BS, Rochester Institute of Technology—Associate Professor, Book and Magazine Production

Werner Rebsamen, Diploma, Academy of Fine Arts, Zurich—Professor, Planning and Finishing



Master of Science Degree Programs in the Center for Imaging Science

The Center for Imaging Science was established in 1985 as an interdisciplinary focus for the study of all aspects of imaging. The Munsell Color Science Laboratory, within the Center for Imaging Science, is devoted to the study of color science, appearance, and technology. Graduate programs within the Center for Imaging Science lead to MS and Ph.D. degrees in imaging science and the MS degree in color science, with much flexibility, and an overlap is possible in course electives.

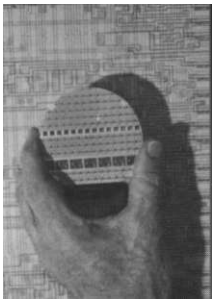
Master of Science Degree in Imaging Science

Dr. Mehdi Vaez-Iravani
Coordinator, MS Program
(716) 475-7179

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 or science. Formal course work includes consideration of the physics and chemistry of radiation-sensitive materials and processes, the application of physical and geometrical optics to photo-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, science, and mathematics. A thesis is required.

Faculty within the Center for Imaging Science supervise thesis research in areas of the chemistry and physics of radiation-sensitive materials and processes, digital image processing, remote sensing, photo-optical instrumentation, medical diagnostic imaging, advanced non-destructive evaluation, and scanned probe microscopy. In addition, research opportunities are available in all aspects of color in the Munsell Color Science Laboratory within the Center for Imaging Science. Other interdisciplinary efforts are possible with the colleges of Engineering and Science. Opportunities also exist to perform thesis work under the direction of selected scientists and engineers in industry who act as adjunct faculty.

The degree requirements can be completed either on a full- or a part-time basis.



Clockwisefrom above: Finger Lakes Area of New York State (Courtesy NASA / USGS EROS Data Center); optical instrumentation lab; a silicon wafer containing more than 100 chips, each chip having thousands of circuit elements; measuring film density with a micro densitometer

1. Master of Science in Imaging Science (Full-Time)

As a result of the recently established PhD. program in Imaging Science at RIT, the MS program curriculum is undergoing some changes as of this printing. Please contact the MS coordinator for details of any changes in requirements.

This program is designed for persons holding a bachelor's degree in science or engineering. All students must complete the PIMG-701, 2, 3 sequence, Basic and Advanced Principles of Imaging Science. These courses develop a necessary broad background in imaging. Students with undergraduate degrees in imaging science are allowed to test out of PIMG-701 and 702, but not 703. In addition, all students must complete a minimum of five quarters chosen from any two of the other three core areas of study: Image Evaluation, Optics, and Imaging Mathematics and Statistics.

The student also must complete nine credit hours of research with three credit hours assigned to the graduate research course and six credit hours assigned to the thesis research and defense. The student will elect graduate courses to bring the total credit count to 57. Up to six credit hours applicable as graduate technical electives may be selected from graduate courses outside the Center for Imaging Science. All non-imaging science courses must be approved by the CIS graduate faculty as acceptable for CIS credit.

2. Master of Science in Imaging Science (Part-Time)

This program is identical to the full-time program except that the requirements can be met on a part-time basis. Part-time students should normally complete the graduate requirements within three to four years. The maximum time allowed for the completion of all degree requirements is seven years.

Some courses are offered in the evening for the benefit of part-time students. Information concerning these courses may be obtained from the coordinator of academic services.

Admission

Admission to full-time or part-time programs 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, university-level (i.e., calculus based) course in physics, with laboratory; and a full-year, college-level course, with laboratory, in chemistry. It is assumed that students can write simple computer programs in any one language and have experience with a high-level language such as PASCAL, FORTRAN, or C. A course in quantum physics is recommended, though not required background.

Applicants must demonstrate to the Graduate 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 the 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 are also required to take the GRE test. Students whose native language is not English must demonstrate proficiency in English, as evidenced, for example, by a TOEFL score of 575 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.

Thesis

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 advisor. 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 shall have an advisor assigned 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. The work shall not have started prior to the assignment of the advisor.
4. In exceptional cases, it may be possible that the candidate is able to present published original work done outside RIT, which can be accepted in lieu of a thesis, and essentially fulfills the requirements for a completed thesis. Then, the thesis requirements may be substituted by elective courses.

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 Guidance does not carry a letter grade and is not included in the average.

SUGGESTED COURSE OF STUDY

	Quarter Credit Hours			
Course Title and Number	**Fall**	**Winter**	**Spring**	**Summer**
Principles of Imaging Science PIMG-701,2,3	3	3	3	
Three-Quarter core sequence	3-4	3-4	3-4	
Two-Quarter core sequence	3-4	3-4		
Research—PIMG-890	1	1	1	6
Technical electives	3-4	3-4	3-4	
Technical electives				3-4

Imaging Science Core Sequences*

PIMG-701, 702, 703	Principles of Imaging Science
PIMG-721, 722	Statistics and Computer Techniques
PIMG-731, 732, 733	Optics
PIMG-708, 709, 785	Complex Variables and Matrix Methods, Linear Continuous Systems, Linear Discrete Systems

Imaging Science Technical Electives

PIMG-746, 747, 748	Digital Image Processing
PIMG-751, 752, 753	Special Topics—varies each year, typical offerings include Electro-Optics, Artificial Intelligence, Medical Imaging, etc.
PIMG-756, 757, 758	Principles of Electrophotography Materials and Processes
PIMG-761, 762, 763	Principles of Remote Sensing and Image Analysis
PIMG-766, 767, 768	Silver-Halide Science
PIMG-890	Research and Thesis Guidance

**CIS core courses also can be taken as technical electives.*

Doctor of Philosophy Degree in Imaging Science

Dr. John Schott
Coordinator, Ph.D. Program
(716)475-5170

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 coursework, including a core curriculum, as defined by the student's plan of study,
2. passing a series of examinations, and
3. completing an acceptable dissertation under supervision of the student's research advisor and Dissertation Committee.

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:

- Graduate Seminar
- Complex Variables and Matrix Methods
- Mathematics of Linear Continuous Systems
- Mathematics of Random Processes
- Computing
- Introduction to Imaging Science
- Basic Principles and Techniques of Imaging Science I, II
- Advanced Principles and Techniques of Imaging Science I, II
- Imaging Laboratory

Admission

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 (e.g. FORTRAN, PASCAL, C)

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, and must request letters of recommendation from two persons well qualified to judge their abilities for graduate study. Students for whom English is not the native language must also submit the results of Test of English as a Foreign Language (TOEFL). Industrial and research experience are also considered in the decision to admit.

Due to the variety of backgrounds of incoming students, it is recognized that some students 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 Comprehensive Examination. The required research credits may not be waived by experience or examination.

Comprehensive Examination

All students must pass a written comprehensive examination. The examination is given each year prior to the fall quarter and is ordinarily taken after completing the core course of study (36 quarter credits), i.e., after the first year of study. The examination consists of sections that cover the core disciplines of imaging and is prepared and administered by the graduate faculty of the center. The student must successfully pass the comprehensive examination to advance to candidacy. A student is permitted only two attempts to pass the comprehensive examination.

By the time that they take the comprehensive examination, all students must select a research advisor. The advisor must be a member of the graduate faculty of the Center for Imaging Science.

Dissertation Committee

After the student passes the comprehensive examination and upon recommendation of the director of the Center for Imaging Science, a Dissertation Committee of four members is appointed for the duration of the student's tenure in the program. One is appointed by the dean of Graduate Studies from the faculty of another college within the Institute, and acts as the chair of the final dissertation defense. The committee must also include

the student's research advisor and at least one other member of the graduate faculty of the Center for Imaging Science. The fourth member may be affiliated with industry or another institution. Persons who are not members of the graduate faculty of the center must be approved by the coordinator of the doctoral program.

The duties of the Dissertation Committee include:

1. reviewing the study plan and dissertation proposal,
2. preparing and administering the examination for admission to candidacy,
3. assisting in planning and coordinating the research,
4. supervising the writing of the dissertation, and
5. conducting the final examination of the dissertation.

Study Plan

The student and the research advisor develop a study plan that defines the course work to be completed, including the technical electives most relevant to the student's field of interest. The study plan must be filed with the doctoral coordinator of the Center for Imaging Science and must be approved by the Dissertation Committee. The plan may be amended if the changes are approved by the Dissertation Committee.

Research Proposal

The student and the research advisor 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: silver halide-imaging, remote sensing, digital image processing, color and visual perception, digital microlithography, and machine vision.

The student must make a formal proposal of the dissertation topic to the Dissertation Committee for approval.

Admission to Candidacy

As soon as possible after acceptance of the Dissertation Proposal, but not later than six months prior to defending the dissertation, the student must pass an examination to be admitted to candidacy for the doctoral degree. The examination is prepared and administered by the Dissertation Committee and may have oral and/or written sections at the committee's option. A typical examination may consist of oral responses to previously assigned written questions.

Course Requirements

All students must complete a minimum of 72 quarter credit hours of course work; the courses are defined by the student and the Dissertation Committee in the study plan, and must include completion of the core sequences plus at least two three-quarter sequences in topical areas. These topical areas include: silver-halide science, remote sensing, digital image processing, digital graphics, electrophotography, electro-optical imaging systems, medical imaging, and microlithographic imaging technologies.

Students may take a maximum of 16 quarter credits in other departments, although it should be noted that many courses in other departments of the Institute are cross-listed and thus apply as courses in imaging science. The student must also complete 27 quarter hours of research, with a maximum of nine credits per quarter.

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.

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 first attempting the comprehensive exam.

Final Examination of the Dissertation

The Dissertation Committee must submit a letter to the dean of Graduate Studies 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 dean of Graduate Studies, 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 Dissertation Committee may also elect to privately question the candidate following the presentation. The Dissertation Committee will immediately notify the candidate and the dean of Graduate Studies of the result of the examination.

Center for Imaging Science

Master of Science in Imaging Science
Doctor of Philosophy in Imaging Science

PIMG-700 **Introduction to Imaging Science**
Registration #0925-700
This course introduces the student to the historical context from which the field of Imaging Science has evolved. It proceeds to define the fundamental scientific principles on which the science is based and to expose the student to the technologies and directions that encompass the field. This course is intended to set the framework for graduate study in Imaging Science and to provide the non-image scientist with a nonquantitative survey of the field.

Credit 3

PIMG-701, 702 **Basic Principles & Techniques of**
Registration #0925-701, 702 **Imaging Science I, II**
This course is a rigorous quantitative treatment of the fundamental science undergirding the physical, chemical, electro-optical and biological aspects of Imaging Science. It is intended to provide a foundation for all advanced study in Imaging Science. The mean-level relationships (governing equations) that define the capture, processing, and reproduction of images are treated. The course will be taught in the context of imaging applications, with examples from the fields of medical imagery and remote sensing, etc. used throughout to reinforce the fundamental concepts.

Credit 3

PIMG-703, 704 **Advanced Principles and Techniques of**
Registration #0925-703, 704 **Imaging Science I, II**
This course builds on the basic principles sequence by introducing concepts of signal-to-noise ratio (S/N) and information theory in an imaging concept. Each aspect of imaging (detection, manipulation, transmission, storage, display, etc.) is analyzed on a fundamental S/N basis, leading to complete image system analysis for complex chemical/optical/electronic/digital imaging processes. This course will be illustrated throughout by practical examples from a wide range of imaging applications. (PIMG-701, 702 and concurrent enrollment in PIMG-705,706, 707)

Credit 3

PIMG-705, 706, 707 **Imaging Laboratory**
Registration #0925-705, 706, 707
This course is designed to parallel the basic principles of Image Science I and II and Advanced Principles I courses. It provides hands-on experience with electro-optical, photographic, and digital imaging materials and devices. 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. (Concurrent enrollment in PIMG-701, 702 and PIMG-703, 704)

Credit 1

PIMG-708 **Complex Variables and Matrix Methods**
Registration #0925-708
This is a course dealing with areas of mathematical analysis which are common to many fields of engineering and the analysis of systems. Included is a study of complex variable theory and its relation to transform methods (particularly inversion) used in the analysis of systems. A second major topic is a study of systems of linear equations, their solutions, and the associated matrix methods. Included here is a discussion of the eigenvalue problem and its application to the diagonalization of a matrix.

Credit 3

PIMG-709 **Mathematics of Linear Continuous Systems**
Registration #0925-709
This is a course in the analysis of linear continuous systems with special emphasis on imaging systems. The concept of linearity is first discussed 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. Included are the Fourier series, the Fourier transform, and the Laplace transform. Emphasis is placed on the physical meaning and interpretation of these transform methods. The theory of complex variables is used heavily in the development of these methods. (PIMG-708)
Credit 3

PIMG-710 **Mathematics of Random Processes**
Registration #0925-710
This course applies probability to the analysis of random processes with specific applications to the description of images as random processes. Random variables and transformations of random variables are studied with specific attention to jointly normal random variables. Stochastic processes are discussed, including the concepts of stationary and ergodicity. Correlation functions and power spectra are treated, as well as linear mean-square estimation. Various kinds of image noise will be introduced and studied. (PIMG-709)

Credit 3

PIMG-720 **Programming for Scientists and Engineers**
Registration #0925-720
A course to prepare graduate students in science and engineering to use computers as required by their disciplines. Topics to be covered include: 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. (ICSS-700)

Credit 4

PIMG-721, 722 **Mathematics and Statistics**
Registration #0925-721, 722 **for Photographic Systems**
A special graduate course in mathematics and applied statistics involving those areas of direct concern in design, analysis, and evaluation of photographic systems.
Credit 4

PIMG-731 **Geometrical Optics**
Registration #0925-731
Starting from Fermat's principle, this course leads to a thorough understanding of the first order geometrical properties of optical imaging systems. The topics addressed are: paraxial optics of axisymmetric systems, Gaussian optics (cardinal points, pupils and stops, Lagrange invariant), propagation of energy through lens systems, geometrical optics of gradient index systems and fibers, finite raytracing and introduction to aberrations.

Credit 4

PIMG-732 **Physical Optics**
Registration #0925-732
The wave properties of light: Polarization, birefringence, interference and interferometers, spatial and temporal coherence, scalar diffraction theory. (PIMG-742)
Credit 4

PIMG-733 **Optical Image Formation**
Registration #0925-733
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

Credit 3

PIMG-751, 752, 753 **Special Topics in Imaging Science**
Registration #0925-751, 752, 753
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 hours vary

PIMG-756, 757, 758 **Principles of Electrophotography**
Registration #0925-756, 757, 758 **Materials and Processes**
The fundamentals of electrophotographic and electrostatic imaging with emphasis on chemistry, physics, and engineering principles. Charge variation and field variation electrophotographic systems are treated including engineering design and analysis and design optimization techniques. Electronic printing, scanning, and analog and digital electronic copying systems are analyzed and characterized.
Credit 3

PIMG-761 **Remote Sensing and Image Analysis I: Introduction**
Registration #0925-761
An introduction to radiometric concepts as they relate to remote sensing. The emphasis is on aerial imaging systems, photo interpretation, and photogrammetry. Techniques for quantification of air photos are introduced.

Credit 4

PIMG-762 **Remote Sensing and Image Analysis II:**
Registration #0925-762 **Quantitative Analysis**
Techniques for quantification of aerial and satellite images are considered with emphasis on radiometric processing. Thermal infrared image collection, recording, and analysis for surface temperature measurement are treated in detail. Atmospheric propagation phenomena in the visible and infrared are treated in terms of their impact on aerial and satellite systems. (PIMG-761)

Credit 3

PIMG-763 **Remote Sensing and Image Analysis HI:**
Registration #0925-763 **Digital Multispectral Techniques**
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, heirarchical classifiers will also be treated. (PIMG-761, 762)

Credit 3

PIMG-764 **Remote Sensing and Image Analysis:**
Registration #0925-764 **Thermal Infrared Image Analysis**
This course deals with thermal infrared radiometric principles, sensors and applications. It involves an in-depth treatment of quantitative methods for sensing and analyzing midwave and longwave infrared energy. Applications to quantitative measurement and modeling are also treated. (PIMG-761, 762)

Credit 3

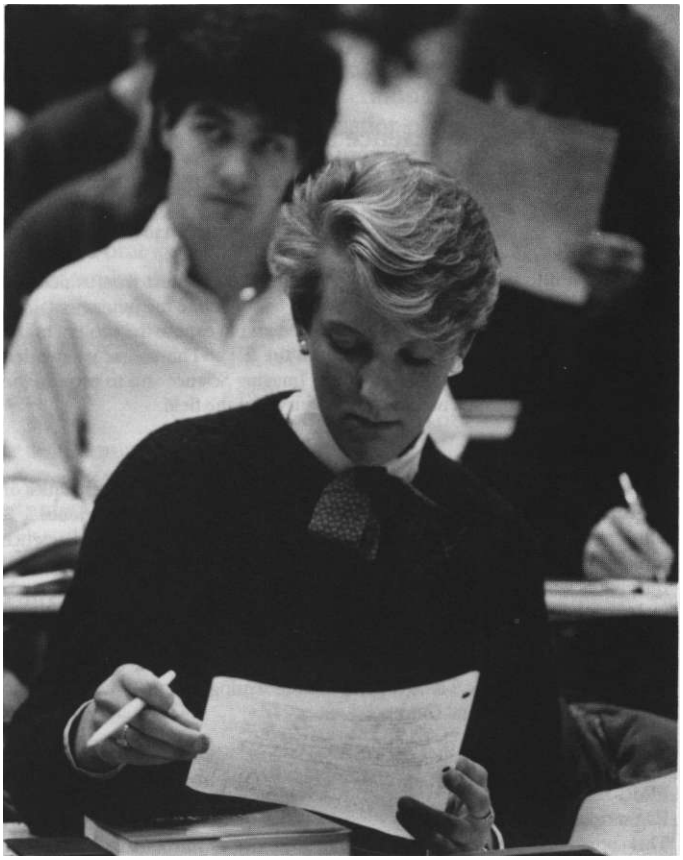
PIMG-766,767,768 **Silver Halide Science**
Registration #0925-766, 767, 768
The science of imaging with silver halide to an advanced level. The course involves both a general sophisticated review of the science and a more intensive examination of certain topics which are important to future developments, as they are currently understood. One feature of it is the development of the skills required for the assessment and criticism of technical literature.

It is an inherent characteristic of this course that it be in a constant state of revision as understanding of Silver Imaging Science and its applications becomes more sophisticated. Thus it is anticipated that the course description will be updated annually. (PIMG-421, 422, 423 or a BS degree in Imaging Science from RIT or a BS degree in Chemistry from a recognized institution or equivalent)

Credit 3

PIMG-770 **Vision**
Registration #0925-770
This course provides an overview of the human visual system and psychophysical techniques used to investigate it. Topics include: the optical design of the eye; mechanisms of photoreception; neural coding; processing of visual information; and experimental techniques. Emphasis is placed on the mechanisms of color vision.
Credit 3

PIMG-771 **Applied Colorimetry**
Registration #0925-771
An introduction to the measurement and specification of color. The CIE system of colorimetry is presented with an emphasis on its practical application to common problems in quality control, reproduction, and imaging. Topics include appearance terminology, color order systems, physics of light sources and materials, spectral-based instrumentation, trichromatic theory, CIE color spaces, and visual and instrumental color tolerancing.
Credit 3



PIMG-772 **Color Modeling**
Registration #0925-772
This course explores mathematical techniques for predicting the coloring of various imaging systems including self-luminous displays, reversal color films, thermal dye transfer printers, and color scanners. Emphasis is placed on both analytical-physical and empirical-phenomelogical approaches. Models include Kubelka-Munk turbid media theory for opaque, transparent, and translucent systems; Grassmann's laws for additive systems; and linear and higher order masking equations. Statistical techniques include multiple-linear regression and non-linear optimization via the simplex method. Accompanying laboratory stresses the characterization, calibration, and prediction of various imaging devices in a systems approach. (PIMG-221, CQAS-712)
Credit 4

PIMG-773 **Vision and Psychophysics Lab**
Registration #0925-773
This laboratory provides an overview of the psychophysical techniques used to investigate the human visual system. The optical, sensory, and neural aspects of vision and image quality are treated. Topics include experimental and analytical techniques, scaling, threshold measurements and independent experiments. (Corequisites: PIMC-700 or PIMG-770)

Credit 1

PIMG-775 **Syntactic Pattern Recognition**
Registration #0925-775
An introduction to the theory and techniques underlying the development of "intelligent" computer software. Emphasis will be placed on programming techniques and languages used in artificial intelligence research. Students will be required to design and implement programs that use these techniques to build game players, theorem provers, natural language understanding systems, or other rudimentary artificial intelligence projects. Programming projects will be required. (ICSS-706)
Credit 4

PIMG-776 **Introduction to Digital Image Processing**
Registration #0925-776

After a brief review of 2-D 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. (PIMG-709 and PIMG-785)

Credit 4

PIMG-777 **Digital Image Processing -**
Registration #0925-777 **Spatial Pattern Recognition**

This course treats methods of spatial shape and pattern recognition in digital images. It includes edge detection, edge following, and line fill and pattern matching algorithms. Methods of image and pattern registration, image segmentation, and hierarchical methods of segmentation are treated. Various methods of representation of segmented images are developed. (PIMG-776)

Credit 3

PIMG-785 **Mathematics of Linear Discrete Systems**
Registration #0925-785

This is a course in the analysis of linear discrete systems with special emphasis on imaging systems. Discrete signals and systems are defined via differential equations. Using the property of linearity, the convolution sum equation is developed and interpreted. This is followed by a discussion of the importance of geometric sequences, and from this the z-transform is developed. Properties of this transform are explored including the inversion integral via complex residue theory. The discrete Fourier transform and its properties are then considered, along with the fast Fourier transform algorithm. (PIMG-709)

Credit 3

PIMG-786, 787, 788 **Lithographic Imaging and Microelectronic**
Registration #0925-786, 787, 788 **Applications I, II. m**

This three-course sequence presents the principles and practice of lithographic imaging with primary focus on applications to the integrated circuit fabrication process. The principles of polymer science, photochemistry, and radiation chemistry are presented. The chemistry of one-and two-component positive- and negative-working resist systems active toward ultraviolet/visible, deep ultraviolet, x-ray, electron beam, and ion beam radiation, the chemistry of the development and processing of resist images, the characteristics of various exposure tools, and the elements of image transfer processes are described. The physics of exposure methods and lithographic imaging are discussed.

Credit 3

PIMG-789 **Remote Sensing: Linear System Theory and**
Registration #0925-789 **Digital Image Processing Applications**

This course draws on the student's knowledge of linear system theory and digital image processing to applications 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 the application of theory to practice. The course is offered Spring Quarter every second or third year. (PIMG-761, 762, and 709 or 776, or permission of instructor based on equivalent course work)

Credit 3

PIMG-792 **Principles of Computerized Tomographic Imaging**
Registration #0925-792

Image reconstruction from projections is introduced as a mathematical problem. Technique for reconstruction via Fourier domain is explained using Fourier slice theorem. Simple and filtered backprojection and iterative methods are introduced. Algorithms for various techniques are developed, and artifacts and noise in discrete case are considered. Applications to several medical imaging modalities are oudined, with brief consideration of the physics of imaging involved in each case. Tomographic imaging with diffracting sources is introduced. (PIMG-709 or PIMG-776)

Credit 3

PIMG-890 **Research and Thesis**
Registration #0925-890

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)

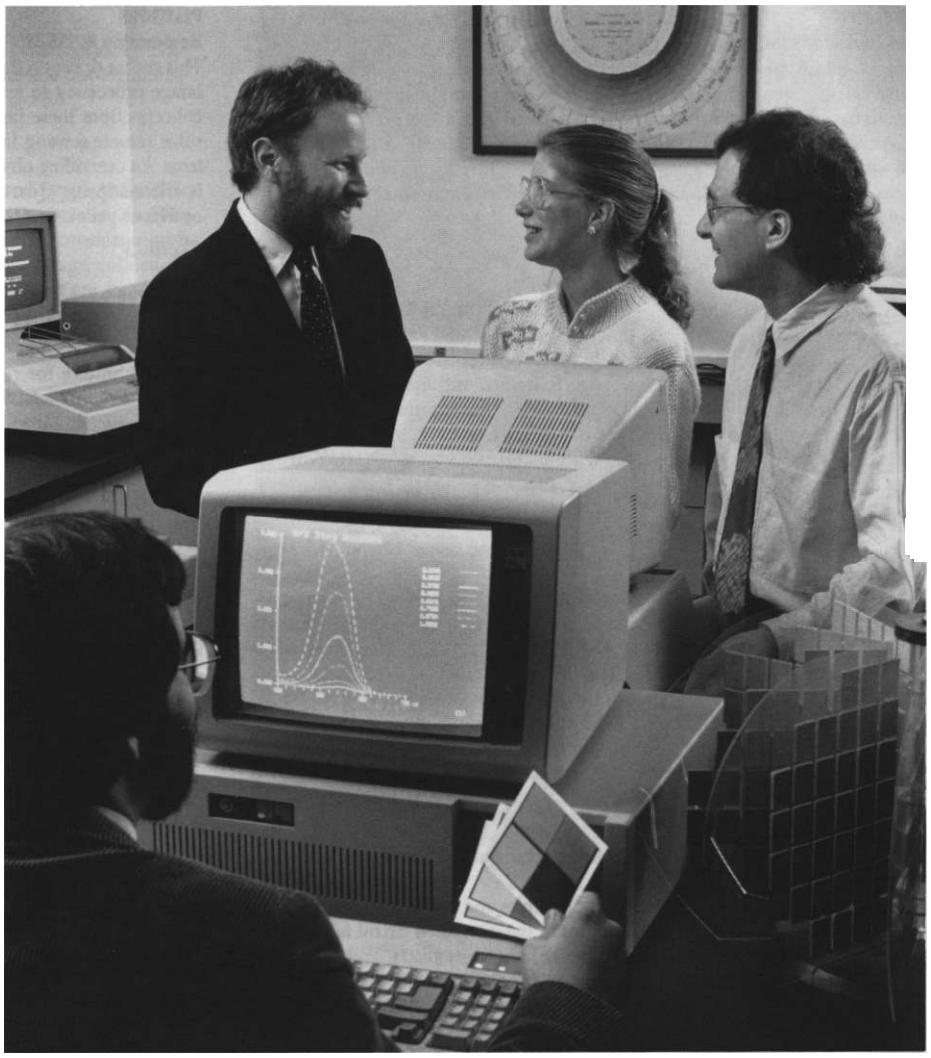
Master of Science Degree in Color Science

Dr. Mark D. Fairchild
Coordinator, MS Program
(716)475-2784

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 is a program developed to educate students using a broad interdisciplinary approach. This is a unique opportunity for students as this is the only graduate program in the country devoted to this discipline. The program is designed for students whose undergraduate majors are in physics, chemistry, imaging science, computer science, electrical engineering, psychology, physiology, textiles, graphic or fine arts, art conservation, or any discipline pertaining to the quantitative description of color. Candidates who do not have adequate undergraduate work in related sciences must make up foundation courses before matriculating into the program.

The color science major provides graduate level study in both color science theory and its practical application. The program will give students a broad exposure to the field of color and will afford students the unique opportunity of specializing in a particular area appropriate for their background and interest. This objective will be accomplished through the program's core courses, selection of electives, and completion of the thesis.

The degree program in color science revolves around the activities of the Munsell Color Science Laboratory within the Center for Imaging Science. The Munsell Laboratory is already the preeminent academic laboratory in the country devoted to color science. Research is currendy underway in color appearance and discrimination psychophysics, imaging device-independent calibration, color reproduction, and high-accuracy spectrophotometry and spectroradiometry. Since its inauguration in 1984, three industrial conferences have been held, drawing participants from around the world. Industrial seminars devoted to the quantitative specification of color are offered on a continuing basis. Students have received co-op and full-time positions through contacts made with the assistance of the Munsell Laboratory.



The program
The color science major is a full-time or part-time master's degree program. The length of time required to earn a degree varies according to the student's undergraduate preparation in mathemetics, statistics, computer science, general science, and the number of courses taken per quarter. 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 six quarters of study at the graduate level. Part-time students generally require three 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 a research thesis. 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 prior to matriculation with graduate status. Foundation courses can be completed in three quarters.

The foundation program
The color science major is designed for the candidate with an undergraduate degree in a scientific or non-scientific discipline. Candidates with adequate undergraduate work in related sciences will start the program as a matriculated graduate student.

Candidates without adequate undergraduate work in related sciences must take foundation courses prior to matriculation into the graduate program.

Students who require foundation courses may be required to take as many as 36 credits in these subjects. A written agreement between the candidate and the coordinator of the program will be developed to identify the courses required to complete the foundation course requirements.

Foundation courses must be completed before a student can matriculate into the graduate program, and the student must earn an overall B average in these undergraduate foundation courses to be accepted. A maximum of nine credit hours at the graduate level may be taken prior to matriculation into the graduate program.

Foundation courses
The courses listed below are representative of the courses often required to meet foundation course requirements.
SMAM-251,252,253 Calculus I, II, III-4cr.
SPSP-211,212,213 College Physics I, II, III—3 cr.
SPSP-271,272,273 College Physics Lab I, II, III—1 cr.
ICSP-309 C Programming—4 cr.
SMAM-309 Elementary Statistics—4 cr.
GSSP-509 Psychology of Perception—4 cr.

Program requirements
The master of science degree program in color science requires the completion of 45 quarter credit hours of study including nine hours for the thesis. The program curriculum is a combination of required courses in color science and elective courses which will satisfy the student's individual needs. The student may choose elective courses with the approval of the coordinator of the program. This flexibility enables the program to be broadly interdisciplinary.

Required Color Science Core Courses
PIMC-700 Vision and Psychophysics—4 cr.
PIMC-701 Applied Colorimetry—3 cr.
PIMC-706 Applied Colorimetry Laboratory—2 cr.
PIMC-702 Theory of Color Measurement—4 cr.
PIMC-801 Color Science Seminar—3 cr.

Electives
Appropriate electives should be selected to bring course work to 36 credit hours. The following is a partial list of possible recommended electives.
PIMC-802 Optical Radiation Measurements—4 cr.
PIMC-803 Color Modeling—4 cr.
EQAS-830,831 Multivariate Analysis I, II—3 cr.
EQAS-841,842 Regression Analysis I, II—3 cr.
PIMG-731 Geometrical Optics—3 cr.
PIMG-732 Physical Optics—4 cr.
PIMG-776 Introduction to Digital Processing—4 cr.
PIMG-756,757,758 Principles of Electrophotography Materials and Processes—3 cr.
ICSG-761 Fundamentals of Computer Graphics—4 cr.
FADG-782 Three-Dimensional Computer Graphic Design—3 cr.
FADG-785 Computer-Generated Slide Design—3 cr.

Thesis
Nine credit hours are required. Topics should be chosen that complement the candidate's undergraduate education. The technical advisory board to the Munsell Color Science Laboratory, in addition to the coordinator of the program, can aid the candidate in selecting a thesis topic which has current industrial relevance.

Admission
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 reasonable chance of success. Scientific reasoning, technical writing, and oral communication skills are particularly important.

Requirements
Graduate application
Earned baccalaureate degree
Graduate record examination (GRE)
Official undergraduate transcript
Two professional recommendations
An on-campus interview when possible
Undergraduate GPA of 3.0 or higher
Foundation course work of 3.0 or higher (if required)
TOEFL score of at least 575 (international students)
TSE-A score of at least 250 (international students)

Munsell Advisory Board
In order to ensure that the research activities surrounding the degree program are relevant to current industrial needs, the Munsell Color Science Laboratory Advisory Board was established. The board's members have expertise in color vision, color measuring instrumentation, psychophysics, computer colorant formulation, lighting, art, and applied color technology. The Advisory Board provides an excellent resource for students in both the selection of a thesis topic and future placement.

A Typical Full-Time* Schedule of Courses

Courses	Credits
Fall	
PIMC-700 Vision and Psychophysics	4
Graduate Electives	6
Winter	
PIMC-701 Applied Colorimetry	3
PIMC-706 Applied Colorimetry Laboratory	2
Graduate Electives	6
Spring	
PIMC-803 Color Modeling	4
Fall	
PIMC-702 Theory of Color Measurement	4
PIMC-890 Thesis	3
Winter	
PIMC-801 Color Science Seminar	3
PIMC-890 Thesis	3
Spring	
PIMC-802 Optical Radiation Measurements	4
PIMC-890 Thesis	3
Total	45

*Note: 12 credit hours per quarter are considered a full-time load. Remaining credits are given as equivalency credits for teaching and research assistantship activities.

Master of Science in Color Science

PIMC-700 **Vision and Psychophysics**
Registration #0926-700
This course provides an overview of the human visual system and psychophysical techniques used to investigate it. Topics include: the optical design of the eye; mechanisms of photo reception; neural coding; processing of visual information; and experimental techniques. Emphasis is placed on the mechanisms of color vision.

Credit 4

PIMC-701 **Applied Colorimetry**
Registration #0926-701
An introduction to the measurement and specification of color. The CIE system of colorimetry is presented with an emphasis on its practical application to common problems in quality control, reproduction and imaging. Topics include appearance terminology, color order systems, physics of light sources and materials, spectral-based instrumentation, trichromatic theory, CIE color spaces, and visual and instrumental color tolerancing.

Credit 3

PIMC-706 **Applied Colorimetry Lab**
Registration #0926-706
An introduction to spectral and colorimetric instrumentation used in colorimetry. Laboratories include spectroradiometry, spectrophotometry, glossimetry, visual and instrumental color tolerances, and instrumental precision and accuracy. Usually taken concurrendy with PIMC-701.

Credit 2

PIMC-702 **Theory of Color Measurement**
Registration #0926-702
This course is designed for students with an understanding of the applications of colorimetry and presents the fundamental research leading to modern color measurement techniques. Lectures and laboratories provide the background for further studies and research and development in the field of color science. Topics include: daylight specification, instrumental geometries, color matching functions, color appearance, color difference, metamerism, and computer colorant formulation. Available to color science MS students or by permission of instructor. (PIMC-700, PIMC-701, PIMC-706)
Credit 4

PIMC-751 **Special Topics**
Registration #0926-751
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 varies

PIMC-801 **Color Science Seminar**
Registration #0926-801
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 instructor. May be taken more than once for credit with permission of coordinator. (PIMC-700, PIMC-701, PIMC-702, PIMC-706)

Credit 3

PIMC-802 **Optical Radiation Measurements**
Registration #0926-802
An in-depth treatment of the instrumentation and standardization required for accurate and precise measurements of optical radiation. The optical properties of objects and radiation sources will be covered. The optical and electronic design of spectroradiometric and spectrophotometric instrumentation is discussed in detail. The use of standard reference materials for the calibration and evaluation of instrumentation is explored. The laboratory is heavily stressed: students fully analyze the design and performance of various instruments. Available to color science MS students or by permission of instructor. (PIMC-701, PIMC-706)
Credit 4

PIMC-803 **Color Modeling**
Registration #0926-803
This course explores mathematical techniques for predicting the coloring of various imaging systems including self-luminous displays, reversal color films, thermal dye transfer printers, and color scanners. Emphasis is placed on both analytical-physical and empirical-phenomelogical approaches. Models include Kubelka-Munk turbid media theory for opaque, transparent, and translucent systems; Grassmann's laws for additive systems; and linear and higher order masking equations. Statistical techniques include multiple-linear regression and non-linear optimization via the simplex method. Accompanying laboratory stresses the characterization, calibration, and prediction of various imaging devices in a systems approach. (PIMC-701, PIMC-706, EQAS-830 or EQAS-841)

Credit 4

PIMC-890 **Research and Thesis**
Registration #0926-890
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)

PIMC-899 **Independent Study**
Registration #0926-899
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.

Class, Credit variable

Graduate Faculty Center for Imaging Science

Rodney Shaw, BS, Leeds University; Ph.D., Cambridge University—Professor, Director of the Center for Imaging Science

Roy S. Berns, BS, MS, University of California; Ph.D. Rensselaer Polytechnic University—Richard S. Hunter Professor, Director of the Munsell Color Science Laboratory

Edward R. Dougherty, BS, MS, Fairleigh Dickinson; Ph.D., Rutgers University—Associate Professor

Roger L. Easton, Jr., BS, Haverford College; MS, University of Maryland; MS, Ph.D., University of Arizona—Assistant Professor

Mark D. Fairchild, BS, MS, Rochester Institute of Technology; Ph.D., University of Rochester—Assistant Professor

Richard Hailstone, BS, Northern Illinois University; MS, Indiana University-Associate Professor

Joseph P. Hornak, BS, Utica College; MS, Purdue University; Ph.D., University of Notre Dame—Wiedman Chair

Dana G. **Marsh,** BS, California State University Long Beach; ME, Rochester Institute of Technology; Ph.D., University of California Riverside—Associate Professor

Pantazis Mouroulis, BS, University of Athens; Ph.D., University of Reading—Assistant Professor

Zoran Ninkov, BS, University of Western Australia; MS, Monash University; Ph.D., University of British Columbia—Assistant Professor

Navalgund Rao, MS, Banaras Hindu University; Ph.D., University of Minnesota—Assistant Professor

Harvey E. Rhody, BSEE, University of Wisconsin; MSEE, University of Cincinnati; Ph.D., Syracuse University—Professor

John Schott, BS, Canisius College; MS, Ph.D., Syracuse University—Professor

Mehdi Vaez-Iravani, BS, Ph.D., University College London—Assistant Professor

Master of Fine Arts Degree in Imaging Arts

Martha Leinroth, Coordinator
MFA Program, (716) 475-2616

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. It is rooted in the belief that the study of imaging as a fine art can be enhanced by the study of imaging as an applied art, as a liberal art and as a technical art. The program provides each student an opportunity to pursue graduate study in photography and other imaging arts as a means to personal, aesthetic, intellectual and career development.

The MFA curriculum is not based on a fixed pattern of study, but rather on a flexible one which is continually sensitive to the needs of each student and builds upon the strengths that he or she brings to the program. Flexibility extends beyond what is to be learned to *where* it can be learned and *how* it can be learned and validated.

The degree in imaging arts is offered with three areas of academic concentration: photography, computer animation and museum studies. Successful completion of the program enables a student to seek careers in education, museum or gallery work, business, broadcasting, *AIM* production, advertising or as a self-employed professional.

The broad goals of the program are to:

1. Provide students the opportunity to use photography and other imaging arts as a means to pursue a career and earn a livelihood.
2. Provide students the opportunity to use photography and other imaging arts as a means to enrich their personal lives and society as a whole.
3. Provide an environment that encourages a sense of community, creativity, scholarship and purpose.

Electives

Elective courses are available in animation, video, video discography, printmaking, painting, sculpture, communications design, museum studies, crafts, bookmaking, typography, color photography, mixed media, studio photography, advertising photography, perception, sensitometry, computer graphics, art history, archival preservation and conservation. There are also opportunities for independent studies and experiential study.

Photography

This program concentration spans a wide range of imaging arts from traditional black-and-white photography to hand-applied emulsions to altered multimedia collage and electronic or computer-generated imagery. Projects can be in the form of video, books or installations—the artist is not limited by the usual connotations of the word "photography."

Computer animation

This concentration in the Film/Video Department emphasizes computer animation as a studio art and views computer graphics programming as a skill

necessary for the mature computer animator. Both course work and thesis work combine the technical and aesthetic practice of computer animation with the learning of programming techniques relevant to the discipline.

Museum studies
The concentration in museum studies is designed to train individuals in the care and identification of photographs from all eras and in the management and interpretation of photographic collections.

The faculty
The MFA in imaging arts program is supported by a staff of 45 faculty members within the School of Photographic Arts and Sciences and adjunct faculty members at the International Museum of Photography, George Eastman House and the Visual Studies Workshop, as well as RIT's Image Permanence Institute.

Faculty and course work are also available from the School of Printing Management and Sciences, College of Fine and Applied Arts and 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. 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 to the coordinator of the program based on the above interlocking criteria.

Students who are judged to need more study in the general areas of art, photography and/or technology will be advised to take such courses either prior to entrance or during their first year of study. Recommendations will be made by the coordinator with advice from the appropriate faculty members. Areas of art and photography include art history, photographic history, aesthetics, criticism, and general studio work in any form of image making.

To apply for admissions to graduate study, a student must submit evidence of his or her undergraduate degree, an acceptable portfolio, a statement of purpose, and references. All correspondence concerning applications or catalogs should be addressed to the Director of Admissions at RIT.

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 18 quarter credit hours (12 semester hours) of B or better graduate work is transferable toward the degree with the approval of the coordinator.

Portfolio
Selection of candidates for the graduate program is a difficult process. Along with written records of accomplishment and recommendations, the portfolio serves to inform the faculty of the applicant's imaging accomplishments. It is a pictorial statement of the candidate's performance to date in terms of his or her skills and visual sophistication.

About 20 black-and-white and/or color slides that represent a cohesive body of photographic work should be sent. (The word *photographic* includes such photo-related media as printmaking, screen printing, computer-generated images, electrophotography, color proofing, gum bichromate, cyanotype and albumen.) Please put your name on each slide.

Applicants who are interested in the computer animation concentration are advised to send in a portfolio that consists of videotape (VHS or %" format) images and/or evidence of computer imagery, animation or cinematography. Do not send master tapes or original films. Museum studies applicants will be reviewed on the basis of a visual portfolio; however, documentation of scholarly papers, projects and/or work experience will weigh heavily in the graduate faculty's decision.

The portfolio should be packaged in such a way as to facilitate handling (unpacking, viewing, repacking and shipping). A label with a return address would be helpful. Be sure to include a check or money order sufficient to cover return postage or shipping. The portfolio should be sent directly to the coordinator of the MFA photography program. Applications are accepted beginning in September of each year. Portfolios should be submitted in time to arrive the first week in March.

Initial selection of the Fall class in the imaging arts program is made in mid-March from among all portfolios and completed applications received from September of the previous year. Under a modified "rolling admissions" policy, some candidates are offered admission after the initial selection process. For further information or advice on this situation contact the MFA Coordinator direcdy.

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 through the intent of the candidate or as a result of necessity to cover certain 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.

MFA in Imaging Arts
The MFA degree encompasses work in three areas of study:

1. Major concentration. Designed to give depth of experience in the area of the student's major interest and chosen from one of three concentrations: photography, museum studies or computer animation. All students will complete 16 of these hours in required courses. Other course work is selected from many flexible alternatives.	40 cr.
2. History and Aesthetics of Imaging Arts and related art forms.	15 cr.
3. Electives	19 cr.
4. Thesis Seminar and Research & Thesis	16 cr.
TOTAL	90 cr.

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 help of the MFA coordinator 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 MFA faculty.

All course work, including an accepted thesis, must be completed within seven years of entrance into the program.

Photo gallery
The photo gallery is used to exhibit graduate thesis work, student work and works of contemporary imagemakers.

Thesis
The thesis exhibition/project should be an original body of work appropriate to the major commitment of the degree candidate. A written thesis of record will be prepared for inclusion in the library. Specific directions are available in the MFA handbook.

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 of Thesis work completed for the master's degree.

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 some of the newer visual imaging methods by courses in computer graphics, computer animation and video discography. The Rochester area is enhanced with outstanding physical and human resources. In addition to those located in the College of Graphic Arts and Photography at RIT, there are resources to be found in two major additional institutions heavily involved in photographic education and innovation: the International Museum of Photography at the George Eastman House 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 45 highly specialized and diverse instructors. The program is designed to reflect this diversity.

School of Photographic Arts and Sciences

All courses in the School of Photographic Arts and Sciences are offered at least once annually, except as noted.

Master of Fine Arts in Imaging Arts

PPHG-701,702,703 **History and Aesthetics of Photography**
Registration #0903-701, 702, 703
The course will survey the major issues throughout the development of the medium: prehistory up to the 19th century; *fin de siecle* to present.
Credit 3

PPHG-704 **Minor White Seminar**
Registration #0903-704
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)

PPHG-705 **Graduate Seminar**
Registration #0903-705
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 photographs, to meet with visiting artists on campus and to participate in a thesis sharing from time to time.
Credit 2

PPHG-707, 708, 709 **Film History and Aesthetics**
Registration #0903-707, 708, 709
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

PPHG-710 **Film/Video Tools for Computer Animation**
Registration #0903-710
A hands-on review of the various methods of copying and manipulating computer-generated animation. This includes the transfer of images and sound to 16mm film or videotape, the skills needed to edit these formats and the technical manipulations available once the images have been transferred.
Credit 3

PPHG-711 **The Landscape as Photographs**
Registration #0903-711
A first-year graduate course in the major artistic, mythological, political, and economic issues influencing the development and use of landscape photography in America from the 1840s to the 1980s. 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

PPHG-712 **Dadaism, Surrealism and Photography**
Registration #0903-712
A first-year course that 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

PPHG-714 **History of Animation**
Registration #0903-714
This course is based upon the belief that a knowledge of the history of animation will enable students to make better informed creative decisions. The four divisions of the subject studies are: origins and early experiments in animation; the industrialization of the process, independent and experimental animation; and computer animation. Students are responsible for writing a paper drawn from an independent investigation of some aspect of the subject, topic to be approved by instructor. The course format is lectures, discussions, and screens of historically significant films.

Credit 4(F)

PPHG-715 **Photographic Extensions**
Registration #0903-715
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

PPHG-717 **Preservation Issues with Fine Art and**
Registration #0903-717 **Historical Photographs**
This is a non-laboratory technical course which surveys the structure and deterioration mechanisms of major historical photographic processes. It examines the technical basis of preservation strategies within a museum or archive and presents an approach to preservation that is integral with collection management and curatorial functions.
Credit 4

PPHG-720, 721, 722 **Photographic Workshop**
Registration #0903-720,721, 722
Each faculty member offers a different opportunity for students to explore the multiplicity of ways that photography can be used as a vehicle for expression and communication. Visual research, group critiques, field trips, studio and laboratory practice are used.

Credit 4

PPHG-725, 726, 727 **Photography Core**
Registration #0903-725,726, 727
Major emphasis is placed on the individual's learning to generate and intensify his or her personal statement through photography. Some of the projects are assigned, while others are selected by the candidate. Work is critiqued weekly by the instructor.

Credit 4

PPHG-730, 731, 732 **Cinematography**
Registration #0903-730,731, 732
Filmmaking workshop: individually planned studies in cinematography, as determined by faculty-student consultation, group critiques, seminars, studio and laboratory practice, field trips.
Seminar 2, Lab 2-6, Credit 3-9 (not offered every year)

PPHG-733 **Animation and Graphic Film Production I**
Registration #0903-733
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, eel, ink and paint animation, and kinestasis. Screenings of professionally made films will illustrate each technique. Proficiency in drawing is not required. No prerequisites.

Class 2, Discussion 1, Lab 2; Credit 4 (F, W)

PPHG-734 **Animation and Graphic Film Production II**
Registration #0903-734
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 PPHG-733. 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. (PPHG-733)

Class 2, Discussion 1, Lab 2; Credit 4 (W, S)

PPHG-735 **Animation and Graphic Film Production III**
Registration #0903-735
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. (PPHG-734)
Class 2, Discussion 2, Lab 2; Credit 4 (S, F)

PPHG-740, 741, 742 **Photographic Museum Practice**
Registration #0903-740, 741, 742
Museum internship workshop, still or motion picture; research, assigned projects; seminars in history, function and administration of museums, with emphasis on photographic curatorial duties; practice in exhibition planning and development; field trips. This cannot be selected as a minor concentration. (Graduate status as museum major)

Credit 4

PPHG-750,751,752 **Special Topics Workshop**
Registration #0903-750, 751, 752
Advanced topics of current or special interest designed to broaden and intensify the student's ability to use photography as a means of communication and expression.

Credit 3-9

PPHG-753 **Photographic Workshop for Teachers**
Registration #0903-753
A graduate course in the principles and practices of photography designed especially for the high school or community college teacher, counselor or advisor, who may be involved in instruction or career guidance in photography.

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 stressed. Teaching methods, course development, and ideas in visual communications are examined. Teaching technique relevant to the instruction of photography will be stressed. Career opportunities in photography will be explored.

Credit 6 (not offered every year)

PPHG-754 **Teaching Photography**
Registration #0903-754
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)

PPHG-755 **Applied Sensitometry**
Registration #0903-755
This course presents relevant sensitometric and photographic theory, principles and practices in a manner sensitive to the background and needs of a fine art photographer.

Credit 4 (not offered every year)

PPHG-756 **Zone System Principles**
Registration #0903-756
An applied course of selected sensitometric statistical and perceptual principles necessary to the understanding and practice of the Zone System. The principles are taught so that they can be generalized and transferred to the understanding and practice of other image-forming systems such as film making, video, graphic arts printing, screen printing, etc.

Credit 4

PPHG-760 **Perception and Photography**
Registration #0903-760
An advanced course which provides an applied psychological framework for the ways we select, code, organize, store, retrieve and interpret visual images and explores how photographs relate to art and perception.

Credit 4 (not offered every year)

PPHG-762, 763, 764 **Alternative Processes**
Registration #0903-762, 763, 764
An advanced course in the production and presentation of 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, the production of visual books, and generative systems such as electrostatics and offset lithography.

Credit 4

PPHG-767, 768, 769 **Contemporary Issues**
Registration #0903-767, 768, 769
A study of current issues relevant to fine art photography, how they relate to broader historical/cultural issues, and how they might suggest future directions.
Credit 2

PPHG-770 **Scriptwriting for Animation**
Registration #0903-770
This course explores the principles of dramatic structure and storytelling in both fiction and non-fiction animated film and video. Students prepare short scripts suitable for production and prepare finished storyboards from those scripts.

Credit 4

PPHG-775 **Introduction to Animation and Graphic Film Production**
Registration #0903-775
This course is designed to introduce students to the expressive potential of single frame film and video making. The course does not use computers and does not concentrate on traditional eel and character animation. Students use a professional animation stand to complete several short film or video disc sequences in response to a variety of creative problems and technical challenges. Screenings and numerous professionally produced films accompany and illustrate the lectures.

Credit 4(F)

PPHG-776 **Microcomputer Animation I**
Registration #0903-776
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.

Credit 4 (W)

PPHG-777 **Microcomputer Animation II**
Registration #0903-777
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. (PPHG-727)

Credit 4 (S)

PPHG-778 **3-D Computer Animation**
Registration #0903-778
Students begin work in modeling three-dimensional space and manipulating objects within that space with particular attention to the role of color and color effects in animation. Emphasis is on color as a vehicle of expression and the techniques used to model, shade, display, and record three-dimensional objects.

Credit 4

PPHG-799 **Independent Study**
Registration #0903-799
Learning experiences not provided by formal course structure may be obtained through the use of an independent study contract.

Credit 1-9

PPHG-877 **Museum Internship**
Registration #0903377
Experiential learning is provided in collections management, cataloguing and classification, exhibition preparation and exhibitions, research and critical writing.

Credit **1-8**

PPHG-887, 888, 889 **Research Seminar**
Registration #0903-887,888, 889
The 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, copyright, and gallery also are covered.

Credit **2**

PPHG-890 **Research and Thesis**
Registration #0903-890
The 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.

Credit **1-12**

Graduate Faculty School of Photographic Arts and Sciences

Bradley T. Hindson, BA, Rutgers; MFA, Ohio University—Associate Professor, Fine Art Photography

Martha Leinroth, AB, Wellesley College; MFA, Rhode Island School of Design-Assistant Professor, Fine Art Photography

Elaine O'Neil, BFA, Philadelphia College of Art; MS, Illinois Institute of Technology-Professor

Elliott Rubenstein, MFA, SUNY, Buffalo; MA, St. John's University-Associate Professor, Fine Art Photography

Erik Timmerman, MFA, USC—Associate Professor, Film/Video Department

Jeff Weiss, BS, University of Michigan—Associate Professor, Fine Art Photography

Ken White, BA, Princeton University; MA, MFA, University of New Mexico—Associate Professor, Chairman, Fine Art Photography

Richard D. Zakia, BS, Rochester Institute of Technology; Ed. D., University of Rochester—Professor; Fine Art Photography

Associates of Graduate Faculty

Christine Compte, MS, Computer Science, Rochester Institute of Technology-Assistant Professor, Applied Computer Studies

Andrew Davidhazy, MFA, Rochester Institute of Technology—Professor, Imaging and Photographic Technology

Guy Johnson, MS, Syracuse—Professor, Chairman, Applied Computer Studies

Steven Kurtz, MFA Photography, MS Computer Science, Rochester Institute of Technology—Assistant Professor, Applied Computer Studies

Judy Levy, MFA, Rochester Institute of Technology—Instructor, Fine Art Photo

James M. Reilly, BA, Franklin and Marshall, MA SUNY Buffalo, Director, Imaging Permanence Institute, Rochester Institute of Technology, Associate Professor, Photography

Grant B. Romer, BFA, Pratt Institute, MFA, Rochester Institute of Technology, Conservator, International Museum of Photography, George Eastman House; Lecturer, Photography

Malcolm Spaull, MFA, Rochester Institute of Technology—Associate Professor, Chairman of Film/Video Department

Michael Starenko, BA, Kalamazoo College; MA, University of Chicago—Lecturer, Fine Art Photography

College of Liberal Arts

Dr. William J. Daniels, Dean

The College of Liberal Arts offers a master of science degree in School Psychology. In addition, the college has a cooperative relationship with the State University of New York at Buffalo, School of Social Work, which offers the MSW degree with a concentration in deafness. Contact Helen Wadsworth at 475-2875 for further details.

The college provides a number of graduate courses which serve as electives for some of the master's degree programs offered by other colleges at RIT. A primary objective of these elective graduate courses is to 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 the professional education, making a direct and distinctive contribution to the student's preparation for a specialized career.

Master of Science Degree in School Psychology

Dr. V. K. Costenbader, Director, School Psychology (716-475-6701)

The College of Liberal Arts offers a graduate program leading to the master of science degree 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 elementary, junior high, and high school students, teachers and administrators, parents and professionals. They offer services which lead to the amelioration of existing student-related educational difficulties, and attempt to prevent school problems. Through diagnostic testing and intervention, they help students deal with their learning difficulties, and improve their adjustment to school.

The school psychology program is rich in resources. RIT-affiliated facilities such as the Learning Development Center, Horton Child Care Center, and the National Technical Institute for the Deaf are available for training experiences. Nearby urban, suburban, and rural public schools offer placements for practicum and internship experiences under the supervision of certified school psychologists.

Admission guidelines

Admission to the program is based on the following criteria:

- Successful completion of the Baccalaureate degree at an accredited college or university
- A cumulative grade point averge of 3.0 or above
- Completion of at least 27 quarter hours in behavioral sciences with a B grade or above

  Prerequisite courses include:
  - General Psychology
  - Elementary Statistics
  - Child or Developmental Psychology
  - Abnormal Psychology
- Minimum Graduate Record Examination (GRE) scores:
  - Verbal 550
  - Quantitative 500
  - Psychology 500
- Evidence of professional commitment and potential for developing effective relationships with children, youth, and adults:
  - Letters of reference
  - Student statement about goals, prior related experience, and future plans
- An individual interview

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

Course number and title	Credits
Required Psychological Foundations and Professional Courses	24
GSSP-701 Developmental Psychology	4
GSSP-723 Behavior Disorders of Children and Youth	4
GSSP-724 Counseling I	4
GSSP-726 Tests and Measurements	4
GSSP-744 Counseling II	4
GSSP-745 Human Learning	4
Required Statistics and Research Methodology	
GSSP-728 Research for the School Psychologist	4
Master's Project	
Required Specialized Courses	28
GSSP-730 Seminar for the School Psychologist	4
GSSP-731 Intellectual Assessment	4
GSSP-732 Assessment of Social and Emotional Functioning	4
GSSP-733 Behavioral Assessment and Management Techniques	4
GSSP-734 Assessment of Exceptional Children and Youth	4
GSSP-742 Learning Disabilities: Identification and Intervention	4
GSSP-749 Consultation Processes	4
Required Field Experience	26
GSSP-735 Practicum in School Psychology I	4
GSSP-736 Practicum in School Psychology II	4
GSSP-777 Internship in School Psychology I	6
GSSP-777 Internship in School Psychology II	6
GSSP-777 Internship in School Psychology III	6
Electives*	12
Total Credits	94

**Educational Psychology (GSSP-702), Cultural Diversity in Education (GSSS-701), Foundations of Education/ Curriculum (GSSP-743), Psychology and Deafness (GSSP-740), and Social Psychology (GSSP-739).*

Proposed plan of study

First Year

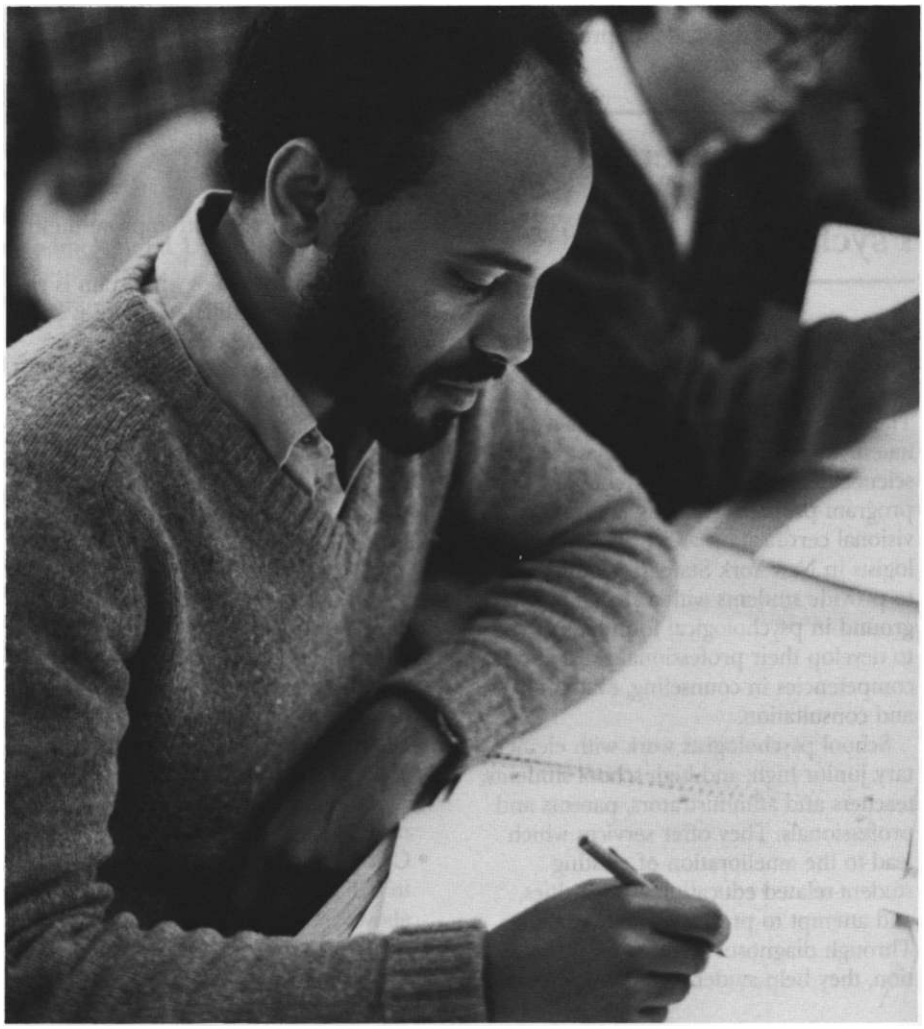
Fall Quarter	
Tests and Measurements	4
Developmental Psychology	4
Educational Psychology	4
Human Learning and Cognition	4
Total Credits	16
Winter Quarter	
Intellectual Assessment	4
Counseling I	4
Behavior Disorders of Children and Youth	4
Practicum I	4
Total Credits	16
Spring Quarter	
Social and Emotional Assessment	4
Behavior Assessment and Management	4
Counseling II	4
Practicum II	4
Total Credits	16
Summer Quarter	
Analysis of Exceptional Children and Youth	4
Seminar in School Psychology	4
Learning Disabilities	4
Research for the School Psychologist	4
Total Credits	16

Second Year

Fall Quarter	
Internship	6
Consultation	4
Total Credits	10
Winter Quarter	
Internship	6
Social Psychology	4
Total Credits	10
Spring Quarter	
Internship	6
Cultural Diversity in Education	4
Psychology and Deafness (Elective)	4
Total Credits	10
Program total hours	94

Degree requirements

A minimum of 94 quarter credit hours is required for completion of the program. Before registering for the internship, students must pass a comprehensive examination and the core battery of the NTE. A cumulative grade point average of 3.0 or above is required.



School Psychology

GSSP-701 **Developmental Psychology**

Registration #0514-701

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 3, Credit 4 (offered annually)

GSSP-702 **Educational Psychology**

Registration #0514-702

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. (See requirements for admission for prerequisites or receive permission of professor.)

Class 3, Credit 4 (offered annually)

GSSP-723 **Behavior Disorders of Children and Youth**

Registration #0514-723

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 requirements for admission for prerequisites or receive permission of instructor)

Class 3, Credit 4

GSSP-724 **Counseling I**

Registration #0514-724

This course focuses on theory and practice relative to counseling individuals within educational settings. Students will examine theories of personality and counseling important when working with children and youth. Students will practice integrating theory, methods, and processes involved in interviewing and individual counseling. Techniques for facilitating individual counseling in the school setting will be emphasized.

Class 3, Credit 4

GSSP-726 **Tests and Measurements**

Registration #0514-726

This introductory course, in a series of assessment courses, discusses basic assessment and measurement processes, types of tests and their uses, strengths and weaknesses, principles of reliability, validity, scales and norms. Students will acquire an understanding of quantitative and qualitative principles of measurement. There will be extensive laboratory experiences on a variety of instruments, the clinical method, and the uses of tests in schools and other settings.

Sample tests include Kaufman Test of Educational Achievement (K-TEA), Peabody Individual Achievement Test (PIAT), Woodcock Johnson Psychoeducational Battery—Part II, Berry Visual Motor Integration (VMI), Wide Range Achievement Test, Bender Visual Motor Gestalt Test, and various standardized diagnostic tests in subject areas. Curriculum-based assessment is introduced. Assessment from a cross-cultural perspective is emphasized. (Matriculation in the School Psychology Program or permission of instructor)

Class 3, Credit 4

GSSP-728 **Research for the School Psychologist**

Registration #0514-728

The different research methods available to school psychologists will be critically examined and utilized in analyzing each method's advantages and disadvantages. The actual procedure of producing a completed research study will be presented, from grant acquisition to publication. Statistics will be reviewed and and amplified in the course. (See requirements for admission for prerequisites or receive permission of instructor.)

Class 3, Credit 4

GSSP-730 **Seminar for the School Psychologist**

Registration #0514-730

Historic foundations, current critical professional issues, and roles and functions of the school pscyhologist 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 16 quarter credit hours successfully completed in the program or permission of instructor)

Class 3, Credit 4

GSSP-731 **Intellectual Assessment**

Registration #0514-731

This course concentrates on development of intellectual assessment skills. Students learn to select and administer individual intelligence tests, to interpret results, and to provide written and oral reports. Assessment of culturally different and handicapped populations is discussed.

Laboratory experiences involve administration, scoring, and interpretation of tests, including the Stanford-Binet-IV, Wechsler Intelligence Scale for Children (WISC-R), Wechsler Adult Intelligence Scale Revised (WAIS-R), Wechsler Pre-school and Primary Scale of Intelligence (WPPSI), Kaufman Assessment Battery for Children (K-ABC), McCarthy Scales of Children's Abilities, Raven's Progressive Matrices. (GSSP-726 and matriculation in the School Psychology Program or permission of instructor)

Class 3, Credit 4

GSSP-732 **Assessment of Social and Emotional Functioning**

Registration #0514-732

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 currendy used in the practice of psychology in the schools. (Matriculation in the School Psychology Program plus GSSP-726 and GSSP-731 or permission of instructor)

Class 3, Credit 4

GSSP-733 **Behavioral Assessment**
Registration #0514-733 **and Management Techniques**

This course offers training in the behavioral assessment of students in educational settings. Various techniques for recording and analyzing behavior are implemented, and programs for behavior management are designed. (Matriculation in the School Psychology Program or permission of instructor)

Class 3, Credit 4

GSSP-734 **Assessment of Exceptional Children and Youth**

Registration #0514-734

An applied course in the diagnostic evaluation of exceptional individuals in order to provide psychoeducational and psychoneurological information to multidisciplinary evaluation teams. Students select, administer and integrate test data, and report results and recommendations for treatment. An overview of relevant information on theory of exceptionality and current status of diagnosis and treatment of exceptional children and adolescents is provided. (Matriculation in the School Psychology Program plus GSSP-726, GSSP-731, GSSP-732 or permission of instructor)

Class 3, Credit 4

GSSP-735 **Practicum in School Psychology I**

Registration #0514-735

The practica serve as a bridge from theory and research to the professional practice of school psychology. Completion of at least 16 hours of sequential courses will serve as a basis for these courses. A weekly classroom seminar will be provided in addition to a six-hour-per-week placement in a school setting. The practica experiences are a major part of preparation for the field placement/internship. These courses are designed to be taken concurrendy with GSSP-724, GSSP-732, and GSSP-744 and GSSP-734.

Class 3, Credit 4

GSSP-736 **Practicum in School Psychology II**

Registration #0514-736

Continuation of GSSP-735

Class 3, Credit 4

GSSP-739 **Social Psychology**
Registration #0514-739
This course examines the way human behavior is affected by the social and physical environment. It analyzes the situational variables which promote or inhibit various behaviors and suggests ways in which individuals can recognize and resist social influence or fashion an environment conducive to attainment of their goals. (See requirements for admission for prerequisites or receive permission of professor.)
Class 3, Credit 4

GSSP-740 **Psychology and Deafness**
Registration #0514-740
This course is an introduction to the cognitive, linguistic and emotional processes of hearing-impaired persons. Emphasis is placed on understanding the functional integrity and the dynamics of hearing-impaired persons' psychological systems. (See requirements for admission for prerequisites or receive permission of professor.)

Class 3, Credit 4

GSSP-742 **Learning Disabilities: Identification and Intervention**
Registration #0514-742
This course provides the student with an overview of the issues and research on learning disabilities. Because the topic of learning disabilities is diverse, the course emphasizes criteria and content that have an established empirical base. Attention is directed to the issues of definition with a focus on identification (definition and diagnosis) and intervention (instruction and service delivery). Issues related to etiology and theoretical constructs of learning disabilities are presented in readings and by lecture content. A neuropsychological approach is emphasized. (See requirements for admission for prerequisites or receive permission of professor.)

Class 3, Credit 4

GSSP-743 **Foundations of Education/Curriculum**
Registration #0514-743
This course will develop an understanding of the changing nature of the schools and the continuing need for the school psychologist to become involved as a change agent and participant in the educational process. Legal and ethical considerations will be addressed. Issues surrounding curriculum, classroom management, and methods of instruction will be discussed. (See requirements for admission for prerequisites or receive permission of instructor.)

Class 3, Credit 4

GSSP-744 **Counseling II**
Registration #0514-744
This course focuses on group counseling, group guidance, and crisis intervention in the public schools. Students will be provided with experiences required to integrate theory, methods, and processes relative to group work. Techniques for facilitating group counseling and guidance in educational settings will be emphasized. Crisis intervention strategies will be examined.
Class 3, Credit 4

GSSP-745 **Human Learning**
Registration #0514-745
Selected topics that introduce the theories, issues, and related research in conditioning, verbal learning, concept formation, problem solving, information processing, perception, attention, and creativity will be applicable to the practicing school psychologist in analysis of learning behaviors. (See requirements for admission for prerequisites or receive permission of professor.)

Class 3, Credit 4

GSSP-749 **Consultation Processes**
Registration #0514-749
This course will concentrate on the development of consultation skills for the psychologist in the schools. Students will acquire an understanding of the basic models of consultation and the stages in the consultation process. Extensive laboratory work will involve observations of trained consultants, role play, and, finally, firsthand experiences in client- and consultee-centered case consultation. Readings will focus on pertinent research in school-based consultation. (Matriculation in the School Psychology Program plus 16 quarter credit hours successfully completed in the program or permission of instructor.)
Class 3, Credit 4

GSSP-777 **Internship in School Psychology I, D & m**
Registration #0514-777
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. The internship requires that students complete and present a research project equivalent to a master's thesis. (Matriculation in the School Psychology Program plus completion of 60 hours in graduate program, satisfactory core battery of NTE, and qualifying examination)

Class 3, Credit 6

GSSS-701 **Cultural Diversity in Education**
Registration #0515-701
This course is designed to lay the foundation for the introduction of a broad multicultural perspective in education. Such perspective will include the examination of cultural differences of various ethnic groups and the role schools play in addressing the questions of interpretation, ability groupings, home environments, equality of opportunity, and equality of outcome. Also analyzed are ways in which the school may act as a cultural transmitter and the teacher as cultural mediator. Different forms of school organizations will be compared, as in the public vs. private dimension. The functionalist theoretical approach will be presented, as well as the conflict perspective to frame the discussion and analysis of opposing sociological systems of thought. The 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.
Class 3, Credit 4

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 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

Liberal Arts Graduate Elective Courses

GLLL-702 **Film and Society**
Registration #0504-702
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 3, Credit 4 (offered occasionally)

GSHF-702 **Film History and Criticism**
Registration #0505-702
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)

GSHF-703 **American Architecture**
Registration #0505-703
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 3, Credit 4 (offered occasionally)

GSHF-705 **Theories of Aesthetics and Art Criticism**
Registration #0505-705
A course for the art-oriented graduate student centering on the student's search for a supportable and reliable basis for making value judgements about works of art as well as introducing the student to major concepts in aesthetics.
Class 3, Credit 4 (offered occasionally)

GSHF-707 **Cubism to the Present**
Registration #0505-707
Cubism as away 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 3, Credit 4 (offered on sufficient demand)

GSHF-711 **20th Century American Art**
Registration #0505-711
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 3, Credit 4 (offered occasionally)

GSHF-712 **Arts and Crafts in Tribal Societies**
Registration #0505-712
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 also will be discussed.

Class 3, Credit 4 (offered occasionally)

GSHF-713 **Contemporary Issues in Art**
Registration #0505-713
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 3, Credit 4 (offered occasionally)

GSHF-714 **Art Vision and Concept**
Registration #0505-714
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 helpftil but not necessary.
Class 3, Credit 4 (offered occasionally)

GSHF-715 **Picasso**
Registration #0505-715
The impact of Picasso and his circle on 20th century art. Their affinities with modern scientific and philosophical attitudes also will be discussed.

Class 3, Credit 4 (offered occasionally)

GSHF-716 **Rembrandt**
Registration #0505-716
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 oudook.

Class 3, Credit 4 (offered occasionally)

GSHF-717 **Topics in Music History**
Registration #0505-717
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 3, Credit 4 (offered occasionally)

GSHF-721 **Oriental Art: China and Japan**
Registration #0505-721
A seminar exploring the philosophical and cultural perspectives underlying traditional Sian 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 3, Credit 4 (offered occasionally)

GSHF-722 **Oriental Art: India and Southeast Asia**
Registration #0505-722
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 3, Credit 4 (offered occasionally)

GSHH-701 **History of American Educational Thought and Practice**
Registration #0507-701
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.

Class 3, Credit 4 (offered occasionally)

GSHP-705 **Seminar in Aesthetics**
Registration #0509-705
The three-hour meetings of this course are not lectures but discussions, and participation is required of all students. Since the examples discussed are mostly from Western art, students should be familiar with the history of Western art, particularly the last 50 years. The questions discussed are philosophical questions about art and aesthetic experience: Can art be defined? Can ugliness be part of aesthetic experience? In appreciating an artwork, do we have to take into account the artist's intentions? What makes an interpretation of an artwork valid or invalid? How is aesthetic value related to ethical values?

Class 3, Credit 4 (offered annually)

GSHP-706 **The Philosophy of the Mind**
Registration #0509-706
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 occasionally)

GSSM-701 **Country Risk Assessment**
Registration #0513-701
An interdisciplinary introduction to the methods and procedures of country risk assessment. Practice in developing a country risk assessment will be offered in order to familiarize the student with the role of international environment analysis (political stability analysis) in the operations of business and financial institutions planning investments or operations abroad.
Class 3, Credit 4 (offered occasionally)

Other graduate courses

The State University of New York at Buffalo, School of Social Work, offers seven graduate social work courses on the RIT campus: Social Welfare Policies and Programs: History and Philosophy of Social Welfare; Behavioral Sciences I; Individual Development; Behavioral Sciences II; Organizational Development; Introduction to Statistical Research; Social Work Research; and Small Group Dynamics. These courses comprise most of the first year of study toward the MSW degree. For information, contact Helen Wadsworth, 475-287.

Graduate Faculty College of Liberal Arts

John Adams, Ph.D., University of California, Los Angeles—Associate Professor, Psychology

Frank Annunziata, Ph.D., Ohio State University—Professor, History

Bruce Austin, Ph.D., Temple University—the William A. Kern Professor in Communications

Brian Barry, Ph.D., Syracuse University-Associate Professor, Psychology

Kathleen Chen, Ph.D., Pennsylvania State University—Professor, Psychology

Douglas Coffey, MA, Case Western Reserve University—Professor, Fine Arts

Charles Collins, Ph.D., University of Iowa—Associate Professor, Fine Arts

Virginia K. Costenbader, Ph. D., Syracuse University—Assistant Professor, Psychology

Janet E. Farnum, Ph.D., University of Rochester—Associate Professor, Psychology

Dane Gordon, MA, Cambridge and University of Rochester—Professor, Philosophy

Roger Harnish, Ph.D., Oklahoma State University—Associate Professor, Psychology

Morton Isaacs, Ph.D., Yeshiva University—Professor, Psychology

Tina Lent, MA, University of California, Los Angeles—Assistant Professor, Fine Arts

Salvatore Mondello, Ph.D., New York University—Professor, History

John Morreall, Ph.D., University of Toronto—Associate Professor, Philosophy

Margery S. **Reading-Brown,** Ph.D., State University of New York at Albany—Assistant Professor, Psychology

Murli M. Sinha, Ph.D., Cornell University—Professor, Sociology

David B. Suits, Ph.D., University of Waterloo—Associate Professor, Philosophy

Charles W. Warren, Ph.D,, Ohio State University—Professor, Fine Arts

Houghton Wetherald, MA, Oberlin College—Professor, Fine Arts

Hans Zandvoort, MFA, Royal Academy of Fine Arts, The Hague—Professor, Fine Arts

College of Science

Master of Science in Chemistry

John D. Paliouras, Dean, College of Science

Gerald A. Takacs, Department Head, Chemistry (475-2497)

Terence C. Morrill, Chair, Chemistry Graduate Committee (475-2047)

The Department of Chemistry offers a program leading to the master of science degree in chemistry on either a part-time or full-time basis with a variety of program options designed to fill the needs of both the practicing chemist in the greater Rochester industrial community and the full-time graduate student.

Objectives

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 a minimum of supervision.

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, etc., are possible.

Admission

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 student must further demonstrate mastery of analytical, organic, and physical chemistry in qualifying examinations administered by RIT's Department of Chemistry.

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 non-matriculated 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 non-matriculated student will be limited to a maximum of 9 credits.

Any applicant who wishes to enroll in a graduate course as a non-matriculated student must obtain permission from the chair of the graduate program plus the appropriate faculty committee.

Full-time graduate work
A number of teaching assistantships and tuition-remission scholarships are available to qualified students to undertake full-time graduate work that includes research experience. The Department of Chemistry has a vigorous, research oriented faculty and 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.

Students enrolled in the program full-time are expected to complete 45 hours of course work and submit an independent research thesis. A full-time student normally takes 6 to 9 graduate credits per quarter, including thesis work. Typically, all requirements are met within two years.

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.

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 accommodates students at the master's level who have or are able to obtain industrial employment which allows for 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.

Program
Each student, together with an advisor, 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/or the qualifying examinations.

In order 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 those with SCH-700 and SCH-800 numbers and should include one or more representing each of the four fields: analytical, inorganic, organic and physical. A maximum of nine quarter credits may be taken in SCH-600 level courses.

Each student must select courses (subject to approval by the student's advisor and the graduate committee) which include the following core: SCHA-711 and 720, either SCHO-737 or SCHO-739, one of SCHP-741, SCHP-743 or SCHP-744, and one of SCHI-762, SCHI-763 or SCHI-764. Demonstrated proficiency can supplant one of the core courses. As part of the required credits, each student must have one or two quarter credit hours in seminar SCHO-870, and three to four quarter credit hours from outside of the Department of Chemistry.

2. A minimum of nine quarter credit hours in research and submission of a satisfactory thesis. This may be waived for part-time students.
3. Demonstrated competence in a foreign or computer language.
4. Pass an oral thesis defense or comprehensive examination.

Additional information
More information may be obtained from the Chair of the Graduate Committee (716) 475-2047, or the Department of Chemistry (716) 475-2497.

Master of Science in Clinical Chemistry

John D. Paliouras, Dean,
College of Science

John M. Waud, Director,
Clinical Chemistry Program (475-2182)

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.

Objectives
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
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.

Financial support
A limited number of teaching assistantships, research assistantships, and tuition scholarships are available for graduate students. Detailed information is available from the office of the director.

Program
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 Biochemistry, SCHB-702; Biochemistry-Metabolism, SCHB-703; Advanced Clinical Chemistry, SCLC-820,821,822; Organizational Behavior and Organization and Management, BBUB-740, 741; Statistics and Quality Control, SCLC-712; Survey of Physical Chemistry, SCHP-742; Clinical Laboratory Computer Applications, SCLC-722; Clinical Chemistry Research, SCLC-877 or 879; Mechanisms of Disease, SCLC-705.

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.

Graduate Faculty College of Science

John D. Paliouras, Ph.D., University of Illinois—Professor and Dean

Department of Biology

Richard L. Doolittle, Ph.D., University of Rochester—Associate Professor, Biology

Irene Evans, Ph.D., University of Rochester—Associate Professor, Biology

Paul A. Haefner, Ph.D., University of Delaware—Professor, Biology

Jeffrey S. Lodge, Ph.D., University of Mississippi—Assistant Professor, Biology

Douglas Merrill, Ph.D., SUNY College of Environmental Science and Forestry, Syracuse University—Professor, Biology

Robert H. Rothman, Ph.D., University of California, Berkeley—Associate Professor, Biology

Franz K. Seischab, Ph.D., SUNY College of Environmental Science and Forestry, Syracuse University—Professor, Biology

Department of Chemistry

Jerry M. Adduci, Ph.D., University of Pennsylvania—Professor, organic chemistry: organic mechanisms, polymer synthesis, and characterizations

B. Edward Cain, Ph.D., Syracuse University—Professor, inorganic chemistry: chemical education, methodologies and adaptation for the handicapped student

Anita C. Chernovitz, Ph.D., Syracuse University—Assistant Professor, physical chemistry: chemical kinetics, laser chemistry, conducting polymer dynamics, radiation chemistry

Robert A. Clark, Ph.D., University of Maryland—Professor and Director of the Center for Materials Science and Engineering: imaging science, physical and organic chemistry, polymers

Thomas Gennett, Ph.D., University of Vermont—Assistant Professor, analytical chemistry: electrochemistry, HPLC, ion implantation of electrode surfaces

Joseph P. Hornak, Ph.D., University of Notre Dame—Associate Professor, Wiedman Chair of Imaging Science, physical chemistry: magnetic resonance spectroscopies and imaging

Marvin L. Dlingsworth, Ph.D., University of Massachusetts—Associate Professor, inorganic chemistry: coordination polymers, synthesis of eight-coordinate complexes and complexes with ambidentate ligands

Earl Krakower, Ph.D., University of British Columbia—Professor, physical chemistry: nuclear magnetic resonance, structure, and properties of molecules, chemical education

Andreas Langner, Ph.D., SUNY Buffalo-Assistant Professor: physical chemistry, polymer science, electro-optical properties of macromolecules, polymer characterization techniques.

Terence C. Morrill, Ph.D., University of Colorado—Chair, Graduate Committee; Professor, organic chemistry: stereochemistry and mechanism of organic reactions, lanthanide-induced shifts in NMR spectrometry; C-13 NMR relaxation reagents

John P. Neenan, Ph.D., University of California, Santa Barbara—Associate Professor, biochemistry (and bio-organic chemistry): design of active-site-directed irreversible enzyme inhibitors

Christian G. Reinhardt, Ph.D., University of Rochester—Associate Professor, biophysical chemistry: biological drug receptor recognition, binding and stereochemistry; quantitative structure-activity studies and biomolecular design

Gerald A. Takacs, Ph.D., University of Wisconsin—Professor and Department Head, physical chemistry: chemical kinetics, atmospheric chemistry, plasma chemistry and photochemistry

Laura Ellen Tubbs, Ph.D., University of Rochester—Associate Professor, physical chemistry: accelerator-based ultrasensitive mass spectroscopy, natural radioisotope dating; neutron activation analysis

Kay G. Turner, Ph.D., Ohio State University—Professor, synthetic organic chemistry: synthesis of natural products including fluorescent estradiol analogs; study of estrogen receptor mechanisms

Vladimir Vukanovic, Ph.D., University of Miinster, Germany—Distinguished Professor Emeritus, physical chemistry: low and high pressure plasma chemistry, atomic spectroscopy

Department of Allied Health Sciences

James C. Aumer, MS, Michigan Technological University—Program Director, Medical Technology; Associate Professor

John M. Waud, Ph.D., Lehigh University—Program Director, Clinical Chemistry; Associate Professor

Adjunct Faculty

Richard M. Bayer, Ph.D., Rutgers University—Rochester General Hospital, Adjunct Clinical Professor

Michael R. Bogovich, BS, MS, Rochester Institute of Technology—Calibration Engineer, Clinical Products Division, Eastman Kodak Company

Nathan Hamblin, BS, Rochester Institute of Technology—Rochester General Hospital, Adjunct Clinical Assistant Professor

Howard Harrison, Ph.D., Cornell University—Rochester General Hospital, Adjunct Clinical Associate Professor

Fred D. Lasky, BS, Ithaca College, Ph.D, SUNY at Buffalo—Senior Clinical Chemist, Clinical Products Division, Eastman Kodak Company

Department of Mathematics

Maurino Bautista, Ph.D., Purdue University—Associate Professor, Mathematics

Patricia Clark, Ph.D, University of Rochester—Professor, Mathematics

David Farnsworth, Ph.D, University of Texas—Professor, Mathematics

Lester B. Fuller, Ph.D, Michigan State University—Professor, Mathematics

George Georgantas, Ph.D, SUNY at Buffalo—Professor, Mathematics

James A. Glasenapp, MA, SUNY at Buffalo—Professor, Mathematics

Marvin Gruber, Ph.D, University of Rochester—Professor, Mathematics

Laxmi Gupta, Ph.D, SUNY at Buffalo—Professor, Mathematics

James J. Halavin, Ph.D, SUNY at Buffalo—Associate Professor, Mathematics

Edwin T. Hoefer, Ph.D., SUNY at Buffalo—Professor, Mathematics
Jack Hollingsworth, Ph.D., University of Wisconsin—Professor, Mathematics
Wanda S.-Lojasiewicz, Ph.D., University of Cracow, Poland—Assistant Professor, Mathematics
James E. Marengo, Ph.D., Colorado State University—Assistant Professor, Mathematics
David Mathiason, Ph.D., University of Rochester—Associate Professor, Mathematics
Douglas Meadows, Ph.D., Stanford University—Associate Professor, Mathematics
Edward A. Newburg, Ph.D., University of Illinois—Professor, Mathematics
Richard Orr, MS, Case Institute of Technology—Professor, Mathematics
Harry M. Schey, Ph.D., University of Illinois—Professor, Mathematics
Theodore Wilcox, Ph.D., University of Washington—Professor, Mathematics
Paul Wilson, Ph.D., University of Illinois—Professor, Mathematics
James A. Wiseman, Ph.D., Boston University—Associate Professor, Mathematics
Elmer Young, Ph.D., Ohio State University—Associate Professor, Mathematics

Department of Physics

John D. Andersen, Ph.D., University of Rochester—Assistant Professor, Physics
Hrishikesh Baneijee, Ph.D., Institute of Nuclear Physics, Calcutta—Professor, Physics
Peter A. Cardegna, Ph.D., Clemson University—Associate Professor, Physics
Tracy A. Davis, Ph.D., Clemson University—Associate Professor, Physics
F. Kingsley Elder, Jr., Ph.D., Yale University—Professor, Physics
Alan B. Entenberg, Ph.D., University of Rochester—Associate Professor, Physics
Charles A. Hewett, Ph.D., University of Missouri—Professor, Physics
Ronald E. Jodoin, Ph.D., University of Rochester—Professor, Physics
James R. Kern, Ph.D., Clemson University—Associate Professor, Physics
Michael Kotlarchyk, Ph.D., Massachusetts Institute of Technology—Associate Professor, Physics
Arthur Z. Kovacs, Ph.D., Duke University—Professor, Physics
Vern Lindberg, Ph.D., Case Western Reserve University—Associate Professor, Physics
Varadaraja V. Raman, Ph.D., University of Paris—Professor, Physics
Earl H. Sexton, Ph.D., SUNY at Albany—Professor, Physics
John S. Shaw, Ph.D., SUNY at Albany—Professor, Physics
Jerome Wagner, Ph.D., University of Wisconsin—Associate Professor, Physics
Anne G. Young, Ph.D., Cornell University—Associate Professor, Physics

Materials Science and Engineering

Paul E. Petersen, Dean, College of Engineering
John D. Paliouras, Dean, College of Science
Robert A. Clark, Director of the Center for Materials Science and Engineering
Peter A. Cardegna, Program Director, Materials Science and Engineering (475-2944)

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 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, electrical and mechanical 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.

Special features of the program

A special feature of the progam 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, and physics; and consequently, to provide a new intellectual identity to those involved in the study of materials.

Second, 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.

Finally, 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 overall thrust of the program is to establish a positive relationship between academia and industry by building a sound academic base in the field of materials.

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 eight 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 the 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.

Financial aid

A limited number of teaching assistantships, research assistantships and tuition scholarships are available for graduate students. Detailed information is available from the office of the director.

Part-time study
Practicing scientists and engineers are encouraged to pursue the program on a part-time basis; therefore, the majority of the courses are offered in the late afternoon or early evening hours. (This may not apply to courses offered off campus at several 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 advisor.

Degree requirements
A minimum of 45 quarter credit hours, which includes five core courses and the seminar course, 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.

Curriculum
The core courses will be offered every year and the elective courses will be scheduled on a periodic basis.

Admission
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. An applicant is permitted to take graduate courses as a non-matriculated student, however, 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.

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 non-matriculated student.

Graduate Faculty

Materials Science and Engineering

College of Engineering and College of Science

Paul E. **Petersen,** Ph.D., Michigan State-Dean, College of Engineering, Professor and Acting Department Head, Electrical Engineering: semiconductor devices

John D. Paliouras, Ph.D., University of Illinois—Dean, College of Science, Professor: mathematics, analysis

Robert A. **Clark,** Ph.D., University of Maryland—Director of the Center for Materials Science and Engineering, Professor: chemistry, physical and organic chemistry, polymers, plasma science

Peter A. Cardegna, Ph.D., Clemson University—Director of Materials Science and Engineering Program, Associate Professor: silver halide physics, superconductivity

Lynn Fuller, Ph.D., University of Buffalo—Associate Professor and Department Head: microelectronic engineering, solid state devices and microelectronics

Charles W. Haines, Ph.D., Rensselaer Polytechnic Institute—Professor and Acting Department Head: mechanical engineering

Arthur Z. Kovacs, Ph.D., Duke University—Professor and Department Head: physics, high energy physics, systems engineering and management science

Gerald A. Takacs, Ph.D., University of Wisconsin—Professor and Department Head: chemistry, plasma physical chemistry and atmospheric science

Jerry M. Adduci, Ph.D., University of Pennsylvania—Professor: chemistry, organic mechanisms, polymer synthesis and characterization

Hrishikesh Baneijee, Ph.D., University of Calcutta—Professor: physics, nuclear physics, solid state and semi-conductor physics

Tracy Davis, Ph.D., Clemson University-Associate Professor: Remote sensing, low temperature solid state physics, optics

Alan B. Entenberg, Ph.D., University of Rochester—Associate Professor: physics, laser fusion and thin films adhesion

G. Thomas Frederick, Ph.D, Ohio State University—Professor and Department Head: biology, scanning electron microscopy, energy dispersive X-ray analysis

William G. Frizelle, MS, P.E, University of Rochester—Associate Professor: mechanical engineering technology, polymer engineering

Surendra K. Gupta, Ph.D, University of Rochester—Associate Professor: applied mechanics, materials science and computer science

Charles A. Hewett, Ph.D, University of Missouri—Professor: physics, solid state physics, fluorescence

Joseph P. Hornak, Ph.D, University of Notre Dame—Associate Professor, Wiedman Chair of Imaging Science, physical chemistry: magnetic resonance spectroscopies and imaging

Marvin L. Illingsworth, Ph.D, University of Massachusetts—Associate Professor: inorganic polymers, coordination compounds, and specialty materials

Michael Jackson, Ph.D, SUNY Buffalo-Assistant Professor: microelectronic engineering, surface analysis, solid state devices, integrated circuit metrology

Ronald E. Jodoin, Ph.D, Univeristy of Rochester—Professor: physics, optics, lasers and digital image processing

Michael Kotlarchyk, Ph.D., Massachusetts Institute of Technology—Associate Professor: physics of neutron depth profiling, characterization and phase transitions in colloidal systems

Santosh Kurinec, Ph.D, University of Delhi—Associate Professor: microelectronic engineering, materials, solid state devices, sensors

Richard Lane, Ph.D., SUNY Alfred-Professor: microelectronic engineering, materials, chemical vapor deposition, crystal growth

Andreas Langner, Ph.D, SUNY Buffalo-Assistant Professor: polymer characterization, photophysics

Vern Lindberg, Ph.D, Case Western Reserve University—Associate Professor: physics, thin film deposition and analysis

Chris Nilsen, Ph.D, P.E., Michigan State-Associate Professor: mechanical engineering, metallurgy and materials science

Alan H. Nye, Ph.D, University of Rochester—Associate Professor: mechanical engineering, solid mechanics and heat transfer

Harvey E. Rhody, Ph.D, Syracuse University—Professor: electrical engineering, communication theory

Robert L. Snyder, Ph.D., P.E., Iowa State-Professor: mechanical engineering, materials science, chemistry

David A. Sumberg, Ph.D., Michigan State University—Associate Professor: electrical engineering, lasers and optoelectronics

Renan Turkman, Ph.D., University of Paris—Associate Professor: electrical engineering, solid state devices, process modeling, plasma processing

Raman M. Unnikrishnan, Ph.D., Missouri—Associate Department Head, Professor: power electronics, control systems

Vladimir Vukanovic, Ph.D., University of Munster—Distinguished Professor Emeritus: chemistry, plasma physical chemistry, atomic spectroscopy with arc plasma source

Jerome Wagner, Ph.D., University of Wisconsin—Associate Professor: physics, defect properties in solids, medical physics and radiation dosimetry

Adjunct Faculty

John F. Carson, MS, Massachusetts Institute of Technology—Eastman Kodak Company, Rochester, N.Y.

Dennis H. Feduke, MS, P.E., Syracuse University—IBM, Endicott, N.Y.

George J. S. **Gau,** Ph.D., University of California, Berkeley—Eastman Kodak Company, Rochester, N.Y.

Mool C. Gupta, Ph.D., Washington State University—Eastman Kodak Company, Rochester, N.Y.

Henry J. Gysling, Ph.D., University of Delaware—Eastman Kodak Company, Rochester, N.Y.

J. Raymond Hensler, Ph.D., Pennsylvania State University—Director of Manufacturing Technology, Bausch and Lomb, Inc., Rochester, N.Y.

Merle N. Hirsh, Ph.D., The Johns Hopkins University—Consulting Physicist

Robert Lord, MS, Syracuse University—Manager, IBM-Endicott, Endicott, N.Y.

Gerald F. Meyers, BS, University of Pittsburgh—Plant Metallurgist, Delco Products, General Motors Corporation, Rochester, N.Y.

J. William Sexton, BS, University of Rochester—Coordinator of Optics Contracts and New Opportunities Development, Eastman Kodak Company, Rochester, N.Y.

Tien-Kuei Su, Ph.D., University of Massachusetts—Supervisor, Mobil Chemical Corporation, Macedon, N.Y.

E. Wayne Turnblom, Ph.D., Columbia University—Manager, Materials Development and Manufacturing, Technical Operations, Graphics Imaging Systems Div., Eastman Kodak Company, Rochester, N.Y.

Edward G. Williams, MS, University of Rochester—Manager of Plastics Technology, Xerox Corporation, Rochester, N.Y.

Chemistry

Courses are offered once each year or in quarter indicated after 5 p.m.

SCHA-620 **Building Scientific Apparatus**
Registration #1008-620
Basic skills associated with the construction of scientific laboratory apparatus, some of which is not commercially available, will be covered: machine shop skills, working with glass, vacuum technology, optics, and electronics. Special emphasis will be placed on the function-structure relationship between an instrument and its intended use. Several references on construction techniques will be provided and information about current manufacturers and suppliers of necessary components will be given. (Corequisite SSEG-621) (SCHP-441, SPSP-212, 213 or 312,313)

Class 3, Credit 3 (offered upon sufficient request))

SSEG-621 **Building Scientific Apparatus Laboratory**
Registration #1018-621
Basic skills associated with the construction of scientific laboratory apparatus, some of which is not commercially available, will be covered: machine shop skills, working with glass, vacuum line technology, optical spectrometer design, and instrument electronics. (Corequisite SCHA-620) (SCHP441, SPSP-212, 213 or 312, 313; or permission of instructor)

Lab 4, Credit 1 (offered upon sufficient request)

SCHA-711 **Instrumental Analysis**
Registration #1008-711
Theory, applications, and limitations of selected instrumental methods in qualitative, quantitative, and structural analysis. Topics covered include mass spectroscopy, nuclear magnetic resonance, electrochemistry, surface methods and new analytical methods. (SCHP-340, SCH0432))

Class 3, Credit 3 (offered every year) (F-X*, W)

SCHA-720 **Instrumental Analysis Lab**
Registration #1008-720
Lab accompanying SCHA-711. Experiments include AA, FT-IR and RAMAN, GC/MS, electrochemistry, and thermal analysis. Problem solving and experimental design are emphasized. (Corequisite SCHA-711)
Lab 6, Credit 2 (offered every year) (F, W-X*)

SCHB-702 **Biochemistry: Biomolecular Conformation & Dynamics**
Registration #1009-702
Introduction to biological chemistry. Chemical structures, reactions, molecular organization and physiological functions of the molecular components of cells; amino acids, proteins, enzymes, enzyme kinetics, co-enzymes, biochemical thermodynamics, carbohydrates and lipids, membrane structure, and function. Emphasis is on the structure-function relationships of biomolecules, their solution behavior and dynamics. (SCHO-433, SCHP-340 or SCHP-742)

Class 3, Credit 3 (offered every year) (F, W)

SCHB-703 **Biochemistry: Metabolism**
Registration #1009-703
Bioenergetics principles; catabolism of carbohydrates, fatty acids and amino acids; photosynthesis, biosynthesis of carbohydrates, lipids, and nitrogenous compounds; metabolic diseases. (SCHB-702)
Class 3, Credit 3 (offered every year) (F, W)

SCHB-704 **Biochemistry: Nucleic Acids and Molecular Genetics**
Registration #1009-704
The biochemistry of inheritance, expression of genetic information, protein biosynthesis, biochemical aspect of viral and bacterial infection. (SCHB-702)

Class 3, Credit 3 (offered every year) (S-X* SR)

X*: course is offered once each year at extended day hours (after 5 p.m.)

SCHC-772 **Special Topics**
Registration #1010-772
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 will 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 (offered every year)

SCHG870 **Chemistry Seminar**
Registration #1010-870

Credit 1 (offered every year)

SCHC-879-00 **Continuation of Thesis**
Registration #1010-879-00

Credit 0 or 1

SCHC-877 **External Research**
Registration #1010-877
Industrial internship research

Credit 1-16 (offered every year)

SCHC-879 **Research and Thesis Guidance**
Registration #1010-879
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 variable (offered every year)

SCHC-899 **Independent Study: Chemistry**
Registration #1010-899

Credit variable (offered every year)

SCHI-762 **Inorganic Chemistry I: Periodicity and Reactivity**
Registration #1012-762
For the common elements, mastery will be required of chemical reactions which describe: (1) their isolation, (2) their characteristic chemical reactivities, and (3) large volume industrial processes. Relationships between the reactivities of neighboring elements will be elucidated and justified according to current theories. (SCH0433, SCHP442)
Class 3, Credit 3 (offered every year) (S, SR-X*)

SCHI-763 **Inorganic Chemistry II:**
Registration #1012-763 **Isomerism, Symmetry, and Bonding**
This course provides an in-depth view of how bonding theories endeavor to account for and predict the physical properties (e.g., color, magnetism, stability, chemical potential, electrical conductivity, and others) of a wide variety of inorganic compounds. (SCH0433, SCHP-442)

Class 3, Credit 3 (offered every year) (F, W-X*)

SCHI-764 **Inorganic Chemistry III:**
Registration #1012-764 **Physical Methods and Recent Advances**
This course introduces the student to the more sophisticated tools with which an inorganic chemist investigates inorganic materials. These physical methods with the bonding theories from SCHI-763, are applied to inorganic reactions that exemplify the similarities and anomalous behavior of the elements in each family of the periodic table. Application of this knowledge to contemporary research areas of inorganic chemistry is conducted. (SCHI-763)

Class 3, Credit 3 (offered every year) (S, SR-X*)

SCHI-765 **Preparative Inorganic Chemistry**
Registration #1012-765
The complexity of many inorganic "building blocks" requires a detailed understanding of inorganic theory, special handling precautions, and special methods to investigate inorganic products. Different areas of the periodic table, new synthetic methods, and new characterization techniques are examined. (Corequisite SCHI-763) (SCHI-762 or permission of instructor)
Class 1, Lab 6, Credit 3 (offered upon sufficient request) (F,W)

SCH0301 **Organic Chemistry of Polymers**
Registration #1013-601
The chemistry of high molecular weight organic polymers and their properties are introduced and discussed in depth. Mechanisms of stepgrowth and chain-growth polymerization reactions, polymer reactions and degradations are studied. (SCH0433)

Class 4, Credit 4 (F-X*)

SCHO-7SO **Chemical Toxicology**
Registration #1013-730
This course provides a comprehensive introduction to the basic science of toxicology, with emphasis placed on (a) basic principles, methods of approach, and applications of toxicological data; (b) types and mechanisms of toxic injury produced in major mammalian organ systems; and (c) characteristics and effects of major classes of environmentally and occupationally significant toxicants. (College biology and chemistry, some biochemistry helpful or permission of instructor)
Class 4, Credit 4 (F, offered upon sufficient request)

SCHO-736 **Spectrometric Identification of Organic Compounds**
Registration #1013-736
Theory and application of proton carbon and 2D nuclear magnetic resonance, infrared, mass spectrometry, and ultraviolet spectra as applied to organic structure determination. (SCHO-433)
Class 4, Credit 4 (offered every year) (W)

SCHO-737 **Advanced Organic Chemistry**
Registration #1013-737
Several of the following advanced topics in organic chemistry are covered: polyfunctional compounds, modern synthetic methods, anion chemistry, stereospecific syntheses, protecting group chemistry, total synthesis with strong emphasis on recent chemical literature. (SCHO-433)

Class 4, Credit 4 (offered every year) (F)

SCHO-739 **Advanced Organic Chemistry**
Registration #1013-739
Selected topics in physical organic chemistry including: techniques for elucidation of mechanism (kinetic, linear free, energy relationships, isotope effects), molecular orbital theory, electrocyclic reactions. (SCHO-433, SCHP-443)

Class 4, Credit 4 (offered every year) (S)

SCHO-832 **Stereochemistry**
Registration #1013332
Advanced treatment of steric relationships, conformational analysis, and stereoisomerism in organic compounds. (SCH0433, SCHP-433)

Class 4, Credit 4 (offered upon sufficient request)

SCHO-833 **Heterocyclic Chemistry**
Registration #1013333
This course will contain a general treatment of heterocyclic chemistry. Syntheses and relative reactivities of heterocyclic compounds as demonstrated by their chemical reactions. (SCHO-433)
Class 4, Credit 4 (offered upon sufficient request)

SCHP-602 **Physical Chemistry of Polymers**
Registration #1014302
Study of the theoretical and experimental aspects of polymer characterization. In addition, theoretical considerations of the configuration of polymer chains and statistical thermodynamics of polymer solutions will be related to experimental results. (SCHP-443)

Class 4, Credit 4 (offered every year) (SR) (X*)

SCHP303 **Structure-Property Relationships in Polymers**
Registration #1014303
An introduction to the microstructure and morphology of amorphous and semicrystalline polymeric systems and their influence on thermomechanical, optical, and electronic properties of polymers. Topics include viscoelasticity and composites. (SCH0301 or SCHP-602)

Class 4, Credit 4 (F-X*)

SCHP304 **Characterization of High Polymers**
Registration #1014304
Experiments on dilute solution viscosity, gel permeation chromatography, microscopy, differential scanning calorimetry, thermogravimetric analysis, tensile testing, infrared spectroscopy, NMR spectroscopy and other aspects of polymer characterization. (SCH0301 or SCHP-602)

lab 6, Credit 2 (S)

SCHP305 **Synthesis of High Polymers**
Registration #1014305
Experiments on condensation, free radical, ring opening, and ionic polymerizations and polymer modification. (SCHO-437)

Lab 6, Credit 2 (F)

SCHP330 **Magnetic Resonance Imaging**
Registration #1014330
This course introduces the principles of magnetic resonance imaging (MRI) at a level understandable by both the scientist and non-scientist. The course begins with the basics of nuclear magnetic resonance, the foundation of MRI. Magnetic resonance imaging techniques and instrumentation will be explained. Emphasis will be placed on understanding the imaging process. A discussion of information available for water proton content images of body parts and tissue types will be presented. Future directions of MRI will be presented. (SPSP-311, 312,313; SPSP-211,212,213; SCHP-648)

Class 4, Credit 4 (W) (X*)

SCHP-648 **Basics of Pulsed NMR**
Registration #1014348
An introduction to the principles of pulsed nuclear magnetic resonance (NMR) spectroscopy. Lectures on instrumentation, pulse sequences, Fourier transforms, and artifacts will be presented. (SCHA-311)

Class 1, Credit 1 (offered every year) (F)

SCHP-741 **Chemical Thermodynamics**
Registration #1014-741
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 will be calculated based on spectroscopic data. Theory of solutions and phase equilibria are discussed. (SCHP443, SMAM-306)

Class 4, Credit 4 (offered alternate years) (W)

SCHP-742 **Survey of Physical Chemistry**
Registration #1014-742
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 applications to the life sciences. Not acceptable for BS in chemistry.

Class 3, Credit 3 (offered alternate years) (W)

SCHP-743 **Chemical Kinetics**
Registration #1014-743
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. (SCHP-443)

Class 4, Credit 4 (offered alternate years) (W)

SCHP-744 **Quantum Mechanics**
Registration #1014-744
Review of basic quantum theory and models. Variation and perturbation methods. Atomic and molecular orbital theory. Emphasis on relationship of spectroscopy and quantum chemistry. (SCHP-442)

Class 4, Credit 4 (offered alternate years) (S)

SCHP-747 **Principles of Magnetic Resonance**
Registration #1014-747
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 2D-NMR and solid state NMR (SCHP443; SCHP-648)
Class 4, Credit 4 (S)

Clinical Chemistry

SCLG705 **Mechanisms of Disease**
Registration #1023-705
Mechanisms of cellular injury, the healing process, atherosclerotic heart disease, hypertension, infectious disease, and many other disease states.

Class 4, Credit 4 (W)

SCLC-712 **Statistics and Quality Control**
Registration #1023-712
The principles of statistics as applied to biomedical research as well as clinical laboratory analysis will be studied. Using a problem-oriented approach, probability, normal values, analysis of variance and quality control as well as the relationship of these procedures to patient care will be studied.

Class 3, Credit 3 (offered every other year)

SCLC-722 **Clinical Laboratory Computer Applications**
Registration #1023-722
Computerized office management and administrative techniques will be discussed with emphasis on PCs. The basic concepts of data processing and spread sheets; design, evaluation, and utilization of computer systems in both hospital and clinical laboratories; and the legal aspects of biomedical data processing will be studied.

Class 3, Credit 3 (offered every other year)

SCLC-820 **Advanced Clinical Chemistry I**
Registration #1023420
Quality control, statistics, electrolytes, acid-base physiology, renal function, trace metals, lipids, carbohydrate metabolism, enzymes, and various standard methods are covered. (Permission of instructor)

Class 4, Credit 4 (offered every other year)

SCLC-821 **Advanced Clinical Chemistry II**
Registration #1023-821
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 every other year)

SCLC-822 **Advanced Clinical Chemistry III**
Registration #1023-822
Radioimmunoassay, hormones, fetal-placental unit, integration of laboratory data. (Permission of instructor)

Class 4, Credit 4 (offered every other year)

SCLC-870 **Clinical Chemistry Seminar**
Registration #1023-870

Credit 1 (W)

SCLC-872 **Special Topics in Clinical Chemistry**
Registration #1023-877
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 examinations.

Class variable, Credit variable (offered upon sufficient request)

SCLC-877 **External Clinical Chemistry Research**
Registration #1023-877
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 for determination of credit to be awarded.
Credit variable

SCLC-879 **Clinical Chemistry Research**
Registration #1023-879
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 1-16

SCLC-899 **Independent Study**
Registration #1023-899
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

Materials Science and Engineering

SESM-701 **Introduction to Materials Science**
Registration #1028-701
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 (offered every year)

SESM-702 **Introduction to Polymer Science**
Registration #1028-702
A study of the chemical nature of plastics detailing the relationships between polymerization conditions, structure and properties in both the solid and fluid states. (SESM-701 or equivalent)

Class 4, Credit 4 (offered every year)

SESM-703 **Solid State Science**

Registration #1028-703

This course will survey topics in the physics of solids. Included in these will be crystal symmetry, structure, and binding; mechanical, thermal, and electrical properties of insulators, semiconductors, and conductors including band theory. (SESM-704 or equivalent)
Class 4, Credit 4 (offered every year)

SESM-704 **Introductory Theoretical Methods**
Registration #1028-704
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.

Class 4, Credit 4 (offered every year)

SESM-705 **Introductory Experimental Techniques**
Registration #1028-705
The course introduces the student 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 will be conducted. (SESM-701, 702 or equivalents)

Class variable, Lab variable, Credit 4 (offered every year)

SESM-706 **Experimental Techniques-**
Registration #1028-706 **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

SESM-707 **Experimental Techniques-**
Registration #1028-707 **Electron Microscopy and Spectroscopy**
The course includes a detailed study of scanning electron microscopy and modern applications in microelectronic engineering. (SESM-701 or equivalent)

Class variable, Lab variable, Credit 4

SESM-708 **Experimental Techniques**
Registration #1028-708
This course is designed to provide an in-depth integrated approach to the analysis, investigation and development of materials, concentrating on specific types or classes. (SESM-701 or equivalent)
Class variable, Lab variable, Credit 4

SESM-710 **Materials Properties and Selection**
Registration #1028-710
A 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. (SESM-701 or equivalent)
Class 4, Credit 4

SESM-714 **Glass Science**
Registration #1028-714
Topics covered will include the structure and properties of glass, applied areas such as glass melting and processing, and various technological applications of glass. (SESM-701 or equivalent, SESM-704)

Class 4, Credit 4

SESM-717 **Materials Degradation/Corrosion**
Registration #1028-717
This course introduces the student to the basic electrochemical nature of corrosion and considers the various factors which influence the rate of corrosion in a variety of environments. Various means of controlling corrosion are considered. (SESM-701 or equivalent)
Class 4, Credit 4

SESM-720 **Organic Polymers**
Registration #1028-720
This course is designed to meet the needs of students in the area of organic chemistry related to synthesis, polymerization mechanism, structures, stereochemistry and reactions of organic polymers and their industrial usage. (SESM-702 or equivalent)

Class 4, Credit 4

SESM-721 **Physical Chemistry of Polymers**
Registration #1028-721
A study of the theoretical and experimental methods available for designing plastic products and selecting appropriate materials, with special emphasis on the interrelationships between materials, product design, tooling construction and manufacturing producibility. (SESM-702 or equivalent)
Class 4, Credit 4

SESM-722 **Polymer Processing**
Registration #1028-722
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. (SESM-702 or equivalent)

Class 4, Credit 4

SESM-730 **Optical Properties of Materials**
Registration #1028-730
Fundamentals of geometrical and physical optics; interaction of radiation with matter; dielectrics and thin films; introduction to electro-optic and acousto-optic effects. (SESM-704 or equivalent)

Class 4, Credit 4

SESM-733 **Magnetic Properties of Materials**
Registration #1028-733
Magnetostatics, creation and measurement of magnetic fields, galvanomagnetic and magneto-optic effects, magnetic materials, applications. (SESM-701 and 704 or equivalents)

Class 4, Credit 4

SESM-734 **Advanced Optics**
Registration #1028-734
Lasers: theory, types and construction; optics of metals; multilayer dielectrics; electro- and acousto-optic modulators and deflectors; optical detectors. (SESM-730 or equivalent)

Class 4, Credit 4

SESM-736 **Amorphous and Semicrystalline Materials**
Registration #1028-736
Electrical, thermal, and optical properties of amorphous materials; model of conduction. (SESM-701, 703, 704 or equivalents)

Class 4, Credit 4

SESM-740 **Nuclear Science and Engineering**
Registration #1028-740
Systemics of the atomic nuclei, radioactivity, nuclear reactions, fission, nuclear reactor principles, designs, materials and safety. (SESM-701 and 704 or permission of instructor)
Class 4, Credit 4

SESM-760 **Plasma Science**
Registration #1028-760
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. (SESM-701 or equivalent)

Class 4, Credit 4

SESM-770 **Physics and Chemistry of I. C. Processing**
Registration #1028-770
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 modelling by using SUPREM. (SESM-703 or permission of instructor)

Class 4, Credit 4

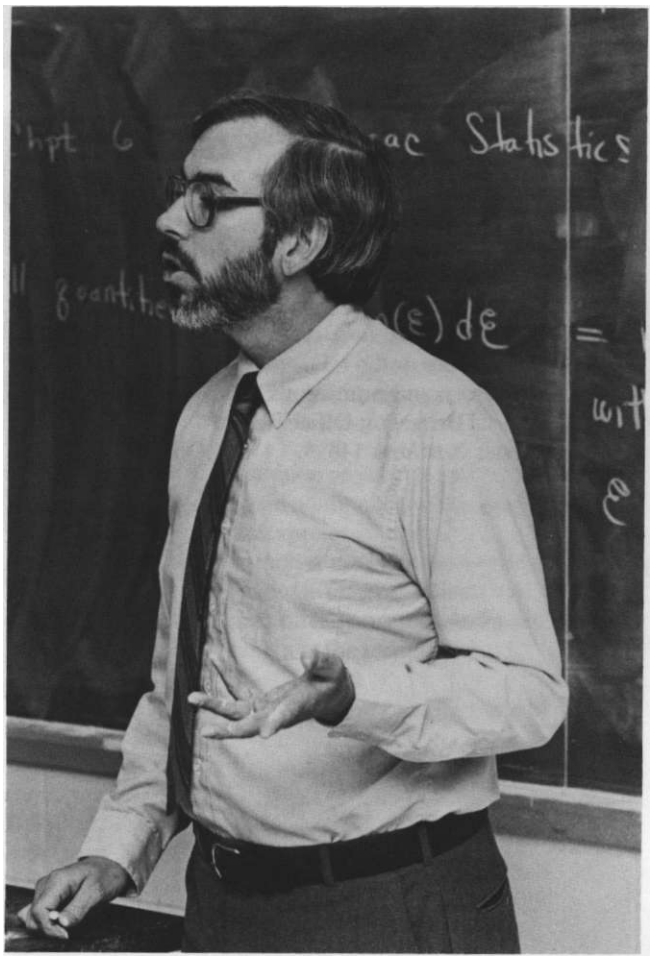
SESM-800 **Special Topics**
Registration #1028-800
In addition to in-depth study of any of the courses listed under Elective Courses, special topics may be selected from such areas as elastomers, organometallics, radiation damage, processing of materials, superconductivity, etc. (Permission of instructor)
Class variable, Credit 4

SESM-877 **External Research Project**
Registration #1028-877
Research using equipment and facilities at a site other than RIT. Prior to enrollment in External Research Project, 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 per quarter, can be applied toward the MS degree. (Permission of the program director)
Credit variable

SESM-879 **Research and Thesis Guidance**
Registration #1028-879
A project involving research on a topic in materials science and engineering. An oral examination and written thesis are required.
Credit variable

SESM-890 **Seminar**
Registration #1028-890
This course is required for completion of the program and will involve a one-hour presentation on some topic in materials science in engineering.
Class variable, Credit 1 (F, S)

SESM-899 **Independent Study**
Registration #1028-899
This course number should be used by students wishing to study a topic on an independent study basis. (Permission of instructor)
Credit variable



The National Technical Institute for the Deaf

William E. Castle, Director
James J. DeCaro, Dean

The National Technical Institute for the Deaf (NTID) was created in 1965 to offer deaf students technical and professional education that can lead to meaningful employment in business, industry, government, and education. Rochester Institute of Technology (RIT) was chosen as NTID's sponsoring institution in late 1966 by the Department of Health, Education and Welfare. In the fall of 1968, the first group of deaf students began their studies at NTID. For more than 20 years, NTID at RIT has provided postsecondary education to deaf students from every state in the nation.

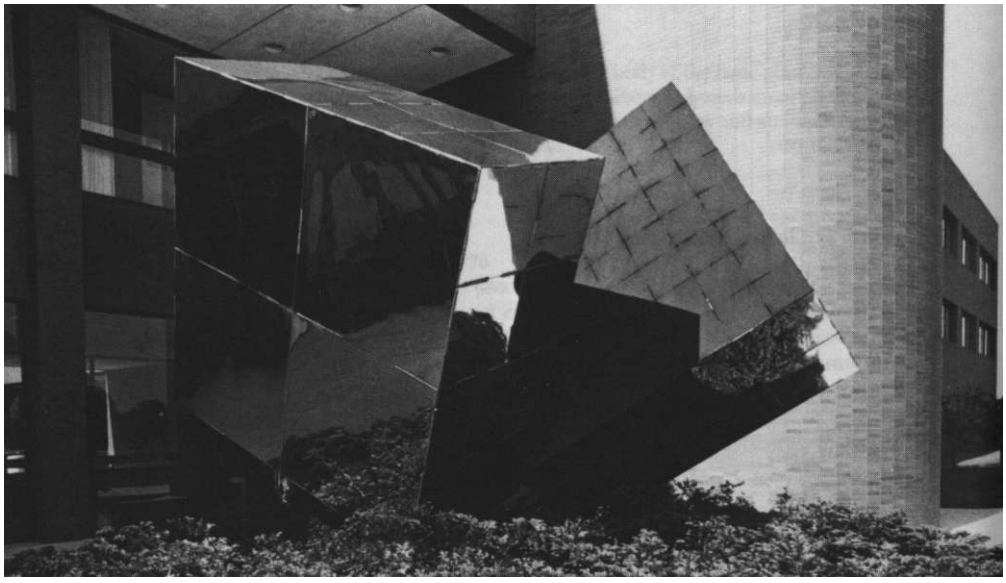
While it is a national institution, it also is one of the nine colleges of RIT. NTID is the world's only technological college serving deaf students in comprehensive career-oriented postsecondary programs.

Graduate programs for deaf students

NTID encourages qualified deaf students to pursue master's degree programs at RIT. Students who request them will receive appropriate support services through NTID, including sign language interpreting, tutoring, notetaking, career counseling, personal/social counseling, and job placement assistance.

Many NTID faculty members teach in the RIT graduate programs and share a wide range of technical expertise as well as knowledge of both deafness and education of deaf people.

For more information, contact the RIT Office of Admissions or the NTID Office of Career Outreach and Admissions, One Lomb Memorial Drive, Post Office Box 9887, Rochester, New York 14623.



Joint Program to Prepare Educational Specialists for the Deaf at the Secondary Level

Cosponsors: University of Rochester
through the Graduate School of Education and Human Development
Philip Wexler, Dean
and
Rochester Institute of Technology
through the National Technical Institute for the Deaf
William E. Castle, Director

A new type of professional

The University of Rochester's Graduate School of Education and Human Development and Rochester Institute of Technology through the National Technical Institute for the Deaf have jointly developed a graduate program designed to improve the quality of education and services for secondary and post-secondary deaf students.

Graduates of the master's degree program will be certified to teach hearing and deaf students at the secondary level in such areas as English, mathematics, science, and social studies.

They will also be qualified to manage special educational support service systems such as tutoring, notetaking, and interpreting and to serve as resources on deafness to schools involved in mainstreaming deaf students into regular school systems.

Graduates will teach in secondary schools serving deaf students, or function as instructional leaders, working with colleges and high schools to enrich and upgrade the quality of education for deaf people nationally.

Certification

Graduates of this program will be eligible for:

- provisional certification from New York State as an academic teacher of the normally hearing, for grades 7-12, in one or more of these areas: English, social studies, mathematics, biology, chemistry, physics, earth science, and general science;
- provisional certification from New York State as a teacher of deaf and hearing-impaired students, kindergarten through grade 12;
- provisional certification from the Council on Education of the Deaf (CED) as a teacher of deaf students in a secondary content area;
- a master of science in education degree from the University of Rochester cosponsored by Rochester Institute of Technology through the National Technical Institute for the Deaf. The program is approved by the Council on Education of the Deaf (CED).

To be certified to teach one or more of the broad fields listed below at the secondary level in New York State, applicants must satisfy the following minimum course work (undergraduate or graduate level) requirements in one of these areas:

English—36 semester hours including work in linguistics, literature, and writing;
Mathematics—36 semester hours including a calculus sequence;
Science—44 semester hours in the natural sciences including a calculus sequence;
Social Studies—36 semester hours in history, geography, and the social sciences, with American studies and at least one course in the methods of inquiry in history, geography, or one of the social sciences.

The University of Rochester and the National Technical Institute for the Deaf: uniquely qualified to jointly prepare educational specialists

The University of Rochester, one of the smallest of the nation's distinguished universities, enrolls about 8,000 students, upwards of 3,000 of them at the graduate level. One of its eight colleges and schools, the Graduate School of Education and Human Development, offers doctorate and master's degrees in a variety of educational specialties. The school maintains long-established programs of teacher preparation for students in the university's departments of English, mathematics, social sciences, and natural sciences in the College of Arts and Science. Individuals and groups from the school's faculty have engaged in a number of joint activities with NTID personnel over the past 12 years. Members of the university's School of Medicine and Dentistry and Center for Visual Science have joined in similar collaborations.

NTID, an integral part of Rochester Institute of Technology, is the world's only technological college for deaf students. It is renowned, both nationally and internationally, for its efforts to integrate deaf students onto a college campus planned primarily for hearing students. Today nearly 1,100 hearing-impaired students from 50 states, the District of Columbia, several U.S. territories and a number of foreign countries study and reside on the RIT campus with 15,000 hearing students.

RIT's students are enrolled in the colleges of Applied Science and Technology, Business, Continuing Education, Engineering, Fine and Applied Arts, Graphic Arts and Photography, Liberal Arts, Science and, of course, NTID.

RIT offers more than 200 individual career study areas leading to doctorate, master's, bachelor's, and associate degrees.

About the program

This full-time master's degree program normally requires three to five semesters to complete, depending upon the applicant's entry-level qualifications. The program is designed for people who seek academic certification to teach both hearing and deaf students. It also serves those who already are certified to teach academic subjects to hearing students at the secondary level and who seek additional certification to teach deaf students.

Applicants must have at least an undergraduate major in an academic area normally taught at the secondary school level, such as English, literature, mathematics, chemistry, or history. Some applicants also may need more advanced work in their area of academic expertise, or may need to develop a broader perspective in several academic areas. For example, persons with an undergraduate degree in mathematics may need additional mathematics preparation to meet the University of Rochester's program requirements, or to attain an appropriate breadth of knowledge in that subject.

Sign language

Participants will be required to demonstrate intermediate level skill in expressive and receptive sign language before their student teaching begins. Those without sign language skills will be encouraged to participate in sign language courses at NTID in the summer that precedes their first semester of graduate study.

Admission requirements

To gain admittance to this graduate program, applicants must:

- complete the equivalent of an undergraduate major in at least one academic area directly related to subjects normally taught at the secondary level.

- demonstrate an interest in serving the needs of deaf people.
- satisfy the University of Rochester admission requirements: solid undergraduate, background in an academic area, good recommendations, and a successful on-campus interview.

Participants will determine their individual programs of study with the assistance of a faculty advisor. Among the major areas of study available to participants will be specialized courses that relate deafness to the communication sciences and disorders, instructional theories and techniques, educational goals and processes, and psychosocial-cultural development. Student teaching will provide exposure to the full range of educational options available to deaf students nationally.

How to apply

Enrollment is limited. Some financial aid may be available. For an application and additional information, please write to:

Dr. Judy Egelston-Dodd
Acting Director, Joint Educational Specialist Program
507 Lattimore Hall
Graduate School of Education and Human Development
University of Rochester
Rochester, New York 14627
Phone (716) 275-4009
(Voice only)
(716)475-6932
(Voice or TDD)
(716) 475-2053

Note: Course descriptions can be found in the University of Rochester Graduate Bulletin.

NTID/RIT graduate internships

The purpose of the NTID Internship program is to provide opportunities for students at the master's or doctoral level to gain practical experience in the application of their discipline. Interns are usually graduate students or professionals who wish to gain advanced in-service training in their career areas and in education and services for deaf people. The duration of the internship depends on individual needs and the calendar of the sponsoring institution. NTID offers graduate internships in:

Audiology
Career and Personal Counseling
Curriculum Planning and Evaluation
Educational Administration
Educational Research
Media Development
Speech Pathology
Teaching
Theatre

In 1990,37 interns from the United States and several foreign countries worked with NTID in their career areas.

For more information, contact:

Rochester Institute of Technology
National Technical Institute for the Deaf
Office of Professional Development
Coordinator of Internships
Lyndon Baines Johnson Building
Post Office Box 9887
Rochester, New York 14623-0887

Graduate Faculty

William E. Castle, Ph.D., Stanford University—Director and Vice President, NTID/RIT, Professor

Jack R. Clarcq, Ed.D., Syracuse University—Associate Vice President, Technical Assistance Programs, NTTD/RIT, Professor

John Albertini, Ph.D., Georgetown University—Associate Professor

Joseph Bochner, Ph.D., University of Wisconsin, Madison—Associate Professor

Laurie C. **Brewer,** Ph.D., University of Rochester—Associate Professor

Diane Brooks, M.S., Gallaudet College—Instructor

Judith Coryell, Ph.D., University of Rochester—Assistant Professor

Kathleen E. Crandall, Ph.D., Northwestern University—Associate Professor

Patricia A. DeCaro, M.S., Brockport—Instructor

Judy Egelston-Dodd, Ed.D., State University of New York at Buffalo—Acting Director of Joint Educational Specialist Program, Professor

Betsy H. McDonald, Ph.D., State University of New York at Buffalo—Assistant Professor

Elizabeth O'Brien, Ed.D., State University of New York at Buffalo—Associate Professor

Donald G. Sims, Ph.D., University of Pittsburgh—Associate Professor

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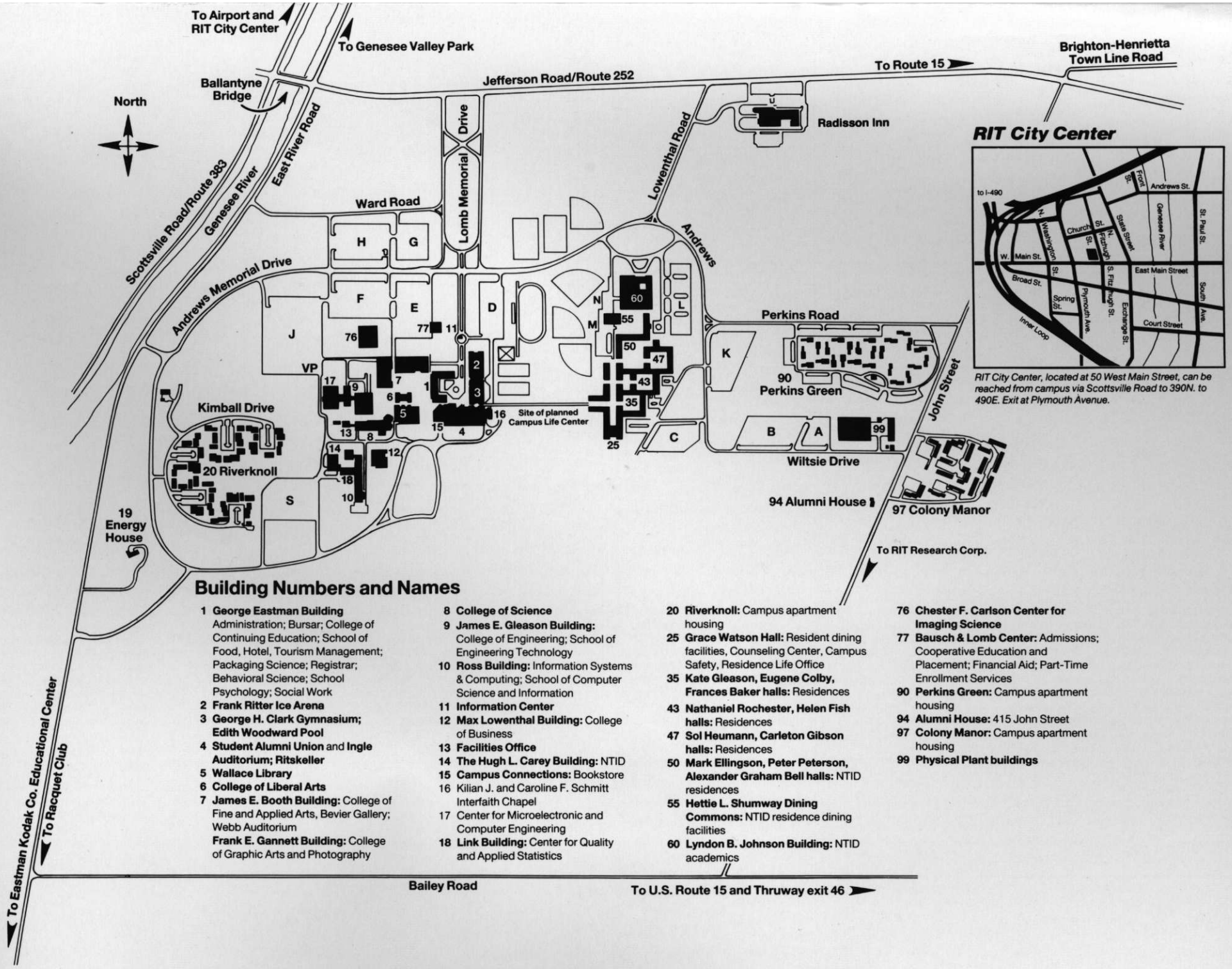

RIT City Center

RIT City Center, located at 50 West Main Street, can be reached from campus via Scottsville Road to 390N. to 490E. Exit at Plymouth Avenue.

Building Numbers and Names

1 **George Eastman Building** Administration; Bursar; College of Continuing Education; School of Food, Hotel, Tourism Management; Packaging Science; Registrar; Behavioral Science; School Psychology; Social Work

2 **Frank Ritter Ice Arena**

3 **George H. Clark Gymnasium; Edith Woodward Pool**

4 **Student Alumni Union** and **Ingle Auditorium; Ritskeller**

5 **Wallace Library**

6 **College of Liberal Arts**

7 **James E. Booth Building:** College of Fine and Applied Arts, Bevier Gallery; Webb Auditorium
Frank E. Gannett Building: College of Graphic Arts and Photography

8 **College of Science**

9 **James E. Gleason Building:** College of Engineering; School of Engineering Technology

10 **Ross Building:** Information Systems & Computing; School of Computer Science and Information

11 **Information Center**

12 **Max Lowenthal Building:** College of Business

13 **Facilities Office**

14 **The Hugh L. Carey Building:** NTID

15 **Campus Connections:** Bookstore

16 Kilian J. and Caroline F. Schmitt Interfaith Chapel

17 Center for Microelectronic and Computer Engineering

18 **Link Building:** Center for Quality and Applied Statistics

20 **Riverknoll:** Campus apartment housing

25 **Grace Watson Hall:** Resident dining facilities, Counseling Center, Campus Safety, Residence Life Office

35 **Kate Gleason, Eugene Colby, Frances Baker halls:** Residences

43 **Nathaniel Rochester, Helen Fish halls:** Residences

47 **Sol Heumann, Carleton Gibson halls:** Residences

50 **Mark Ellingson, Peter Peterson, Alexander Graham Bell halls:** NTID residences

55 **Hettie L. Shumway Dining Commons:** NTID residence dining facilities

60 **Lyndon B. Johnson Building:** NTID academics

76 **Chester F. Carlson Center for Imaging Science**

77 **Bausch & Lomb Center:** Admissions; Cooperative Education and Placement; Financial Aid; Part-Time Enrollment Services

90 **Perkins Green:** Campus apartment housing

94 **Alumni House:** 415 John Street

97 **Colony Manor:** Campus apartment housing

99 **Physical Plant buildings**