

# MICROELECTRONIC ENGINEERING



## CAREER OVERVIEW FOR STUDENTS

RIT is pleased to offer the nation's oldest undergraduate degree program in Microelectronic Engineering. This ABET accredited program was initiated in 1982 in response to the growing shortage of engineers in semiconductor processing and design. The program provides a broad interdisciplinary background in device physics, material science, chemistry, computer science, electrical engineering, optics, imaging science, statistics, and semiconductor manufacturing. The Master of Engineering program graduated the first class in 1988 and the Master of Science program began in 1995. A five year dual degree program (BS Microelectronic Engineering/MS Material Science) is also available. This program also prepares students to work in emerging technologies such as nanotechnology, microelectromechanical (MEM) devices and Microsystems. The co-op requirement enhances student knowledge acquired in the classroom and the laboratory.

### Minor in Microelectronics and Nanofabrication

This minor is designed to provide basic knowledge to non-microelectronic engineering students from math & statistics, science, and other engineering disciplines whose career plans involve the semiconductor industry. This minor also prepares students to pursue graduate studies in Microsystems Engineering, research in semiconductor applications, and nanotechnology. Students take at least five courses that include microlithography, IC technology and thin film processes.

### Microelectronic Engineering Department Information

<http://www.rit.edu/kgcoe/ue/>

### Degree(s) Awarded

Bachelor of Science, Master of Science, Master of Engineering, Bachelor of Science/Master of Science (Microelectronic Engineering/Material Science), Doctor of Philosophy in Microsystems.

### Enrollment

Approximately: 100 students enrolled in Bachelor of Science; 20 students enrolled in Master of Science or Master of Engineering; 10 enrolled in BS/MS, 35 students enrolled in Doctor of Philosophy.

### Cooperative Education Component

All undergraduate students are required to complete 5 co-op work assignments. Students typically co-op for 6 months; 3 month assignments are available. Students pursuing a ME degree are required to complete an internship.

### Salary Information Average/Range

Co-op:	Average: \$19.50	\$11.00 - \$26.00
BS:		\$61,000 - \$75,000
MS/ME:		\$60,000 - \$90,000

### Equipment & Facilities

Semiconductor and Microsystems Fabrication Laboratory (SMFL). A 56,000 square foot laboratory opened in 1986 – class 10 and class 100 clean rooms; labs; and classrooms. IC lab includes 4&6" wafer processing facility, maskmaking, test and evaluation rooms, chemical and gas storage, gowning and line maintenance. Capabilities include electron beam lithography, chemical vapor deposition, plasma etching, ion implantation, diffusion, photolithography, metallization, surface analysis and electrical testing. An expansion of the SMFL has been dedicated to applied research and development work in Microsystems; which includes integrated microelectronics, MEMS, and photonic devices.

### Accreditation

The microelectronic engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

### Student Skills & Capabilities

**End of Second Year:** Clean room experience (approximately 200 hours). Understanding of semiconductor and IC fabrication and design of experiments. Useful to a process engineer in assisting with projects.

**Middle of Third Year:** Understand basic diode and transistor circuits. Enhanced understanding of ion implant, physical vapor deposition and plasma etch.

**End of Third Year:** Understand the inner workings of MOS devices and analog and digital integrated circuits.

**Middle of Fourth Year:** Able to work independently on projects in diffusion, oxidation or ion-implant areas.

**End of Fourth Year:** Well prepared to work independently on projects in diffusion, oxidation, ion-implant, chemical vapor deposition or lithography areas. Understand design of microchips and operation of semiconductor devices.

Understand the interaction of light with materials including reflections from multilayer substrates.

**Middle of Fifth Year:** Understand and prepared to work independently in the manufacture of today's IC's.

**End of Fifth Year:** Prepared for engineering positions in process, process development, device, test, product, quality assurance, applications, etc. Students develop skills to carry out independent design/research and communicate in a technical forum. Students are ready to go on to top graduate schools.

## Nature of Work

With the dawn of the new millennium, semiconductor technology has advanced into the deep submicron era (entering nanoscale regime) with new challenges and there is a critical need for an engineering workforce to meet these challenges. The field is one that continues to provide highly educated and skilled engineers, current in knowledge for the semiconductor industry. The integrated circuit (IC) technology makes use of many diverse fields of science and engineering. The physics and operation of semiconductor devices involve the understanding of band theory of solids, statistical distribution of electrons and holes in semiconductors, and fundamentals of electrostatics fields. The design of microelectronic circuits requires a sound knowledge of electronics and circuit analysis. The optical lithography tools, which print microscopic patterns on wafers, represent one of the most advanced applications of the principles of Fourier optics. Plasma etching involves some of the most complex chemistries used in manufacturing today. Ion implantation draws upon understanding from research in high-energy physics. Thin films on semiconductor surfaces exhibit complex mechanical and electrical behavior that stretches our understanding of basic materials properties. Computing skills are necessary to design, model, simulate, and predict processes and device behavior, extremely vital to manufacturing. A comprehensive knowledge of statistics is required to manipulate data and process control. As the devices are shrinking in size approaching nanoscale regime where molecular and atomic scale phenomena come into play, elements of quantum mechanics become important.

One of the great challenges in integrated circuit manufacturing is the need to draw on scientific principles and engineering developments from such an extraordinary wide range of disciplines. Scientists and engineers, who work in this field need broad understanding and the ability to seek out, integrate, and use ideas from many fields.

## Training/Qualifications

This ABET-accredited, five-year program provides this broad interdisciplinary background in electrical and computer engineering, solid-state electronics, physics, chemistry, materials science, optics, and applied math and statistics necessary for entry into the semiconductor industry.

## Job Outlook

As the advancement of electronics and technology continue to improve and expand our lifestyles, so do opportunities for students in microelectronic engineering.

## Job Titles

Process Engineer, Device Engineer, Development Engineer, Research Engineer, Equipment Engineer, Principle Engineer  
Process Integration Engineer, Manufacturing Yield Engineer, Photolithography Engineer

## Significant Points

- Overall job opportunities in engineering are expected to be good, but will vary by specialty.
- A bachelor's degree is required for most entry-level jobs.
- Starting salaries are significantly higher than those of college graduates in other fields.
- Continuing education is critical for engineers wishing to enhance their value to employers as technology evolves.
- The Kate Gleason College of Engineering is proud to offer a bachelor of science degree program in microelectronic engineering, the first program of its type in the United States and one that continues to provide highly educated and skilled engineers, current in knowledge for the semiconductor industry.

## Employment

Electrical and electronics engineers held about 291,000 jobs in 2006, making up the largest branch of engineering. Most jobs were in professional, scientific, and technical services firms, government agencies, and manufacturers of computer and electronic products and machinery. Wholesale trade, communications, and utilities firms accounted for most of the remaining jobs. (*Source: U.S. Bureau of Labor Statistics O.O.H '08-'09.*)

## Selected Employers of RIT Microelectronic Engineering Co-op and Graduating Students:

Analog Devices, ASML, BAE, Eastman Kodak, Fairchild Semiconductor, Freescale, GE, Global Foundries, IBM, Smart System Technology Commercialization Center, Intel Corporation, KLA, L-3 Communications, Microchip, Micron Technology, National Semiconductor, Northrop Grumman, Samsung, Sandia National Labs, Texas Instruments.

## Contact Us:

We appreciate your interest in your career and we will make every effort to help you succeed. Feel free to contact either Maria Pagani Wiegand or Maureen Arquette, the program coordinators who work with the Microelectronic Engineering program. You can access information about services through our web site at <http://www.rit.edu/co-op/careers>.

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*Unless otherwise noted, information is based upon data collected by RIT Office of Cooperative Education and Career Services.*