Abstract

The semiconductor industry has experienced exceptional double-digit growth over the past 25 years, fueled by strong demand in end-use markets such as computing, communications, consumer appliances, and industrial applications driven by the Moore’s law. The industry has already announced its readiness for the 45nm node in production. The curricula developed by Rochester Institute of Technology (RIT) have kept pace with the rapid advancements sharing 25 of the 40 years the Moore’s Law and have contributed significantly in generating the workforce and research for this growing high tech industry. This paper describes our unique undergraduate and graduate programs in Microelectronic and Microsystems Engineering.

1. Introduction

One of the great challenges in for the future microelectronics and semiconductor technology will be the need to draw on scientific principles and engineering developments from such an extraordinary wide range of disciplines not adequately provided by traditional engineering or science programs. Education must not only keep pace with this trend but also lead and foster this growth. RIT has developed novel curricula to address this need.

2. Educational Programs

Microelectronic Engineering Education at RIT

RIT started the nation’s first Bachelor of Science program in Microelectronic Engineering in 1982 to drive the PC revolution that had just begun. The 196 quarter credit BS program combines the basic electrical engineering curriculum with optics, lithography, semiconductor processing, materials science, CAD, and manufacturing. The program requires 15 months of co-op experience. The Co-op commences after the second year, and students alternate school with paid employment in the semiconductor industry. The program has constantly advanced its integrated circuit fabrication laboratory in order to graduate students with state-of-the-art knowledge, who become immediate and efficient contributors to their company or graduate program. Today, this facility serves as a key resource for research in semiconductor devices, processes, MEMS, nanotechnology, and Microsystems. A new Nanotechnology concentration has been designed to meet the forthcoming needs of the industry. This concentration consists of four courses in nanotechnology fundamentals and practice and a qualified capstone design.

A combined Bachelor of Science in Microelectronic Engineering / Master of Science in Materials Science and Engineering program was implemented in the year 2003-4. This five-year interdisciplinary program consists of completion of 225 credits that include a minimum of 36 graduate credits. It substitutes a co-op quarter by graduate thesis work. Students with interest in materials science aspect of microelectronics find this program very attractive. In the Master of Engineering (ME) program in Microelectronics Manufacturing Engineering, degree is awarded upon successful completion of an approved graduate program consisting of a minimum of 45 credit hours. The program consists of one transition course, seven core courses, two elective courses and a minimum of 5 credits of internship and is also available online. The Masters of Science program in Microelectronic Engineering focuses on advanced level courses in semiconductor device physics, process and device modeling and simulation and higher level
courses in processes. It accompanies graduate thesis on a well planned experimental device and process research study. These graduate programs have been the driving force behind the realization of advanced processes and structures – nanolithography, submicron CMOS, quantum tunnel devices, MEMs, sensors, and CMOS on glass. These students are highly sought after by the industry. The programs have a well established advisory board and assessment methodologies.

**PhD Program in Microsystems Engineering**

These curricular developments led to the creation of the first PhD program in Microsystems Engineering in the nation. This multi-disciplinary program builds on the strengths in microelectronic fabrications, photonic, imaging and micro-power research programs at the institute. A total of 99 quarter credit hours of graduate course work and research are required of which 16 quarter credit hours are in designated Microsystems foundation courses. Minimum of 20 quarter credit hours in the major research area and 16 quarter credit hours in two minor specialization areas are required (Fig.2).

One of the minor specialization areas is a field different from that of the student’s undergraduate degree. An additional 27 quarter credit hours (minimum) are expected in dissertation research. The program has graduated six students in the last four years.

**Summary**

The silicon industry has entered into a new paradigm of system engineering encompassing integration of a variety of technologies that include information technology, biotechnology, MEMs and nanotechnology. The next decades will belong to a new era of micro/nano-fusion. We have recently enhanced our programs to the next level by introducing state-of-the-art educational material into a variety of curricula. The educational programs in Microelectronic and Microsystems Engineering at RIT are well positioned to educate engineers for the 21st century semiconductor technology.

**References**

[1] [http://www.microe.rit.edu](http://www.microe.rit.edu)


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**Fig.1. Credit distribution in the RIT BS program in Microelectronic Engineering.**

**Fig.2. Structure of the PhD program in Microsystems Engineering.**