

The Master's Degree Program in Electrical and Computer Engineering

M. Lee Edwards and Dexter G. Smith

The Master's of Science in Electrical and Computer Engineering, the first Johns Hopkins degree to be offered through APL, continues to build upon its rich history: using a talented faculty to communicate fundamental knowledge and critical skills to the leaders of tomorrow.

INTRODUCTION

Originally established as a part-time program in the early 1960s,¹ the Electrical and Computer Engineering (ECE) Program reflects the JHU Whiting School of Engineering and APL commitment to offer lifelong educational opportunities for working professionals. In addition to the obvious benefits and satisfaction in extending the students' technical strengths, such a program offers satisfaction to part-time instructors who are full-time engineers. Teaching gives these professionals the opportunity to organize and structure new material in an area of interest that might be outside their normal work environment. Our instructors have well-established technical achievements that are combined with a clear commitment to learning in the modern classroom. As a result, ECE students receive a strong theoretical and practical education from faculty drawn from the area's premier research and development institutions as well as from local commercial and government organizations.

Today's advanced ECE students pursue a variety of sophisticated topics. Among these are hardware

and software architectures for next-generation communications systems, laser systems for high data rate local network connections, ultra wideband technology's role in the "wireless infrastructure," efficient communications systems for transmitting real-time HDTV from Mars, and the effect of digital signal processing and modern hardware design language CAD systems.

These complex issues will significantly impact our future, particularly our effectiveness in the highly competitive global marketplace of ideas, technology, and systems. Consequently, the Whiting School/APL ECE Master's Program incorporates critical technology and applications issues into the coursework. As a result, students expand and strengthen their foundational knowledge and learn state-of-the-art applications in a wide range of areas (Fig. 1). They are prepared to be at the forefront of exciting new discoveries in the rapidly evolving Information Age, where electrical and computer engineers design and implement the hardware and software of nearly all modern products and systems.



Figure 1. The Field Programmable Gate Array (FPGA) Laboratory gives students “hands-on” and application experience.

PROGRAM OVERVIEW

Although the ECE Program is designed principally for working professionals with a variety of applied interests, students interested in pursuing a research-oriented education find that this program serves their needs. The program is characterized by

- State-of-the-art techniques that result in popular classes

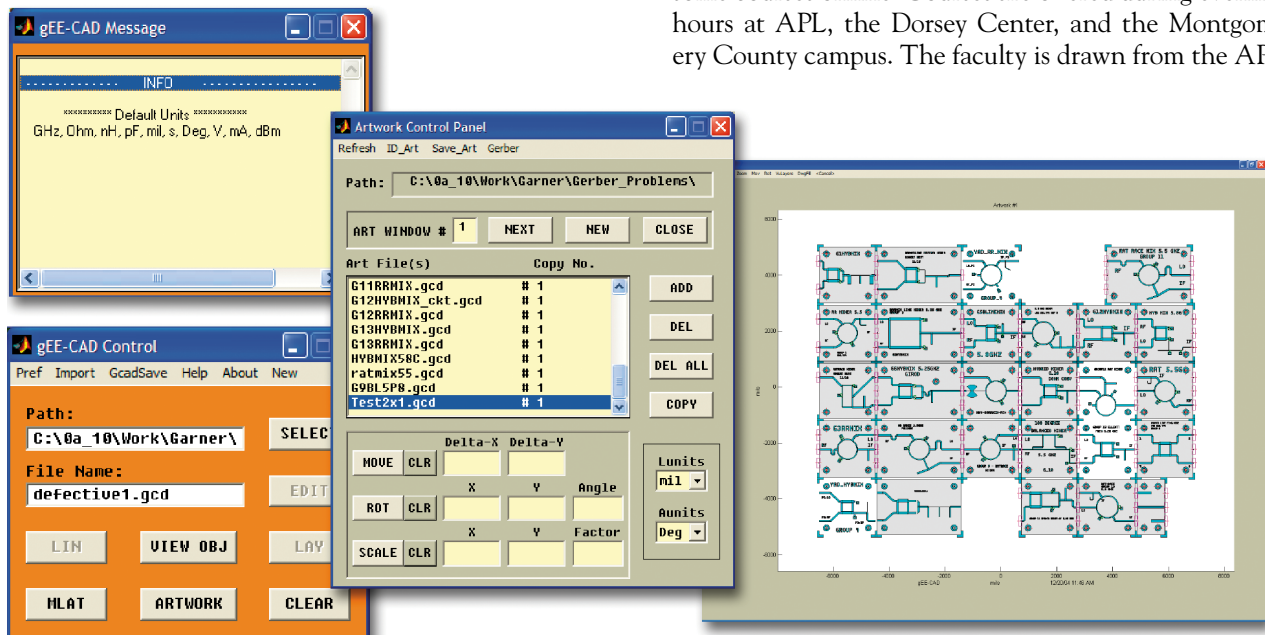


Figure 2. Microwave CAD system developed by M. Lee Edwards and Sheng Cheng using MatLab. The system is used by students in the RF and microwave classes for the design, fabrication, and testing of circuits.

- Optional laboratory courses that complement theoretical courses
- Instructors with a practical background who are leaders in their fields
- A comprehensive curriculum
- Convenient late afternoon and early evening class schedules
- Online classes for students wishing web-based instruction
- Independent study projects mentored by ECE faculty members
- Modern CAD systems featured in the RF and microwave course (Fig. 2)
- High-tech classrooms with modern audiovisual and teleconferencing capabilities

ADMINISTRATION

The ECE Program is administered by a committee of leading practitioners representing industry, government, and academia. This committee regularly evaluates the ECE courses and faculty to ensure that the program remains up to date with the changing technical environment. The program administrators seek and respond to both student and employer inputs. Current courses are adapted to meet new requirements and new courses are introduced regularly. The Whiting School/APL program provides graduate education in both the fundamentals of various branches of electrical and computer engineering and in the more specific aspects of current important technologies. Because the majority of our students participate on a part-time basis, the program aim is to serve working engineers, which includes offering some courses online. Courses are offered during evening hours at APL, the Dorsey Center, and the Montgomery County campus. The faculty is drawn from the APL

technical staff, local industry and government, as well as the full-time JHU faculty.

Members of the ECE Program Committee are

- M. Lee Edwards, Chair
- Dexter G. Smith, Vice Chair
- Charles Alexander
- Robert S. Bokulic
- Andrew D. Goldfinger
- Brain K. Jennison
- Richard Joseph
- Vincent L. Pisacane

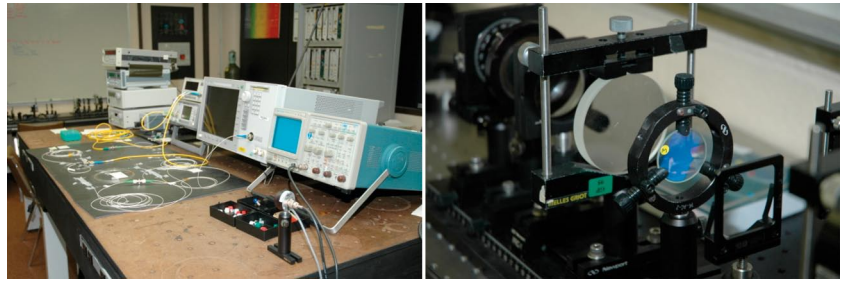


Figure 3. The Photonics Laboratory provides state-of-the-art experience to supplement theoretical knowledge.

Most of the above are APL staff except for Charles Alexander, a retired Senior Electrical Engineer from the DoD, Richard Joseph, a Professor of Electrical Engineering in the Whiting School of Engineering, and Vincent Pisacane, a Professor of Aerospace Engineering at the U.S. Naval Academy.

ADMISSIONS

The minimum requirements for admission to the ECE Program are as follows:

- Bachelor's degree in Electrical Engineering or Electrical and Computer Engineering from an accredited engineering school
- 3.0 technical grade point average
- 3.0 grade point average from the last half of the student's undergraduate program

An Admissions Subcommittee evaluates those applicants who do not meet the minimum requirements. This committee is particularly sensitive to candidates from other technical or scientific fields that apply for acceptance into the ECE Master's Degree Program. Committee members consider all available information, including academic performance, technical course experience, and work experience. On the basis of these criteria, an admissions plan is developed and may include prerequisite course requirements that will strengthen the student's background before full admission to the program.

CONCENTRATION AREAS

The ECE Master's Program allows degree-seeking students to select one of the following concentrations. Students may choose courses from any concentration, provided the general degree requirements are satisfied.

- Computer Engineering
- Electronics and the Solid State
- Photonics (Fig. 3)
- RF and Microwave Engineering (Fig. 4)
- Signal Processing
- Systems and Control
- Telecommunications and Networking

The current ECE curriculum offers more than 80 introductory and advanced graduate courses. Most courses are offered at least once a year. Core courses are offered more frequently. A sampling of ECE courses is shown on the next page.

M.S. AND ADVANCED CERTIFICATE FOR POST-MASTER'S STUDY IN ECE

Each student is assigned an advisor, who counsels the student on curriculum requirements and must approve

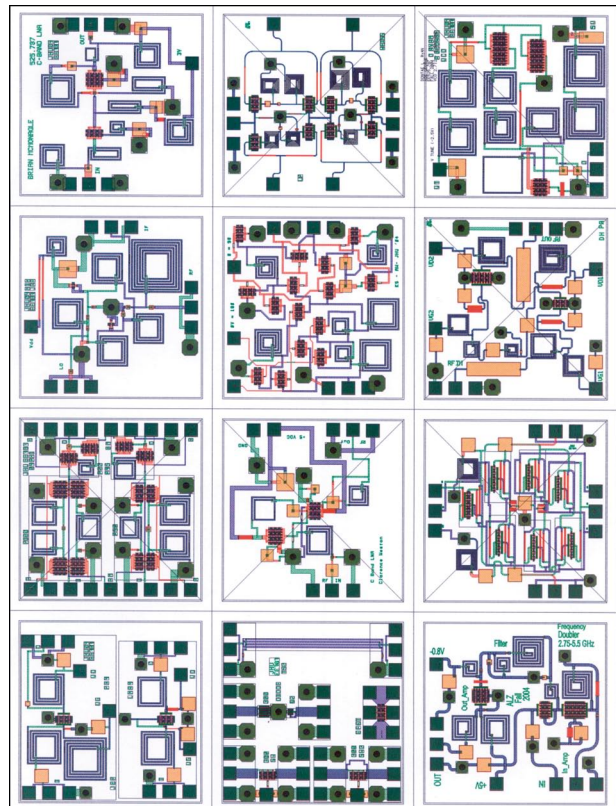


Figure 4. A tile of chips designed by the MMIC class and ready for submission to the TriQuint Foundry for fabrication. Finished chips are eventually tested by students to compare predicted and actual performance.

SAMPLING OF ECE MASTER'S PROGRAM COURSE OFFERINGS

Computer Engineering

- CAE for Digital Systems
- Computer Architecture
- Microprocessor Systems
- Parallel Processing Systems
- Testability and Fault Tolerance
- VHDL/FPGA Design

Electronics and the Solid State

- Analog Electronic Circuit Design
- Electronic Packaging
- Electronics and the Solid State
- Micropower Integrated Circuit Design

Photonics

- Electro-Optical Systems
- Fiber-Optic Communication Systems
- Fourier Techniques in Optics
- Laser Systems and Applications
- Optical Propagation

RF and Microwave Engineering

- Antenna Systems
- Microwave Systems and Components
- MMIC Design
- Principles of Radar
- RF and Microwave Circuits
- Wireless Technology

Signal Processing

- Digital Image and Video Processing
- Digital Signal Processing
- Mixed Analog/Digital VLSI Sensory Systems
- Multi-Rate Digital Signal Processing
- Wavelet Signal Processing

Systems and Control

- Continuous Control Systems
- Digital and Sampled-Data Control
- Nonlinear Control Systems
- Stochastic Optimization and Control

Telecommunications and Networking

- Communication Systems Engineering
- Computer and Data Network Communications
- Digital Telephony
- High-Speed Networks
- Propagation of Radio Waves
- Speech Processing
- Wireless and Mobile Cellular Communications

course selections. This degree program requires the student to complete 10 one-term courses, a minimum of 4 courses at the 700 level (more advanced), at least 7 courses from ECE Program offerings, and a maximum of 3 courses from outside the ECE curriculum, *with advisor approval*. In addition, most students who desire an elective course select from among the offerings of the Applied Mathematics, Applied Physics, and Computer Science programs. Advisors have broad flexibility to approve other suitable courses in science or engineering.

Students can choose one of two options, which are *specifically noted on their transcripts*.

1. **Photonics:** This option requires a core of three ECE photonics courses and three additional photonics courses from the ECE or Applied Physics program. The four remaining required courses needed to complete the degree may be any courses approved by the advisor that will fulfill the general requirements for the M.S. as described above.
2. **Telecommunications and Networking:** This option requires seven ECE courses, with at least two of the remaining three courses from computer science telecommunications and networking courses. At least four courses must be at the 700 level. The full program may contain at most three electives, including the two or three computer science telecommunications and networking electives.

CONCLUSION

The part-time Master's Program in ECE has been providing quality education to working electrical engineers for more than 40 years. It strives to offer its students a state-of-the-art education covering both the theoretical and practical aspects of advanced technology. We value the feedback and comments given by our students and our highly qualified instructors.

REFERENCE

- ¹Edwards, M. L., "The Master's Degree Program in Electrical Engineering," *Johns Hopkins APL Tech. Dig.* 10(2), 146-153 (1989).

THE AUTHORS

M. Lee Edwards began teaching in the ECE Program in 1979 and developed a number of the RF courses that are currently taught, promoted the use of CAD in classes, and pioneered the Dorsey Center Microwave Laboratory. Dr. Edwards is the ECE Program Chair, a member of the APL Principal Professional Staff, and a former APL Supervisor of the RF Engineering Group in the Space Department and the Systems Group in the National Security Technology Department. He received his B.S.E.E. from North Carolina State University, his M.S.E.E. from Northwestern University, and his Ph.D. in mathematics from the University of Maryland. **Dexter G. Smith**, a member of the APL Principal Professional Staff, began teaching digital signal processing in the ECE Part-Time Master's Program with-



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in the Whiting School of Engineering and currently serves as Vice Chair of the program. Dr. Smith is also APL's Biomedicine Business Area Executive and Head of the Biotechnology Branch in the National Security Technology Department. He received his D.Eng. in electrical engineering from Rensselaer Polytechnic Institute and did his doctoral research at the Albany Medical Center Trauma Unit, Albany, New York. For further information, contact Dr. Edwards. His e-mail address is lee.edwards@jhuapl.edu.