Certificate of Advanced Study in Microwave Engineering

The Department of Electrical Engineering and Computer Science (EECS) at Syracuse University offers the ***Certificate of Advanced Study in Microwave Engineering (CASME)***. This certificate program reflects the Department's strength in the theoretical and practical aspects of microwave engineering.

Background

There is a shortage of microwave engineers in the U.S. This is primarily due to the fact that a microwave engineer must have a solid background in microwave theory coupled with hands-on experience designing, simulating, building, and testing microwave devices. The defense industry has traditionally employed microwave engineers since many of the electronic devices used by the defense industry work at microwave frequencies. During the last decade, the demand for microwave engineers in the commercial world has soared due to the recent "explosion" in the wireless systems.

Overview of Certificate

The comprehensive set of courses in this certificate program provides a strong theoretical basis for microwave engineering. Moreover, participants of the program gain hands-on experience in practice of microwave engineering. The project-based courses of the certificate teach the student how to design, simulate, build and test a microwave device such as an amplifier, filter, oscillator or antenna. The simulation tools used in these courses are identical to some of the commercial software used by the microwave industry. The test equipment used is state-of-the-art microwave measurement devices commonly used by industry.

Educational Objectives and Outcomes

The students earning this certificate will have developed a thorough understanding of microwave theory coupled with the ability to design, simulate, build, and test microwave devices.

The certificate is composed of a comprehensive and coherent collection of courses to ensure that students acquire the following educational outcomes:

1. mastery of the underlying principles of microwave theory;

2. use of microwave theory concepts to design microwave devices satisfying a given set of specifications and to predict their behavior;

3. use the latest software tools to simulate microwave circuit behavior;

4. use microwave theory concepts and CAD software to optimize microwave circuits to meet given specifications;

5. mastery of the use of microwave equipment such as network and spectrum analyzers.

CASME Requirements

The CASME program builds on the foundation established in a standard undergraduate electrical engineering program.

To earn a CASME the student must take a series of courses depicted below whose description can be found in Appendix A.

1. Students must successfully complete:

   ELE 621 – Electromagnetic Fields
   ELE 623 – Microwave Measurements

2. Students must successfully complete four courses from the following list*, satisfying the restriction specified below:

   ELE 721– Antennas & Antenna Systems
   ELE 722 – Microwave Filters
   ELE 723 – Microwave Transistor Amplifiers
   ELE 724 – Microwave Oscillators
   ELE 725 – Electromagnetic Engineering I
   ELE 726 – Computational Methods of Field Theory
   ELE 728 – Planar Microwave Antennas
   ELE 751 – Wireless Communications

RESTRICTION: A selection of four courses must include at least two of the following courses: ELE 722, ELE 723, ELE 724, or ELE 728.

The student must maintain a cumulative total GPA of at least a 3.0 in those courses to be credited towards the CASME.

Credits Towards a Masters Degree

Successful completion of the CASME does not ensure admission to the Master of Science in Electrical Engineering (MSEE). However, the credits earned by completing the courses specified above can be accepted towards the MSEE program.

Admission Requirements

Admission is based on academic record of a BS in electrical engineering, professional experience, and letters of recommendation.

* Special topics courses 700-level or above may be used to fulfill this requirement if approved by the Electrical Engineering Program Committee.

Local Employment

The employees of the following local industries/labs will benefit from completing this certificate:

- Anaren
- Arcom
- Dielectric Lab
- Eagle
- Lockheed Martin
- Rome Lab
- Sensis
- Sonnet, PPC
- Syracuse Research Corp.

Appendix A

Course Descriptions

ELE 621 **Electromagnetic Fields** (3 credits)
Development of electromagnetic theory from the basic postulates leading to Maxwell's equations in differential and integral forms. Solution to static, quasi-static, and wave-propagation problems. Prereq: Vector calculus.

ELE 623 **Microwave Measurements** (3 credits)
Experimental illustration of fundamentals of microwave measurement: reflection and transmission measurements; characteristics of common microwave components. Manual and automatic network analyzers and their use. Spectrum analysis techniques.

ELE 721 **Antennas and Antenna Systems** (3 credits)
Characteristics of electromagnetic radiators. Equivalent circuits of antenna elements: dipoles, loops, helices, horns, and other radiators. Phased arrays. Pattern synthesis. Numerical methods. Broadband antennas. Measurement techniques. Prereq: ELE 621.

ELE 722 **Microwave Filters** (3 credits)
General filter structures at microwave frequencies. Prototype filters obtained by network synthesis method. Image parameters. Richards' transformation. Kuroda Identities. Coupled-line equivalent circuits. Design, simulate, build, and test a microwave filter. Prereq: ELE 623.

ELE 723 **Microwave Transistor Amplifiers** (3 credits)
Two-port network representations, matching networks, power gain equations, stability conditions, simultaneous conjugate match, constant gain, VSWR and noise figure circles, balanced and feedback amplifiers. Design, simulate, build, and test a microwave amplifier. Prereq: ELE 623.

ELE 724 **Microwave Oscillators** (3 credits)
Matching networks, S-parameters. Oscillation conditions, One-port and two-port Negativeresistance Oscillators, oscillator design using large-signal measurements, DROs, YIG Oscillators, VCOs, and Phase noise. Design, simulate, build, and test a microwave oscillator. Prereq: ELE 623.

ELE 725 **Electromagnetic Engineering I** (3 credits)
Time varying electromagnetic fields. Field theorems, propagation and reflection of waves, wave guides, resonators, radiation, and diffraction. Applications to antenna theory. Prereq: ELE 621.

ELE 728 **Planar Microwave Antennas** (3 credits)
Review of the fundamentals of antennas. Theory of microstrip antennas, dual and circularly polarized antennas, feeding techniques, mutual coupling, arrays of patches, effect of substrate and the ground plane. Design, simulate, build, and test a planar microwave antenna. Prereq: ELE 621 and 623.