MISSION STATEMENT

The mission of the Department of Electrical and Computer Engineering is to serve society as a center for learning and innovation in all major areas of electrical and computer engineering. The department accomplishes its mission by disseminating existing knowledge through teaching, by creating new knowledge through research and publications, and by converting original ideas and concepts into new technologies. Through integration of education and research, the department creates the academic environment necessary for training innovators and leaders for the future.

Bachelor of Science Degree in Electrical Engineering

The fundamental goal of the undergraduate program in Electrical Engineering is to offer a high-quality education, designed to achieve the following specific educational objectives:

EDUCATIONAL OBJECTIVES

Within a few years of graduation, Electrical Engineering graduates are expected to attain:

1. Increasing responsibility beyond that in their entry-level description in job functions within Electrical Engineering or related employment, and/or
2. Successful progress within graduate degree programs in Electrical Engineering or other professional degrees such as other Engineering, Business, Law or Medicine, and
3. Continued successful professional development and adaptation to evolving technologies within their chosen field.

The flexibility of the electrical engineering curriculum allows the students to choose courses among four tracks: (a) Electronic Circuits and Devices: electronic circuits, instrumentation, RF circuit design, microwave circuit design. Relevant courses: ECE 423, ECE 438, ECE 440, ECE 446, ECE 447, ECE 449, ECE 479. (b) Electromagnetics and Photonics: microwave engineering, antenna systems, fiber optic systems. Relevant courses: ECE 441, ECE 448, ECE 472, ECE 477, ECE 479. (c) Power Systems and Energy: utility power systems, energy systems, electric drives. Relevant courses: ECE 481, ECE 483, ECE 484, ECE 486, ECE 487, ECE 488, ECE 489. (d) Signals and Control: signals and systems, signal processing, telecommunications, control. Relevant courses: ECE 456, ECE 459, ECE 466, ECE 467, ECE 468A, ECE 471, ECE 476, ECE 478.

Employment opportunities exist within a wide range of organizations, such as computer, semiconductor, aviation, electronics, microelectronics, broadcasting, telecommunications, defense, automotive, manufacturing and electric power companies, state and federal agencies and laboratories. Employment opportunities cover the spectrum of engineering activities, ranging from research and development, to systems analysis, automation, manufacturing, customer service and support, marketing and sales.

The undergraduate program in Electrical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.
THE CAPSTONE OPTION FOR TRANSFER STUDENTS

The SIU Capstone Option (see chapter three) is available to students who have earned an Associate in Engineering Sciences (AES) degree with a minimum cumulative 2.0/4.0 GPA on all accredited coursework prior to the completion of the AES, as calculated by SIU. The Capstone Option reduces the University Core Curriculum requirements from 39 to 30 hours, therefore reducing the time to degree completion. Students interested in the Capstone Option should contact the College of Engineering Advisement Office to develop a personal coursework pathway to degree completion.

Bachelor of Science Degree in Electrical Engineering, College of Engineering

Electrical Engineering Major

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td>MATH 150</td>
<td>4</td>
</tr>
<tr>
<td>ECON 240-3 or ECON 241-3</td>
<td>3</td>
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<tr>
<td>BIOL 202</td>
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<tr>
<td>PHIL 104-3 and PHIL 105-3</td>
<td>6</td>
</tr>
<tr>
<td>ENGR 304I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 205A / PHYS 255A</td>
<td>4</td>
</tr>
<tr>
<td>Requirements for Major in Electrical Engineering</td>
<td>87</td>
</tr>
<tr>
<td>PHYS 205B, PHYS 255B</td>
<td>4</td>
</tr>
<tr>
<td>MATH 250, MATH 251, MATH 305</td>
<td>10</td>
</tr>
<tr>
<td>Required ECE Courses</td>
<td>48</td>
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<tr>
<td>ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315,</td>
<td>48</td>
</tr>
<tr>
<td>ECE 327, ECE 327L, ECE 336, ECE 345, ECE 345L, ECE 355,</td>
<td></td>
</tr>
<tr>
<td>ECE 356, ECE 356L, ECE 356L, ECE 375, ECE 375L, ECE 385,</td>
<td></td>
</tr>
<tr>
<td>ECE 385L, ECE 495E, ECE 495D</td>
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<tr>
<td>Technical Electives ¹</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
</tr>
</tbody>
</table>

1 Approved by the Department. At least 21 hours of ECE electives, including at least nine hours of Engineering Design.
## Electrical Engineering Major - Biomedical Specialization

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td><strong>Foundation Skills</strong></td>
<td>13</td>
</tr>
<tr>
<td>UNIV 101U</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 101, ENGL 102</td>
<td>6</td>
</tr>
<tr>
<td>CMST 101</td>
<td>3</td>
</tr>
<tr>
<td>MATH (see major)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Disciplinary Studies</strong></td>
<td>23</td>
</tr>
<tr>
<td>ECON 240 or ECON 241</td>
<td>3</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Fine Arts Elective</td>
<td>3</td>
</tr>
<tr>
<td>Natural Sciences (see major)</td>
<td>6</td>
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<tr>
<td>BIOL 202</td>
<td>2</td>
</tr>
<tr>
<td>PHIL 104, PHIL 105</td>
<td>6</td>
</tr>
<tr>
<td><strong>Integrative Studies</strong></td>
<td>3</td>
</tr>
<tr>
<td>Engineering 304I</td>
<td>3</td>
</tr>
<tr>
<td><strong>Requirements for Electrical Engineering with a Biomedical Specialization</strong></td>
<td>(9)+87</td>
</tr>
<tr>
<td>Basic Sciences</td>
<td>6</td>
</tr>
<tr>
<td>PHYS 205A, PHYS 205B, PHYS 255A, PHYS 255B</td>
<td>(6)+2</td>
</tr>
<tr>
<td>Science Elective (with lab)</td>
<td>4</td>
</tr>
<tr>
<td>Mathematics</td>
<td>11</td>
</tr>
<tr>
<td>MATH 150, MATH 250, MATH 251, MATH 305</td>
<td>(3)+11</td>
</tr>
<tr>
<td><strong>Required ECE Courses</strong></td>
<td>48</td>
</tr>
<tr>
<td>ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315, ECE 327, ECE 327L, ECE 336, ECE 345, ECE 345L, ECE 355, ECE 355L, ECE</td>
<td></td>
</tr>
</tbody>
</table>
Degree Requirements | Credit Hours
---|---
356, ECE 356L, ECE 375, ECE 375L, ECE 385, ECE 385L, ECE 495D, ECE 495E | 356
Technical Electives$^2$ | 22
Total | 126

1. For Science Elective choose from Chemistry or Biology.
2. Approved by the Department. At least 17 hours of ECE, BME electives, including at least nine credit hours from ECE 438, ECE 458, ECE 467, ECE 468A, ECE 472, BME 485, ECE 534, ECE 539, ECE 568, ECE 572, ECE 578, BME 597. Limited to six credit hours of 500-level courses with approval from the Department.

Electrical Engineering Major - Power and Energy Engineering Specialization

Degree Requirements | Credit Hours
---|---
University Core Curriculum Requirements | 39
Foundation Skills | 13
UNIV 101U | 1
ENGL 101, ENGL 102 | 6
CMST 101 | 3
MATH 150 | 3
Disciplinary Studies | 23
ECON 240 or ECON 241 | 3
Social Science Elective | 3
Fine Arts Elective | 3
Natural Sciences (see major) | 6
BIOL 202 | 2
PHIL 104, PHIL 105 | 6
Integrative Studies | 3
ENGR 304I | 3
Requirements for Electrical Engineering with a Power and Energy Specialization | (9)+87
Degree Requirements | Credit Hours
---|---
Basic Sciences | 5

PHYS 205A, PHYS 205B, PHYS 255A, PHYS 255B | (6)+2

Science Elective | 4

Mathematics | 11

MATH 150, MATH 250, MATH 251, MATH 305 | (3)+11

Required ECE Courses | 48

ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315, ECE 327, ECE 327L, ECE 336, ECE 345, ECE 345L, ECE 355, ECE 355L, ECE 356, ECE 356L, ECE 375, ECE 375L, ECE 385, ECE 385L, ECE 495D, ECE 495E | 48

Technical Electives | 22

Total | 126

1 Approved by the Department. At least 18 hours from ECE 456, ECE 472, ECE 467, ECE 481, ECE 482, ECE 483, ECE 484, ECE 486, ECE 487, ECE 488, ECE 488.

**Bachelor of Science Degree in Computer Engineering**

The fundamental goal of the undergraduate program in Computer Engineering is to offer a high-quality education, designed to achieve the following specific educational objectives:

**EDUCATIONAL OBJECTIVES**

Within a few years of graduation, Computer Engineering graduates are expected to attain:

1. Increasing responsibility beyond that in their entry-level description in job functions within Computer Engineering or related employment, and/or
2. Successful progress within graduate degree programs in Computer Engineering or other professional degrees such as other Engineering, Business, Law or Medicine, and
3. Continued successful professional development and adaptation to evolving technologies within their chosen field.

In the computer engineering curriculum the students can choose courses in (a) Design Automation and Application Programming: Algorithms and software development for digital integrated circuits, embedded systems, microcontrollers, multicore architecture, networks. Relevant courses in this track are ECE 422, ECE 424, ECE 425, ECE 432, and ECE 456. (b) Computer Hardware Design: Design and evaluation of integrated circuits, configurable hardware, embedded systems, computer architectures. Relevant courses: ECE 422, ECE 423, ECE 424, ECE 425, ECE 427, ECE 428, ECE 429.

Employment opportunities exist within a wide range of organizations, such as computer, semiconductor, aviation, electronics, microelectronics, broadcasting, telecommunications, defense, automotive, manufacturing and electric power companies, state and federal agencies and laboratories. Employment opportunities cover the spectrum of engineering activities, ranging from research and development, to systems analysis, automation, manufacturing, customer service and support, marketing and sales.
The undergraduate program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

**Bachelor of Science Degree in Computer Engineering, College of Engineering**

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
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<tbody>
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<td>39</td>
</tr>
<tr>
<td>Foundation Skills</td>
<td>13</td>
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<tr>
<td>UNIV 101U</td>
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<td>ENGL 101, ENGL 102</td>
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<td>CMST 101</td>
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<td>MATH (see major)</td>
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<td>Disciplinary Studies</td>
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<td>ECON 240 or ECON 241</td>
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<td>Fine Arts Elective</td>
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<td>Natural Sciences (see major)</td>
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<td>PHIL 104, PHIL 105</td>
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<td>Integrative Studies</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 304I</td>
<td>3</td>
</tr>
<tr>
<td>Requirements for Major in Computer Engineering</td>
<td>(9)+87</td>
</tr>
<tr>
<td>Basic Sciences</td>
<td>6</td>
</tr>
<tr>
<td>PHYS 205A, PHYS 205B, PHYS 255A, PHYS 255B</td>
<td>(6)+2</td>
</tr>
<tr>
<td>Science Elective with lab ¹</td>
<td>4</td>
</tr>
<tr>
<td>Mathematics</td>
<td>11</td>
</tr>
<tr>
<td>MATH 150, MATH 250, MATH 251, MATH 305</td>
<td>(3)+11</td>
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<tr>
<td>Required ECE Courses</td>
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### Degree Requirements

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<tbody>
<tr>
<td>ECE 222, ECE 235, ECE 235L, ECE 296, ECE 296L, ECE 315, ECE 321, ECE 321L, ECE 327, ECE 327L, ECE 329, ECE 329L, ECE 345, ECE 345L, ECE 355, ECE 355L, ECE 495C, ECE 495D</td>
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</table>

**Technical Electives**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>30</td>
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</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>126</td>
</tr>
</tbody>
</table>

1 Science Elective choose from Chemistry or Biology.
2 Approved by the Department. At least 25 hours of ECE electives. At least 20 hours from the following list: ECE 422, ECE 423, ECE 424, ECE 425, ECE 427, ECE 428, ECE 429, ECE 432, two approved CS courses.

### Dual B.S. Degree in Electrical Engineering and Computer Engineering

#### Electrical and Computer Engineering Dual Degree

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td>Foundation Skills</td>
<td>13</td>
</tr>
<tr>
<td>UNIV 101U</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 101, ENGL 102</td>
<td>6</td>
</tr>
<tr>
<td>CMST 101</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics (see major)</td>
<td>3</td>
</tr>
<tr>
<td>Disciplinary Studies</td>
<td>23</td>
</tr>
<tr>
<td>ECON 240 or ECON 241</td>
<td>3</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Fine Arts Elective</td>
<td>3</td>
</tr>
<tr>
<td>Natural Sciences (see major)</td>
<td>6</td>
</tr>
<tr>
<td>BIOL 202</td>
<td>2</td>
</tr>
<tr>
<td>PHIL 104, PHIL 105</td>
<td>6</td>
</tr>
<tr>
<td>Integrative Studies</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 304I</td>
<td>3</td>
</tr>
</tbody>
</table>
Degree Requirements | Credit Hours
---|---
Requirements for Dual Major in Electrical and Computer Engineering | (9)+11

Basic Sciences | 6
- PHYS 205A, PHYS 205B, PHYS 255A, PHYS 255B | (6)+2

Science Elective (with lab) | 4

Mathematics | 11
- MATH 150, MATH 250, MATH 251, MATH 305 | (3)+11

Required ECE Courses | 54
- ECE 222, ECE 235, ECE 296, ECE 315, ECE 321, ECE 327, ECE 329, ECE 336, ECE 345, ECE 355, ECE 356, ECE 375, ECE 385, ECE 495C, ECE 495D

Technical Electives | 40

Total | 150

1 Science Elective choose from Chemistry or Biology.

2 Approved by the Department. At least 35 hours of ECE electives. At least 20 hours from the following list: ECE 422, ECE 423, ECE 424, ECE 425, ECE 427, ECE 429, ECE 432, two approved CS courses.

Second Bachelor’s Degree

A student already holding one of the degrees may earn the other bachelor’s degree upon completion of at least 24 hours (making a total of 150 hours minimum), provided that the student fulfills the Department requirements for both the degrees and the University Core Curriculum requirements.

Electrical and Computer Engineering Courses

**ECE222 - Intro to Digital Computation** 222-3 Introduction to Digital Computation. Digital computation to solve basic problems in electrical and computer engineering. Analyzing problems, flowcharting, coding, executing, diagnosing, and verifying solutions. Programming in C++ language. Prerequisite: Mathematics 111 with a grade of C or better. Lab fee: $10 to help defray cost of equipment.


electric circuits. Prerequisite: MATH 250 with a minimum grade of C. Lab fee: $55 to help defray cost of equipment.

ECE296 - Intro Software Tools Robotics 296-2 Introduction to Software Tools and Robotics. Scientific computing using MATLAB and Simulink. Introduction to interpreted programming languages and basic programming principles. Introduction to Programmable Logic Controllers and Microcontrollers. Prerequisite: MATH 250 with a grade of C or better. Co-requisite: ECE 296L.

ECE296L - SW Tools & Robotics Lab 296L-2 Introduction to Software Tools and Robotics Lab. Hands-on application of micro-controllers for motor control, basic robotics, and data acquisition using various sensors. Application of interpreted programming languages to interact with various hardware. Use of Mindstorms hardware to demonstrate principles of robotic control. Hands-on application of programmable logic controllers and ladder logic. Prerequisite: MATH 250 with a grade of C or better. Co-requisite: ECE 296. Lab fee: $25 to help defray cost of software licenses and equipment.


ECE321 - Intro Software Engineering 321-3 Introduction to Software Engineering. Introduction to tools, concepts and techniques to develop complex software projects. The tools include object-oriented programming and advanced data structures. Concepts and techniques include introduction to principles of operating systems and introduction to software engineering, including requirements specifications, design methodology, and testing. Prerequisite: ECE 222 with a grade of C or better.

ECE321H - Intro to Software Engineering 321H-3 Introduction to Software Engineering. (University Honors Program) Introduction to tools, concepts and techniques to develop complex software projects. The tools include object-oriented programming and advanced data structures. Concepts and techniques include introduction to principles of operating systems and introduction to software engineering, including requirements specifications, design methodology, and testing. Prerequisite: ECE 222 with grade 'C' or better.

ECE321L - Intro to Software Engr Lab 321L-1 Introduction to Software Engineering-Lab. Application development on Visual Studio. Prerequisite: ECE 222 with a grade of C or better. Co-requisite: ECE 321. Lab fee: $10 to help defray cost of equipment.

ECE324 - Computer Systems Security 324-3 Computer Systems Security. Principles of computer systems security. Security basics (thread models, attacks and defenses), basic security tools (cryptography, primitives, authentication, digital signature, access control), software systems security (buffer overflow, virus, SQL injection etc.), networked systems security (denial of service attack, firewall and IDS, Wi-Fi security), cloud security, principles of hardware platform security. Prerequisite: ECE 315 with a grade of C or better.


ECE327L - Digital Circuit Design HDL Lab 327L-1 Digital Circuit Design with HDL-Laboratory. Implementation of digital combinational and sequential designs in hardware using SSI/MSI parts. Synthesis and simulation with the Verilog Hardware Description Language (HDL) using the Cadence SimVision and Cadence RTL Compiler CAD tools. Prerequisite: ECE 315 with a grade of C or better. Lab fee: $60 to help defray cost of software licenses, equipment and consumable items.

ECE329 - Computer Organization & Design 329-3 Computer Organization and Design. Introduction to the design and organization of digital computers: data-path and control, hardwired and microprogrammed control, interrupts, memory organization concepts. An introduction to optimization issues. Design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 315 with a grade of C or better. Concurrent enrollment required in ECE 329L.

ECE329H - Computer Organization & Design 329H-4 Computer Organization and Design. (University Honors Program) Introduction to the design and organization of digital computers: data-path and control, hardwired and microprogrammed control, interrupts, memory organization concepts. An introduction to optimization issues. Design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 327.

ECE329L - Computer Org/Design Lab 329L-1 Computer Organization and Design Lab. A sequence of labs for design and implementation of simple computers with hardwired and microprogrammed control. Prerequisite: ECE 315 with a grade of C or better. Concurrent enrollment in ECE 329 required. Lab fee: $50 to help defray cost of equipment and consumable items.

ECE336 - Electric Circuits II 336-3 Electric Circuits II. Sinusoidal steady state power, three-phase circuits, magnetic circuits, mutual inductance, frequency response, Laplace transform and applications to circuits, Fourier series and Fourier transform, filter circuits, Two- and three-port networks. Use of Pspice. Prerequisite: ECE 235 with a minimum grade of C.

ECE337 - Bioelectricity & Biosensing 337-3 Bioelectricity and Biosensing. The course introduces the sources of electrical signals in biologic systems, such as nerve, brain and muscle, and the techniques to sense such signals for biomedical applications. Topics include bio-properties and electrical properties of membranes, ion channels, action potentials and Hodgkin-Huxley model, electrical signal propagation, synaptic transmission, electrical stimulation, potentiometric and amperometric biosensors. The fundamental challenges in sensing bioelectrical signals are also discussed.

ECE345 - Electronics 345-3 Electronics. Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Lecture. Prerequisites: ECE 235 and PHYS 205B with grades of C or better. Concurrent enrollment in ECE 345L allowed.

ECE345H - Electronics Honors 345H-3 Electronics-Honors. (University Honors Program) Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Lecture. Prerequisite: ECE 235 and PHYS 205B with grades of C or better. Concurrent enrollment allowed in ECE 345L.

ECE345L - Electronics Lab 345L-1 Electronics Lab. Introduction to microelectronics, analog and digital systems, basic physics of semiconductors, diode models and circuits, bipolar junction transistors (BJTs) and BJT amplifier circuits, MOSFETs and MOSFET amplifier circuits, operational amplifiers (op-amps), op-amp circuits, non-ideal characteristics of the op-amp. Laboratory. Prerequisite: ECE 235 and PHYS 205B with grades of C or better. Co-requisite: ECE 345. Lab fee: $50 to help defray cost of equipment and consumable items.

ECE355 - Signals & Systems 355-3 Signals and Systems. Signal and system classification, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, application to communications, Laplace transform, application to linear circuits and systems, frequency response techniques, introduction to discrete-time signals and systems, sampling, discrete and fast
Fourier transforms. Lecture. Prerequisite: ECE 235 and MATH 305 with grades of C or better. Concurrent enrollment in ECE 355L allowed. Lab fee: $20 to help defray cost of software licenses and equipment.

**ECE355H - Signals & Systems** 355H-3 Signals and Systems Honors. (University Honors Program) Signal and system classification, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, application to communications, Laplace transform, application to linear circuits and systems, frequency response techniques, introduction to discrete-time signals and systems, sampling, discrete and fast Fourier transforms. Lecture. Prerequisite: ECE 235 and MATH 305 with grades of C or better. Concurrent enrollment allowed in ECE 355L. Lab fee: $20 to help defray cost of software licenses and equipment.

**ECE355L - Signals and Systems Lab** 355L-1 Signals and Systems Lab. Signal and system classification, operations on signals, time-domain analysis, impulse response and stability, Fourier series and transform, application to communications, Laplace transform, application to linear circuits and systems, frequency response techniques, introduction to discrete-time signals and systems, sampling, discrete and fast Fourier transforms. Laboratory. Prerequisite: ECE 235 and MATH 305 with grades of C or better. Concurrent enrollment in ECE 355 required.

**ECE356 - Systems and Control** 356-3 Systems and Control. Introduction to signals, linear systems theory, the Laplace transform, modeling of dynamic systems and circuits, dynamic response, basic properties of feedback PID control, root-locus design method, and frequency-response design method. Prerequisite: ECE 235, ECE 355 (may be taken concurrently), and MATH 305. ECE 356L may also be taken concurrently.

**ECE356L - Systems & Control Lab** 356L-1 Systems and Control Laboratory. Modeling and identification of linear time-invariant systems, understanding the effects of time delay, lead/lag controller design, PID control, controller implementation on digital computers all on a heat flow testbed. Prerequisite: ECE 356 with a grade of C or better. Lab fee: $20 to help defray cost of equipment.

**ECE361 - Intro Biomedical Engineering** 361-3 Introduction to Biomedical Engineering. This course provides an introductory overview of current trends and principles of biomedical engineering. Application of engineering approaches to the analysis of biomedical systems. Principles, practice, and the role of biomedical engineers in science, engineering, healthcare, and commercialization of medical products. Professional moral and ethical issues in biomedical engineering. Prerequisite: ECE 296 with a grade of C or better or consent of instructor.

**ECE375 - Intro Electromagnetic Fields** 375-3 Introduction to Electromagnetic Fields. Elementary electromagnetic field theory, vectors, static, quasi-static and time-harmonic fields, transmission lines and materials, Smith charts, Maxwell's equations in integral and differential forms, force, energy and power, plane waves, engineering tools and applications. Lecture. Prerequisite: ECE 235, MATH 251 and PHYS 205B with grades of C or better. Concurrent enrollment allowed in ECE 375L.

**ECE375H - Intro Electromagnetic Fields** 375H-4 Introduction to Electromagnetic Fields. (University Honors Program) Elementary electromagnetic field theory, vectors, static, quasi-static and time-harmonic fields, transmission lines and materials, Smith charts, Maxwell's equations in integral and differential forms, force, energy and power, plane waves, engineering tools and applications. Lecture and laboratory. Prerequisites: ECE 235, Mathematics 251 and Physics 205B.

**ECE375L - Intro Electromagnetic Lab** 375L-1 Intro Electromagnetic Laboratory. Study of elementary electromagnetic fields and waves, guided and wireless, using engineering simulation, fabrication, measurement and testing tools and design applications. Laboratory. Prerequisite: ECE 235, MATH 251 and PHYS 205B with grades of C or better. Co-requisite: ECE 375. Lab fee: $110 to help defray cost of software licenses.

ECE385L - Electric Machines Lab 385L-1 Electric Machines Lab. Laboratory experiments to accompany the ECE 385 course. AC power measurements, power transformers, synchronous machine, induction machine, DC machine. Prerequisite: ECE 235 with a grade of C or better; co-requisite: ECE 385. Lab fee: $70 to help defray cost of equipment.

ECE391 - Engr Analysis of Kinetics 391-3 Engineering Analysis of Kinetics. The purpose of this course is to introduce students to engineering analysis of human movement based on the mechanical laws of motion. Kinetics is an important branch of biomedical engineering, and it combines the fields of engineering mechanics with the fields of biology and physiology. In the course, students should gain an understanding of the mechanical and anatomical principles that govern human motion and develop the ability to link the structure of the human body with its function from an engineering perspective. Prerequisite: MATH 305, or consent of instructor. Concurrent enrollment allowed in ECE 361.

ECE392 - ECE Co-op Education 392-1 to 6 Electrical Engineering Cooperative Education. Supervised work experience in industry, government or in a professional organization. Students work with on-site supervisor and faculty adviser. Reports are required from the student and the employer. Hours do not count toward degree requirements. Mandatory Pass/Fail. Restricted to sophomore standing.

ECE412 - Wireless Networks 412-3 Wireless Networks. (Same as ECE 512) This undergraduate level course first introduces several widely adopted wireless communication technologies and then presents the concept, structure, and principles of ad hoc wireless networks. Novel applications in those networks will also be introduced. The coursework will include paper and literature reviews, presentations, assignments, and projects that will enable students to be familiar with ad hoc wireless networks. NS3 will be used for student projects in this course. Prerequisites: ECE 222 and ECE 355 with grades of C or better. Lab fee: $10 to help defray cost of equipment.

ECE422 - Comp Network Syst Arch 422-4 Computer Network System Architecture. (Same as ECE 553) Principles of Computer Networks. Protocols and system level implementations. Socket programming, router and switching fabric architecture, security and packet classification techniques, multimedia networking and QoS. Prerequisite: ECE 327. Lab fee: $10 to help defray cost of equipment.

ECE423 - Digital VLSI Design 423-4 Digital VLSI Design. (Same as ECE 513) Principles of the design and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. MOS transistor theory and the CMOS technology. Characterization and performance estimation of CMOS gates, CMOS gate and circuit design. Layout and simulation using CAD tools. CMOS design of datapath subsystems. Design of finite state machines. Examples of CMOS system designs. Laboratory experience in CMOS VLSI design. Lecture and Laboratory. Prerequisite: ECE 327 and 345. Lab fee: $35 to help defray cost of software licenses and equipment.

ECE424 - Design of Embedded Systems 424-4 Design of Embedded Systems. (Same as ECE 514) Introduction of modern embedded system application, platform architecture and software development. Principles of embedded processor architecture, operating systems and networking connectivity. Design and optimize in terms of system power, security and performance. Rapid prototyping using Intel-Atom based platform. Lecture and laboratory. Prerequisite: ECE 321 and ECE 329, or consent of instructor. Lab fee: $10 to help defray cost of equipment.

ECE425 - VLSI Design & Test Automation 425-4 VLSI Design and Test Automation. (Same as ECE 520) Principles of the automated synthesis, verification, testing and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. Resource allocation and scheduling in high-level synthesis. Automation of the logic synthesis for combinational and sequential logic. The physical design automation cycle and CMOS technology considerations. Fault modeling and testing. Timing analysis. Laboratory experience using commercial tools for synthesis and layout. Prerequisite: ECE 329. Lab fee: $30 to help defray cost of software licenses and equipment.

ECE426 - Implement VLSI Systs w/HDL 426-4 Implementation of VLSI Systems with HDL. (Same as ECE 516) This course is dedicated for advanced Digital VLSI architecture and system implementation for high performance and low power digital signal processing applications. Application-specific processors and architectures to support real time processing of signal processing systems will be studied. Hands-on experience of using state-of-the-art CAD tools on designing such kind of VLSI architecture and systems. Upon completion of this course, students will entail large HDL-based implementation of a complete VLSI
system. Prerequisite: ECE 327 with a grade of C or better. Lab fee: $35 to help defray cost of software licenses and equipment.

**ECE427 - Intro Interconnection Networks** 427-3 Introduction to Integrated Interconnection Networks. Role of interconnection networks. Specifications and constraints. Topology, routing, flow control, deadlock, livelock, arbitration, allocation. Prerequisite: ECE 329 with a grade of C or better.

**ECE428 - Programmable ASIC Design** 428-4 Programmable ASIC Design. (Same as ECE 528) Principle and practice of designing and implementing Application-Specific Integrated Circuits (ASIC). Field Programmable Gate Arrays (FPGA). Timing analysis, timing closure and managing difference clock domains in ASIC design. Complex arithmetic circuits. Digital signal processing (DSP) circuits. FPGA microprocessors. Prerequisite: ECE 327 with a grade of C or better. Lab fee: $50 to help defray cost of equipment and consumable items.

**ECE429 - Computer Systems Architecture** 429-3 Computer Systems Architecture. (Same as ECE 529) Principles of performance evaluation, processor microarchitecture, instruction-level parallelism, static and dynamic pipeline considerations. Superscalar processors. Multiprocessor systems. Memory hierarchy design, cache design. Mutual exclusion and synchronization mechanisms. Prerequisite: ECE 329 with a grade of C or better.

**ECE430 - Systems Programming** 430-4 Principles of Systems Programming. Introduction to concepts, techniques and tools to develop complex software to manage hardware resources. Operating system modules and interfaces, kernel development, process scheduling, dynamic memory control, device drivers. Design methodologies to meet system requirements specifications. Prerequisite: ECE 321 with a grade of C or better. Lab fee: $20 to help defray cost of equipment.

**ECE431 - Cloud Computing** 431-3 Cloud Computing. Cloud computing has evolved as a widely accepted and adopted computing model recently. This undergraduate course introduces the concepts, basic principles, overall structures, and key technologies of cloud computing, as well as several popular cloud computing services offered by major IT companies. In addition to the general cloud computing, the course is also featured by the introduction of MapReduce and Hadoop, which are the most popular programming model and platform for processing large amounts of data in parallel on cluster machines, respectively. The course work will include paper and literature review, presentations, assignments, and projects that will enable students to learn and use state-of-art cloud computing technologies and products. Amazon EC2 and Hadoop will be used for course projects, through which students will gain experience on how to deploy or build applications over computing clusters. Prerequisite: ECE 329 with a minimum grade of C or instructor consensus. Lab fee: $10 to help defray cost of equipment.

**ECE432 - Program Multi-Core Processors** 432-3 Programming for Multi-Core Processors. (Same as ECE 532) Multi-core architecture, threads, thread execution models, thread priority and scheduling, concurrency, multi-threaded programming models, synchronization, performance measurement and local balance, software tools for multi-threaded programming. Restricted to ECE students or consent of advisor. Prerequisite: ECE 222 with a grade of C or better. Lab fee: $20 to help defray cost of equipment.

**ECE436 - Comp Methods in BME** 436-3 Computational Methods in Biomedical Engineering. Algorithmic, statistical and machine learning foundations of computational biology. Maps, sequences, and genomes. Biological sequence analysis, microarray data, gene expression analysis, gene selection, sequence alignment. Prerequisites: ECE 222, ECE 321 with grades of C or better, or consent of instructor.

**ECE438 - Medical Instrumentation** 438-3 Medical Instrumentation: Application and Design. (Same as BME 538 and ECE 538) This course introduces the students to the field of medical instrumentation. Medical instrumentation is the application of advanced engineering technology to problems in biology and medicine. The course will focus on fundamentals of instrumentation systems, sensors, amplifiers, and signal precondition. In addition, the course also includes design and applications of medical instrumentation, biopotential measurement, biosensor, biomedical signal processing, and other related topics. Prerequisites: MATH 305 and ECE 361 with grades of C or better, or consent of instructor. Concurrent enrollment in ECE 361 allowed. Lab fee: $45 to help defray cost of software licenses and equipment.

**ECE440 - CMOS RF-IC Design** 440-4 CMOS Radio-Frequency Integrated Circuit Design. (Same as ECE 535) Introduction of RF IC, passive RLC Networks, passive IC components, MOS Transistors, distributed
systems, Smith Chart and S-Parameters, introduction to Band-width estimation, biasing and voltage reference, basic High Frequency Amplifiers, introduction to: noise in RF IC, Low Noise Amplifiers, Power Amplifiers, Phase-Locked Loops and Oscillators. Lecture and laboratory. Prerequisite: ECE 345, ECE 375 or equivalent. Lab fee: $35 to defray the cost of software licenses and equipment.

ECE441 - Photonics I 441-4 Photonics I. (Same as ECE 542) Ray optics, wave optics, beam optics, polarization of light, statistical optics, photons and atoms. Prerequisite: ECE 375 with a grade of C or better. Lab fee: $50 to help defray the cost of consumable items as well as maintaining or replacing the existing equipment.

ECE446 - Electronic Circuit Design 446-4 Electronic Circuit Design. (Same as ECE 546) Analysis and design of electronic circuits, both discrete and integrated. Computer-aided circuit design and analysis. Design of amplifier and filter circuits. Circuit stability analysis and frequency compensation techniques. Prerequisite: ECE 345 and ECE 355 with a grade of C or better. Lab fee: $10 to help defray cost of software licenses and equipment.


ECE448 - Photonics II 448-4 Photonics II. (Same as ECE 544) Fourier optics, fiber optics, electro-optics, nonlinear optical media, acousto-optics, photonic switching, optical and interconnections and optical storage. Prerequisite: ECE 441 or consent of instructor. Lab fee: $80 to help defray the cost of consumable items as well as maintaining or replacing the existing equipment and also to cover the cost of two licenses for VPIPhotronics software. Lab fee: $80 to help defray cost of software licenses.

ECE449 - VLSI Characterization 449-3 VLSI Material and Device Characterization. Materials for modern VLSI: semiconductor crystals, tubular and monolayer materials, organic materials, heterostructures, wafers and notations. Nanoscale fabrication processes: IC production flow, selective doping, nanolithography, etching, contacts and interconnects, spontaneous formation and ordering of nanostructures, fabrication of MEMS/NEMS systems, IC assembly and packaging. VLSI device characterization: electrical CV and IV profiling, defect characterization using DLTS, carrier mobility and lifetime measurements, optical microscopy and spectroscopy, particle beam and X-ray techniques. Reliability of devices and ICs: harsh environments, hot carriers, NBTI, electromigration, electrostatic discharge, IC power dissipation and cooling. Prerequisite: ECE 447 or ECE 423 or PHYS 425 with a grade of C or better or instructor consent.

ECE456 - Mechatronics/Embedded Control 456-4 Mechatronics and Embedded Control. (Same as ECE 561) Components of mechatronics systems, mathematical modeling, system identification, numerical tools for design and analysis, single-loop controller design, embedded systems, data acquisition and signal conditioning, sensors, actuators, networked control. This course includes lab session. Prerequisite: ECE 315 and ECE 356. Lab fee: $35.


ECE458 - Digital Image Processing I 458-3 Digital Image Processing I. (Same as ECE 558) Basic concepts, scope and examples of digital image processing, digital image fundamentals, image sampling and quantization, an image model, relationship between pixels, enhancement in the spatial domain,
enhancement in the frequency domain, image segmentation, basics of color image processing. Prerequisite: ECE 355 or consent of instructor.

**ECE459 - MEMS and Micro-Engineering** 459-3 MEMS and Micro-Engineering. Introduction to micro-electro-mechanical systems (MEMS), manufacturing techniques, microsensors, microactuators, microelectronics and micro-controllers. Lecture and laboratory. Prerequisite: ECE 315 and ECE 356.

**ECE460 - Principles of BME** 460-2 Principles of Biomedical Engineering. Principles of biomechanics, biomaterials, electrophysiology, modeling, instrumentation, biosignal processing, medical imaging, and biomedical optics. Not for credit towards the BS in Electrical or in Computer Engineering. Prerequisite: MATH 305 with a grade of C or better or consent of instructor.

**ECE466 - Linear Control Systems** 466-3 Linear Control Systems. Introduction to analysis of linear dynamical systems in time and frequency. Review of linear algebra and solutions of linear differential equations. State space representations, state transition matrix, and stability. Design and synthesis of controllers for linear systems. Prerequisites: ECE 355 and ECE 356.

**ECE467 - Intro to Biomedical Imaging** 467-4 Introduction to Biomedical Imaging. (Same as ECE 567 and BME 532) Biomedical imaging. X-ray imaging. Computed tomography (CT). Ultrasound. Magnetic resonance imaging (MRI). Image quality. Image reconstruction. Prerequisite: MATH 305 with a grade of C or better, or consent of instructor. Lab fee: $30 to help defray cost of software licenses and equipment.


**ECE468B - Digital Signal Processing** 468B-3 Digital Signal Processing. Discrete-time signals and systems: z-transform; discrete Fourier transform, fast Fourier transform algorithms; digital filter design; digital filter realizations. Lecture and laboratory. Restricted to graduate standing. Lab fee: $20 to help defray cost of software licenses.

**ECE471 - Wireless Communication** 471-3 Wireless Communication Systems. This course covers fundamentals of wireless communication systems. Topics include wireless system architectures, channel modeling, introduction to cellular systems, digital modulation and multiple-access techniques, introduction to multi-antenna techniques, performance analysis, wireless physical layer security, future trends in wireless communications. Prerequisite: ECE 315 and ECE 355 or consent of instructor. Restricted to enrollment in ECE program or consent of instructor. Project-based fee: $20 to help defray cost of software licenses.

**ECE472 - Antennas I** 472-4 Antennas I. (Same as ECE 575) Analysis, design, fabrication, measurement and CAD applied to basic antenna types. Fundamental parameters. Friis transmission equation. Impedance and pattern measurements. Resonant microstrip and wire antennas. Arrays and line sources. Lecture and Laboratory. Prerequisite: ECE 375. Lab fee: $120 to help defray cost of software licenses.

**ECE474 - Speech Processing** 474-3 Speech Processing. (Same as BME 533, ECE 533) This course introduces students to the rapidly developing field of speech processing. Fundamentals of speech production system, acoustic theory, signal analysis of speech, speech coding, speech synthesizing, and speech recognition algorithms. Prerequisites: MATH 305 and ECE 361 with grades of C or better or consent of instructor. Concurrent enrollment allowed in ECE 361.

**ECE476 - Intro to Info Theory** 476-3 Introduction to Information Theory and Channel Coding. (Same as ECE 555) Entropy and Mutual Information. Channel Capacity. Gaussian Channel. Linear Block Codes. Convolutional Codes. Advance Channel Coding Techniques. Prerequisite: ECE 315 and ECE 355.


**ECE478 - Communication Systems** 478-4 Principles of Communication Systems. (Same as ECE 570) This course covers principles of communication systems. Topics include (1) representation of signals and
systems, (2) amplitude modulation, (3) angle modulation, (4) probability theory and random processes for communication system designs, (5) transition from analog to digital and pulse code/delta modulation, (6) baseband digital transmission, (7) digital band-pass transmission techniques, (8) introduction to information theory and coding, (9) wireless channel modeling, (10) cellular systems and performance analysis. Restricted to enrollment in ECE program or consent of instructor. Lectures and laboratory projects. Prerequisites: ECE 315 and ECE 355 or consent of instructor.

ECE479 - Microwave Engineering I 479-4 Microwave Engineering I. (Same as ECE 562)
Electromagnetic theory, analysis, design, fabrication, measurement and CAD applied to passive networks at microwave frequencies. Topics include: Transmission lines, Waveguides, Impedance matching, Tuning, Resonators, Scattering parameters, the Smith Chart. Lecture and Laboratory. Prerequisite: ECE 375. Lab fee: $100 to help defray cost of software licenses.

ECE481 - Wind & Solar Pwr Systems 481-3 Wind and Solar Energy Power Systems. (Same as ECE 581) This course introduces students to wind and solar energy power systems. Planning of wind generation; and operation of wind generators, mechanical and electrical design, power conditioning, control and protection. Planning, operation and design of solar power systems; power conditioning, control and protection. Prerequisite: ECE 235 with a grade of C or better or equivalent.

ECE482 - Power Converter Design 482-3 Power Converter Design and Control. (Same as ECE 582) This course covers all the steps required for designing an actual power converter or electric drive system. The power stage design considerations, gate drive circuits, isolated high voltage/current measuring circuits, and application of a Texas Instrument Digital Signal Processor (DSP) for implementing different control schemes are discussed in detail. A brief introduction about the digital control theory and implementation of digital controller transfer functions using the DSP are provided as well. Prerequisite: ECE 356 with a grade of C or better. Lab fee: $65 to help defray cost of software licenses and equipment.

ECE483 - Electric Drive Systems 483-3 Electric Drive Systems. (Same as ECE 583) Course content is roughly 1/3 power electronics, 1/3 applied control and 1/3 electric machinery and focuses on analysis, simulation, and control design of electric drive based speed, torque, and position control systems. Advanced topics depending on the semester are taught. Prerequisite: ECE 356 with a grade of C or better. Lab fee: $65 to help defray cost of software licenses and equipment.

ECE484 - Electric and Hybrid Vehicles 484-3 Electric and Hybrid Vehicles. (Same as ECE 584) This course covers an entire range of topics related to analysis, design, control, and optimization of electric, hybrid, and plug-in hybrid power trains including automotive applications of adjustable speed motor drives, energy storage systems, and advanced power converters. Prerequisite: ECE 235 with a grade of C or better or instructor consent. Lab fee: $65 to help defray cost of software licenses and equipment.

ECE486 - Clean Electric Energy 486-3 Clean Electric Energy. History and future of energy resources and their use as a component of electrical systems. Fossil fuels and renewable energy sources. Environmental and economical impacts of various energy sources. Electric energy generating plants and distributed generation. Design of hybrid renewable energy systems. Prerequisite: ECE 385 with a grade of C or better.

ECE487 - Power Systems Analysis 487-3 Power Systems Analysis. Modeling and analysis of electric power systems. Topics covered: ac power, generators, power transformers, transmission line parameters and steady state operation, computation of power flows. The course uses power system analysis software. Lecture. Prerequisite: ECE 385 with a minimum grade of C.

ECE488 - Power System Engineering 488-3 Power System Engineering. (Same as ECE 588) The course covers topics involving the design and operation of a power system. Topics: symmetrical and unsymmetrical power system faults, power system protection design, transient stability of power generators, power system economic operation, power system control, transient operation of transmission lines. The course uses power system software. Lecture. Prerequisite: ECE 235 with a grade of C or better or consent of instructor.

techniques and systems. Protection of distribution systems. Special topics related to power distribution. Prerequisite: ECE 235 with a grade of C or better.

ECE490 - Biomedical Systems Modeling 490-3 Biomedical Systems Modeling. Modeling and analysis of biomedical systems. Engineering principles and computational methods to solve problems that are biological, physiological, and/or medical. Quantitative understanding of major physiologic functions. Prerequisites: MATH 305 and ECE 361 with grades of C or better or consent of instructor. Concurrent enrollment allowed in ECE 361.

ECE492 - Special Studies Electrical Eng 492-1 to 6 Special Studies in Electrical Engineering. Individual projects and problems selected by student or instructor. Open to seniors only. Not for graduate credit. Special approval needed from the instructor.

ECE493 - Special Topics Electrical Engr 493-1 to 4 Special Topics in Electrical Engineering. Lectures on topics of special interest to students in various areas of electrical engineering. Designed to test new and experimental courses in electrical engineering. Special approval needed from the instructor.

ECE494 - Biomedical Ultrasound 494-3 Biomedical Ultrasound. (Same as ECE 539 and BME 541) Diagnostic ultrasound is an ultrasound-based biomedical imaging technique used to visualize muscles, tissue, and many internal organs, to capture their size, structure and any pathological lesions. This course is an introduction to the principles and applications of biomedical ultrasound. This course will focus on fundamentals of acoustic theory, principles of ultrasonic detection and imaging, design and use of currently available tools for performance evaluation of diagnostic devices, and biological effects of ultrasound. Prerequisites: MATH 305 and ECE 361 with grades of C or better, or consent of instructor. Concurrent enrollment allowed in ECE 361.

ECE495C - CEGR Senior Design I 495C-3 Computer Engineering Senior Design I. Capstone Design part 1. Preparation for professional computer engineering practice with a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Includes aspects of project development and design within a team such as communicating, documenting, establishing goals, planning tasks, meeting deadlines, analyzing risk and fulfilling responsibilities professionally and ethically. Not for graduate credit. Prerequisites: ECE 315, 321, 329, and 345 with grades of C or better. Restricted to senior standing in Computer Engineering. Lab fee: $50 to help defray cost of software licenses, equipment and consumable items.

ECE495D - ECE Senior Design II 495D-3 Electrical and Computer Engineering Senior Design II. Capstone Design part 2. Continuation of a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Team approach in engineering projects. Work plan/time scheduling. Design options & cost-benefit analysis. Development of the final decision. Team coordination & documentation of team member efforts, design stages, team communication and team decision making processes. Implementation of the design (if the project warrants). Evaluation of the final product. Written, oral and poster presentation of final design. Not for graduate credit. Prerequisite: ECE 495C or ECE 495E. Lab fee: $50 to help defray cost of software licenses, equipment and consumable items.

ECE495E - EE Senior Design I 495E-3 Electrical Engineering Senior Design I. Capstone Design part 1. Preparation for professional electrical engineering practice with a major design experience based on earlier coursework, incorporating appropriate engineering standards and multiple constraints. Includes aspects of project development and design within a team such as communicating, establishing goals, planning tasks, meeting deadlines, analyzing risk and fulfilling responsibilities professionally and ethically. Not for graduate credit. Prerequisites: ECE 327, 345, 356, 375 and 385 with grades of C or better. Restricted to senior standing in Electrical Engineering. Lab fee: $50 to help defray cost of software licenses, equipment and consumable items.

ECE495M - BME Senior Design I 495M-3 Biomedical Engineering Senior Design I. Capstone Design part 1. Includes proposal and preliminary designs as part of a team project. Project development skills, scope of work, feasibility and cost-benefit analysis, trade studies, quality function deployment, ethical issues, professionalism, documentation of team member efforts, preliminary designs, identification and assignment of tasks to project team members, coordination of interdisciplinary team effort, development
of final proposal, design work, design review, oral presentations of final proposal. Prerequisites: ECE 361, 337, 391.

**ECE496A - ECE Honors Reading** 496A-3 Honors in Electrical and Computer Engineering-Honors Reading. Must be taken during the last two years of the undergraduate's career. Special approval needed from the department.

**ECE496B - ECE Honors Research** 496B-3 Honors in Electrical and Computer Engineering-Honors Supervised Research. Must be taken during the last two years of the undergraduate's career. Research culminating in an honors thesis for the University Honors Program. Prerequisite: ECE 496A or consent of department.

**ECE497 - Neuroengineering** 497-3 Neuroengineering. Fundamental topics in neuronal and neural signal generation, recording methods, and stimulation methods. Advanced understanding of how signals are generated and propagated in neurons and neuronal circuits, and applications of neuroengineering technology in medicine. Prerequisites: MATH 305 and ECE 361 with grades of C or better or consent of instructor. Concurrent enrollment allowed in ECE 361.

**ECE498 - Biomedical Signal Modeling** 498-3 Biomedical Signal Modeling. (Same as ECE 534, BME 536) The nature of biomedical signals. Memory and correlation. Impulse response and frequency response of biomedical signals. Modeling continuous-time and discrete-time biomedical signals. Noise removal and biomedical signal compensation. Prerequisites: MATH 305 and ECE 361 with grades of C or better or consent of instructor. Concurrent enrollment allowed in ECE 361.

**ECE499 - Biomedical Optics** 499-3 Biomedical Optics. This course introduces students to the rapidly growing field of biomedical optics with applications in medicine, genetics and biology. Topics include: fundamental background in modern and classic optics, principles of optical measurement in biological tissues, Monte Carlo modeling of light-tissue interaction, optics and lasers in medicine and biology, and noninvasive bio-optical imaging. Prerequisites: MATH 305 and ECE 361 with grades of C or better or consent of instructor. Concurrent enrollment allowed in ECE 361.

**ECE512 - Wireless Networks** 512-3 Wireless Networks. (Same as ECE 412) Compared to infrastructure based wireless communication systems, ad hoc wireless networks present several unique advantages. Thus, it has been widely studied as an important wireless communication paradigm. This graduate level course first introduces several widely adopted wireless communication technologies and then presents the concept, structure, and principles of ad hoc wireless networks. The course also introduces the details of several popular ad hoc wireless networks including mobile ad hoc networks, delay tolerant networks, wireless sensor networks, and connected vehicle networks. Novel applications in those networks will also be introduced. The course work will include paper and literature review, presentations, assignments, and a project that will enable students to be familiar with ad hoc wireless networks. NS2 will be used for student project in this course. Students can gain experience on NS2. Project-based fee: $10 to help defray cost of equipment.

**ECE513 - Digital VLSI Design** 513-3 Digital VLSI Design. (Same as ECE 423) Principles of the design and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. MOS transistor theory and the CMOS technology. Characterization and performance estimation of CMOS gates, CMOS gate and circuit design. Layout and simulation using CAD tools. CMOS design of datapath subsystems. Design of finite state machines. Examples of CMOS system designs. Laboratory experience in CMOS VLSI design. Restricted to enrollment in ECE program. Project-based fee: $35 to help defray cost of software licenses and equipment.


**ECE515 - Three Dimension Integrtn Systs** 515-3 Three Dimensional Integration Systems. This course introduces the design of three dimensional VLSI integration systems, including through-silicon-via (TSV) process, characterization and modeling, 3D IC systems design, mixed signal simulation, data management, testing, process, variation, thermal and reliability challenges, as well as review of 3D
system design examples. Laboratory experience in design tools (Cadence Virtuoso and Liberate, AMS simulator). Prerequisite: ECE 345 and ECE 423 with a grade of C or better. Restricted to enrollment in ECE program.

**ECE516 - Implement VLSI Systs w/HDL** 516-3 Implementation of VLSI Systems with HDL. (Same as ECE 426) This course is dedicated for advanced Digital VLSI architecture and system implementation for high performance and low power digital signal processing applications. Application-specific processors and architectures to support real time processing of signal processing systems will be studied. Hands-on experience of using state-of-the-art CAD tools on designing such kind of VLSI architecture and systems. Upon completion of this course, students will entail large HDL-based implementation of a complete VLSI system. Prerequisite: ECE 327 with a grade of C or better. Project-based fee: $35 to help defray cost of software licenses and equipment.

**ECE520 - VLSI Design & Test** 520-3 VLSI Design and Test Automation. (Same as ECE 425) Principles of the automated synthesis, verification, testing and layout of Very Large Scale Integrated (VLSI) circuits concentrating on the CMOS technology. Resource allocation and scheduling in high-level synthesis. Automation of the logic synthesis for combinational and sequential logic. The physical design automation cycle and CMOS technology considerations. Fault modeling and testing. Timing analysis. Laboratory experience using commercial tools for synthesis and layout. Prerequisite: ECE 329 with a C or better or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $30 to help defray cost of software licenses and equipment.


**ECE522 - VLSI Circuit Testing** 522-3 VLSI Circuit Testing. Theoretical and practical aspects of production testing of VLSI circuits. Relations between physical defects and fault models. Procedures for generating test inputs. Design modifications for test application and theory of built-in self-test. Prerequisite: ECE 425 or ECE 520 with a minimum grade of C or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $25 to help defray cost of software licenses.

**ECE523 - Low Power VLSI Design** 523-3 Low Power VLSI Design. Source of power dissipation, technology impact on power dissipation, low power circuit techniques, energy recovery, synthesis of low power circuits, low power components. Prerequisite: ECE 423 or ECE 513 with a minimum grade of C or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $35 to help defray cost of software licenses and equipment.

**ECE524 - Synth/Verif Digital Circuits** 524-3 Synthesis and Verification of Digital Circuits. Binary decision diagrams, finite state machines and finite automata. Design automation concepts in logic level synthesis, optimization and verification for combinational as well as sequential logic. Technology mapping. Prerequisite: ECE 425 or ECE 520 with a minimum grade of C or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $35 to help defray cost of software licenses and equipment.

**ECE525 - Adv Physical Design Automation** 525-3 Advances in Physical Design Automation. Advances in the automation of VLSI layouts with emphasis on recent developments in deep submicron, FPGA and MCM technologies. Floor planning, placement, routing objectives in high performance designs using deep submicron technology. Timing analysis in the presence of crosstalk. FPGA architectures and design with dynamically reconfigurable FPGAs. Physical design automation for MCMs. Prerequisite: ECE 425 or ECE 520 with a minimum grade of C or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $35 to help defray cost of software licenses and equipment.

**ECE526 - Network Process Syst Design** 526-3 Network Processing Systems Design. Protocol processing, packet processing algorithms, classification and forwarding, queuing theory, switching fabrics, network processors, network systems design tradeoffs. Prerequisite: ECE 422 and ECE 429 or consent of the instructor. Restricted to enrollment in ECE program.


ECE530 - Engineering Data Acquisition 530-3 Engineering Data Acquisition. (Same as ENGR 530) Theory of data acquisition and measurement systems. Criteria for selection of data acquisition hardware and software, instruments, sensors and other components of scientific and engineering experimentation. Methods for sampled data acquisition, signal conditioning, interpretation, analysis and error estimation. Restricted to enrollment in ECE program. Project-based fee: $60 to help defray cost of software licenses and equipment.


ECE532 - Parallel Programming 532-3 Programming Parallel Processors. (Same as ECE 432) Multi-core architecture, threads, thread execution models, thread priority and scheduling, concurrency, multi-threaded programming models, synchronization, performance measurement and local balance, software tools for multi-threaded programming. Restricted to ECE students or consent of advisor. Project-based fee: $20 to help defray cost of equipment.

ECE533 - Speech Processing 533-3 Speech Processing. (Same as BME 533, ECE 474) Fundamentals of speech production system, signal analysis of speech, speech coding, linear prediction analysis, speech synthesizing, and speech recognition algorithms. Prerequisite: MATH 305, or consent of instructor.

ECE534 - Biomedical Signal Modeling 534-3 Biomedical Signal Modeling. (Same as ECE 498, BME 536) The nature of biomedical signals. Electricity in living tissue. Biomedical signal processing and modeling. Modeling and simulation of biomedical systems. Prerequisite: MATH 305 with a grade of C or better or consent of instructor. Project-based fee: $20 to help defray cost of software licenses.

ECE535 - CMOS RF-IC Design 535-3 CMOS Radio-Frequency Integrated Circuit Design. (Same as ECE 440) Introduction of RF IC, passive RLC Networks, passive IC components, MOS Transistors, distributed systems, Smith Chart and S-Parameters, introduction to Band-width estimation, biasing and voltage reference, basic High Frequency Amplifiers, introduction to: noise in RF IC, Low Noise Amplifiers, Power Amplifiers, Phase-Locked Loops and Oscillators. Lecture and laboratory. Lab fee: $35 to defray the cost of software licenses and equipment.

ECE536 - Many-Core Embedded Systems 536-3 Many-Core Embedded Systems. Advanced software concepts and techniques to develop complex software projects. Concepts and techniques include advanced dynamic memory management, cross-compilation issues, scheduling techniques and resource management.

ECE537 - Integrated Photonics 537-3 Integrated Photonics. Fundamentals of electromagnetic theory, waveguides, photonic structures including photonic crystals and integrated micro-ring resonator, numerical simulations of photonic integrated circuits using the beam propagation method, finite-difference
ECE538 - Medical Instrumentation 538-3 Medical Instrumentation: Application and Design. (Same as ECE 438 and BME 538) This course introduces the students to the field of medical instrumentation. Medical instrumentation is the application of advanced engineering technology to problems in biology and medicine. The course will focus on fundamentals of instrumentation systems, sensors, amplifiers, and signal precondition. In addition, the course also includes design and applications of medical instrumentation, biopotential measurement, biosensor, biomedical signal processing, and other related topics. Prerequisite: MATH 305 with a grade of C or better, or consent of instructor. Project-based fee: $45 to help defray cost of software licenses and equipment.

ECE539 - Diagnostic Ultrasound Physics 539-3 Diagnostic Ultrasound Physics. (Same as ECE 494 and BME 541) Diagnostic ultrasound is an ultrasound-based biomedical imaging technique used to visualize muscles, tissue, and many internal organs, to capture their size, structure and any pathological lesions. This course is an introduction to the principles and applications of biomedical ultrasound. This course will focus on fundamentals of acoustic theory, principles of ultrasonic detection and imaging, design and use of currently available tools for performance evaluation of diagnostic devices, and biological effects of ultrasound. Prerequisite: MATH 305, or consent of instructor. Project-based fee: $30 to help defray cost of software licenses and equipment.

ECE540 - CMOS RF-IC Design II 540-3 CMOS Radio-Frequency Integrated Circuit Design II. High frequency amplifier design techniques, noise in RF IC and CMOS low noise amplifiers (LNA), mixers, oscillators, PLLs, frequency synthesizers, power amplifiers, an overview of wireless architectures. Prerequisite: ECE 440 or ECE 535 or equivalent. Lab fee: $50 to defray the cost of software licenses and equipment.

ECE541 - Nanofabrication 541-3 Nanofabrication. Fundamentals of nanofabrication for integrated circuits, micro-electromechanical systems (MEMS), biosensors, and chemical sensors. Topics include: materials, hot processing and ion implantation, pattern transfer, thin films, and process integration. Prerequisite: PHYS 320, 328; CHEM 210; or equivalent. Restricted to enrollment in ECE program.

ECE542 - Photonics I 542-3 Photonics I. (Same as ECE 441) Ray optics, wave optics, beam optics, polarization of light, statistical optics, photons and atoms. Prerequisite: ECE 375 with a grade of C or better. Project-based fee: $50 to defray the cost of equipment and consumable items.


ECE544 - Photonics II 544-3 Photonics II. (Same as ECE 448) Fourier optics, fiber optics, electro-optics, nonlinear optical media, acousto-optics, photonic switching, optical and interconnections and optical storage. Prerequisite: ECE 441 or consent of instructor. Project-based fee: $80 to help defray cost of software licenses.


ECE549 - Fiber Optic Communications 549-3 Fiber Optic Communications. Fundamentals of step index and graded index fiber waveguides using geometrical optics and Maxwell's equations. Other topics include design criteria, practical coupling techniques, discussion of optical sources and detectors used in light-wave communications, system examples, characterization and measurement techniques. Prerequisite: ECE 447 or ECE 448 or consent of instructor. Restricted to enrollment in ECE program.

ECE550 - Nanoelectronic Devices 550-3 Nanoelectronic Devices. Principles of semiconductor materials and devices. NanoTransistors: Charge-based devices-MOSFETs, non-ideal and quantum effects in nanoscale MOSFETs, advanced MOSFETs: trigate FETs, FinFETs, ETSOI, SiGe, Ge and III-Vs, carbon nanotubes and graphene ribbons, 2-D monolayers, nanowires, high electron mobility transistors (HEMTs), compact and SPICE models for advanced MOS devices. VLSI interconnects, parasitic elements, and reliability issues. Non-charge based devices-spinFET. Quantum devices-resonant tunnel diodes, tunnel FETs, single electron transistors (SETs). NanoMemory: EEPROM and Flash, phase change memory, electrolyte, magnetic and ferroelectric RAM, spin-torque devices, DRAM and ZRAM. Prerequisite: ECE 447 or PHYS 425 or PHYS 430 or instructor consent. Project-based fee: $25 to help defray cost of software licenses.

ECE551 - Prob and Stochastic Processes 551-3 Probability and Stochastic Processes for Engineers. (Same as ENGR 521) Axioms of probability, random variables and vectors, joint distributions, correlation, conditional statistics, sequences of random variables, stochastic convergence, central limit theorem, stochastic processes, stationarity, ergodicity, spectral analysis, and Markov processes. Restricted to graduate student status. Restricted to enrollment in ECE program. Project-based fee: $20 to help defray cost of software licenses.

ECE552 - Signal Detection & Estimation 552-3 Signal Detection and Estimation. Estimation theory: parameter estimation, minimum variance unbiased estimators, sufficient statistics, Cramer-Rao lower bound, best linear unbiased estimators, maximum likelihood estimators, least squares, Bayesian estimation, maximum a posteriori estimators, minimum mean square error estimators, linear minimum mean square error estimators, Wiener filtering. Detection theory: hypothesis testing, likelihood ratios, Neyman-Pearson detection, Bayesian hypothesis testing, matched filtering, multiple hypothesis testing, sequential detection, composite hypothesis testing, uniformly most powerful tests, generalized likelihood-ratio tests. Prerequisite: ECE 551 or consent of instructor. Restricted to enrollment in ECE program.


ECE554 - Broadband Wireless Comm 554-3 Broadband Wireless Communications. This course covers fundamentals of broadband wireless communications. Topics include concepts of space-time propagation, probabilistic modeling of space-time channel and signal models, multi-antenna (MIMO) systems, space-time coding, spatial diversity, spatial multiplexing, space-time receivers, orthogonal frequency division multiplexing (OFDM), MIMO OFDM, multi-user MIMO, performance analysis and trade-
offs in MIMO channels, concepts of spread spectrum systems, frequency hopping, and direct sequence systems. Restricted to enrollment in ECE program or consent of instructor.

ECE555 - Intro to Info Theory 555-3 Introduction to Information Theory and Channel Coding. (Same as ECE 476) Entropy and Mutual Information. Channel Capacity. Gaussian Channel. Linear Block Codes. Convolutional Codes. Advance Channel Coding Techniques. Restricted to enrollment in ECE program.

ECE556 - Digital Communications 556-3 Digital Communications. Digital communication signals and systems characterization. Deterministic receiver design. Probabilistic receiver design. Error control coding. Communication over band limited channels. Prerequisite: ECE 551 or consent of the instructor. Restricted to enrollment in ECE program.


ECE558 - Digital Image Processing I 558-3 Digital Image Processing I. (Same as ECE 458) Basic concepts, scope and examples of digital image processing, digital image fundamentals, image sampling and quantization, an image model, relationship between pixels, enhancement in the spatial domain, enhancement in the frequency domain, image segmentation, basics of color image processing. Special approval needed from the instructor. Restricted to enrollment in ECE program.

ECE559 - VLSI Characterization 559-3 VLSI Material and Device Characterization. Materials for modern VLSI: semiconductor crystals, tubular and monolayer materials, organic materials, heterostructures, wafers and notations. Nanoscale fabrication processes: IC production flow, selective doping, nanolithography, etching, contacts and interconnects, spontaneous formation and ordering of nanostructures, fabrication of MEMS/NEMS systems, IC assembly and packaging. VLSI device characterization: electrical CV and IV profiling, defect characterization using DLTS, carrier mobility and lifetime measurements, optical microscopy and spectroscopy, particle beam and X-ray techniques. Reliability of devices and ICs: harsh environments, hot carriers, NBTI, electromigration, electrostatic discharge, IC power dissipation and cooling. Prerequisite: ECE 447 or ECE 423 or PHYS 425 with a grade of C or better or instructor consent.

ECE561 - Mechatronics/Embedded Control 561-3 Mechatronics and Embedded Control. (Same as ECE 456) Components of mechatronics systems, mathematical modeling, system identification, numerical tools for design and analysis, single-loop controller design, embedded systems, data acquisition and signal conditioning, sensors, actuators, networked control. This course includes lab session. Lab fee: $35 to help defray the cost of software licenses.


ECE565 - Nonlinear Control Systems 565-3 Nonlinear Control Systems. Analysis and design of nonlinear dynamical systems. Topics include: nonlinear differential equations, stability, Lyapunov
stability analysis, stability of perturbed systems, linearization, and central manifold theorem. Stabilization, feedback linearization, and controller design methods such as backstepping and sliding mode control.

**ECE566 - Linear Systems Theory** 566-3 Linear Systems Theory. Introduction to the structure and analysis of linear dynamical systems in time domain. Linear algebra review, solutions of linear differential equations, state-space representations, state transition matrix, and time varying systems. Introduction to fundamental mathematics of linear spaces and linear operator theory. Structural properties of linear systems such as controllability, observability, and stability. Design and synthesis of controllers and state observers for linear systems. Linear quadratic regulatory theory and Kalman filter.

**ECE567 - Modern Biomedical Imaging** 567-3 Modern Biomedical Imaging. (Same as ECE 467 and BME 532) Modern biomedical imaging. Diagnostic x-ray projection imaging. Tomographic imaging. Ultrasound imaging and therapy. Magnetic resonance imaging (MRI). Signal and noise characteristics. Image quality evaluation. Three-dimensional image reconstruction algorithms. Prerequisite: ECE 355 or consent of instructor. Restricted to enrollment in ECE program. Project-based fee: $30 to help defray cost of software licenses and equipment.

**ECE568 - Pattern Classification** 568-3 Pattern Classification. Classification models, discriminant functions, decision surfaces, generalized linear discriminant functions, parameter estimation, problems of dimensionality, component analysis, Fisher discriminant analysis, hidden Markov models, nearest neighbor rules, classification trees, string matching, resampling for classifier design and evaluation, clustering algorithms, projects. Special approval needed from the instructor. Restricted to enrollment in ECE program.

**ECE569 - Biomedical Instrumentation** 569-3 Biomedical Instrumentation. (Same as BME 538) Basic concept of Medical instrumentation, basic sensors and principles, amplifiers, biopotential electrodes, blood pressure and sound, measurement of respiratory system, chemical biosensors, Cellular measurements, Nervous system measurements, magnetic resonance imaging. Prerequisites: PHSL 410A or CHEM 444 or consent of instructor. Restricted to enrollment in ECE program. Lab fee: $45 to help defray cost of software licenses and equipment.

**ECE570 - Communication Systems** 570-3 Principles of Communication Systems. (Same as ECE 478) This course covers principles of communication systems. Topics include (1) representation of signals and systems, (2) amplitude modulation, (3) angle modulation, (4) probability theory and random processes for communication system designs, (5) transition from analog to digital and pulse code/delta modulation, (6) baseband digital transmission, (7) digital band-pass transmission techniques, (8) introduction to information theory and coding, (9) wireless channel modeling, (10) cellular systems and performance analysis. Lectures and laboratory projects. Prerequisites: ECE 315 and ECE 355 or consent of instructor. Restricted to enrollment in ECE program or consent of instructor.

**ECE571 - Advanced Wireless Comm** 571-3 Advanced Wireless Communication. This course covers advanced topics in wireless communications. Topics include wireless system architectures, wireless channel modeling, cellular systems and co-channel interference, advanced digital modulation and multiple-access techniques, massive MIMO, mm-wave communications, performance analysis, radio resource allocation and optimization, wireless physical layer security, enabling technologies for 5G. Restricted to enrollment in ECE program or consent of instructor. Project-based fee: $20 to help defray cost of software licenses.

**ECE572 - Neural Networks** 572-3 Neural Networks. Anatomy and physiology of the cerebral cortex. Feed-forward Networks, Linear Associator, Multilayer Perceptrons. Feedback Networks, Hopfield Networks, ART. Applications to pattern recognition, robotics and speech processing. Optical and electronic implementations. Prerequisite: MATH 305 or consent of instructor. Restricted to enrollment in ECE program.

**ECE573 - Fields and Waves II** 573-3 Field and Waves II. Time-harmonic electromagnetic fields in dielectric and lossy media, transmission lines, antennas and resonators. Techniques include duality, image theory, reciprocity and integral equations. Boundary value problems solved for several frequently encountered symmetries. Prerequisite: ECE 477. Restricted to enrollment in ECE program.

**ECE574 - Nonlinear Optics** 574-3 Nonlinear Optics. Coupled-mode-analysis applied to nonlinear wave interactions, harmonic generation, parametric amplification, backward wave amplifiers, backward
oscillation in laser systems, phase conjugation and multiple-wave mixing systems, Pockel and Kerr effects, and electro-optical modulations in optical communication systems. Prerequisite: ECE 375 or consent of instructor. Restricted to enrollment in ECE program.

ECE575 - Antennas I 575-3 Antennas I. (Same as ECE 472) Analysis, design, fabrication, measurement and CAD applied to basic antenna types. Fundamental parameters. Friis transmission equation. Impedance and pattern measurements. Resonant microstrip and wire antennas. Arrays and line sources. Lecture and laboratory. Prerequisite: ECE 375 or equivalent. Restricted to enrollment in ECE program. Project-based fee: $120 to help defray cost of software licenses.

ECE576 - Numeric Electromagnetics 576-3 Numerical Electromagnetics. Numerical solution of electromagnetic problems by methods that include finite element, integral equation, moment, spectral domain and finite difference. Examination of electromagnetic problems and their solutions in current literature. Prerequisite: ECE 573. Restricted to enrollment in ECE program.

ECE577 - Antennas II 577-3 Antennas II. Analysis, design and CAD of antennas. Numerical methods. Broadband, traveling-wave, frequency independent, electrically-small, aperture and microstrip antenna types. Prerequisite: ECE 472. Restricted to enrollment in ECE program.

ECE578 - DIP II 578-3 Digital Image Processing II. Full-color image processing, image noise and degradation models, image restoration, inverse filtering. Wiener filtering, geometric transformations, image compression models, error-free compression, lossy compression, compression standards, dilation and erosion, opening and closing operations, morphological filtering, boundary descriptors, regional descriptors, principal components, vision-based pattern recognition. Prerequisite: ECE 558. Restricted to enrollment in ECE program.

ECE579 - Microwave Engineering II 579-3 Microwave Engineering II. Analysis and design of passive and active devices at microwave frequencies. Topics include: power dividers, couplers, filters, ferrite devices, noise, noise effects in detectors, mixers, modulators, amplifier and oscillator design, and an introduction to microwave systems. Prerequisite: ECE 479. Restricted to enrollment in ECE program.

ECE580 - Seminar 580-1 Seminar. Study and formal presentation by students of selected research in electrical and computer engineering. Restricted to students in the graduate program in Electrical and Computer Engineering. Special approval needed from the instructor.

ECE581 - Wind & Solar Power Systems 581-3 Wind and Solar Energy Power Systems. (Same as ECE 481) The course introduces students to wind and solar energy power systems. Planning of wind generation; and operation of wind generators, mechanical and electrical design, power conditioning, control and protection. Planning, operation and design of electric solar plants; power conditioning, control and protection.

ECE582 - Power Converter Design 582-3 Power Converter Design and Control. (Same as ECE 482) This course covers all the steps required for designing an actual power converter or electric drive system. The power stage design considerations, gate drive circuits, isolated high voltage/current measuring circuits, and application of a Texas Instrument Digital Signal Processor (DSP) for implementing different control schemes are discussed in detail. A brief introduction about the digital control theory and implementation of digital controller transfer functions using the DSP are provided as well. Project-based fee: $65 to help defray cost of software licenses and equipment.

ECE583 - Electric Drive Systems 583-3 Electric Drive Systems. (Same as ECE 483) Course content is roughly 1/3 power electronics, 1/3 applied control and 1/3 electric machinery and focuses on analysis, simulation, and control design of electric drive based speed, torque, and position control systems. Advanced topics depending on the semester are taught. Project-based fee: $65 to help defray cost of software licenses and equipment.

ECE584 - Electric and Hybrid Vehicles 584-3 Electric and Hybrid Vehicles. (Same as ECE 484) This course covers an entire range of topics related to analysis, design, control, and optimization of electric, hybrid, and plug-in hybrid power trains including automotive applications of adjustable speed motor drives, energy storage systems, and advanced power converters. Restricted to enrollment in ECE program or consent of the instructor. Lab fee: $65 to help defray cost of software licenses and equipment.

ECE586 - Power System Methods 586-3 Computational Methods in Power Systems. The course covers advanced methods for the computation and analysis of power systems. Topics: circuit graph theory and network matrices, computation of electromagnetic transients, computation of power flows and faults, computation of system stability, stochastic methods in power systems, load forecasting, state estimation, unit dispatch. The course uses power system software. Lecture. Restricted to enrollment in the ECE program.

ECE587 - Modern Power Systems Op 587-3 Modern Power Systems Operation. This course provides students with a comprehensive picture of the techniques used in modern power systems operation. The course introduces central "terminal" characteristics for thermal and hydroelectric power generation systems, along with new optimization techniques for tackling "real-world" power systems operating problems. The topics include: analysis of different bidding strategies in competitive electricity markets, prediction of load and price, analysis of power systems security, different methods of optimal power flow, analysis of power systems uncertainty and reliability, economic dispatch, and unit commitment analysis. Project-based fee: $65 to help defray cost of software licenses and equipment.

ECE588 - Power System Engineering 588-3 Power System Engineering. (Same as ECE 488) The course covers topics involving the design and operation of a power system. Topics: symmetrical and unsymmetrical power system faults, power system protection design, transient stability of power generators, power system economic operation, power system control, transient operation of transmission lines. The course uses power system software. Lecture.


ECE592 - Special Investigations 592-1 to 3 Special Investigations in Electrical Engineering. Individual advanced projects and problems selected by student or instructor. Restricted to graduate standing. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593A - Adv Topics ECE Antennas/Propag 593A-1-3 Advanced Topics in Electrical Engineering-Antennas and Propagation. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593B - Adv Topics ECE-ASIC Design 593B-1-3 Advanced Topics in Electrical Engineering-ASIC Design. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593C - Adv Topics ECE-Communications 593C-1-3 Advanced Topics in Electrical Engineering-Communications. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593D - Adv Topics ECE-Comp Architect 593D-1-3 Advanced Topics in Electrical Engineering-Computer Architecture. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593E - Adv Topics ECE-Control Systems 593E-1-3 Advanced Topics in Electrical Engineering-Control Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.
ECE593F - Adv Topics ECE-Design Automatn 593F-1-3 Advanced Topics in Electrical Engineering-Design Automation. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593G - Adv Topics ECE-Digital Design 593G-1-3 Advanced Topics in Electrical Engineering-Digital Design. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593H - Adv Topics-Digital Test/Verify 593H-1-3 Advanced Topics in Electrical Engineering-Digital Testing and Verification. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593I - Adv Topics ECE-Elec Flds/Waves 593I-1-3 Advanced Topics in Electrical Engineering- Electromagnetic Fields and Waves. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593J - Adv Topics ECE-Embedded System 593J-1-3 Advanced Topics in Electrical Engineering- Embedded Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593K - Adv Topics ECE-Medical Imaging 593K-1-3 Advanced Topics in Electrical Engineering-Medical Imaging. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593L - Adv Topics ECE-Mix Signal Test 593L-1-3 Advanced Topics in Electrical Engineering- Mixed-Signal Testing and Design. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593M - Adv Topics ECE-Nanotechnology 593M-1-3 Advanced Topics in Electrical Engineering- Nanotechnology. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593N - Adv Topics ECE-Network Systems 593N-1-3 Advanced Topics in Electrical Engineering- Network Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593O - Adv Topics ECE-Photonics 593O-1-3 Advanced Topics in Electrical Engineering-Photonics. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593P - Adv Topics ECE-Phys Des Automt 593P-1-3 Advanced Topics in Electrical Engineering- Physical Design Automation. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593Q - Adv Topics ECE-Pwr Elec Conv 593Q-1-3 Advanced Topics in Electrical Engineering- Power Electronic Converters and Drive Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.
ECE593R - Adv Topics ECE-Power Quality 593R-1-3 Advanced Topics in Electrical Engineering-Power Quality. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593S - Adv Topics ECE-Pwr Sys Con/Pro 593S-1-3 Advanced Topics in Electrical Engineering-Power System Control and Protection. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593T - Adv Topics ECE-Renewbl Energy 593T-1-3 Advanced Topics in Electrical Engineering-Renewable Energy. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593U - Adv Topics ECE-RF/M'Wave Syst 593U-1-3 Advanced Topics in Electrical Engineering-RF and Microwave Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593V - Adv Topics ECE-Signal Process 593V-1-3 Advanced Topics in Electrical Engineering-Signal Processing. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593W - Adv Topics ECE-Software Engr 593W-1-3 Advanced Topics in Electrical Engineering-Software Engineering. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE593X - Adv Topics ECE-Wireless System 593X-1-3 Advanced Topics in Electrical Engineering-Wireless Systems. Lectures on advanced topics of special interest to students in various areas of Electrical & Computer Engineering. This course is designed to offer and test new experimental courses in ECE. Restricted to enrollment in ECE program. Special approval needed from the instructor.

ECE595 - Communication Skills 595-3 Communication Skills for Engineering Graduate Students. This course prepares graduate engineering students to communicate technical information to various audiences and for various purposes. Principles and strategies are applied to theses, dissertations, scholarly presentations, and other engineering documents such as lab reports, user manuals, business correspondences, job application materials, and engineering ethics. Research tools and software programs prepare students to deliver oral presentations on current engineering topics. Restricted to graduate standing. Does not count toward the hours required for graduation in the ECE program. Restricted to enrollment in ECE program.

ECE596 - Intro to BME 596-3 Introduction to Biomedical Engineering. (Same as BME 596) Principles of biomechanics, biomaterials, electrophysiology, modeling, instrumentation, biosignal processing, medical imaging, and biomedical optics. Professional moral and ethical issues in biomedical research and development. Prerequisite: MATH 305, or consent of instructor.

ECE597 - Biomedical Research Ethics 597-1 Biomedical Research Ethics. (Same as BME 597) Series of lectures from distinguished speakers, from academia, industry and government, regarding ethical issues associated with biomedical research and development. Graded S/U or DEF only. Restricted to: Enrollment in BME or ECE program. Does not count toward the hours required for graduation in the ECE program.

ECE599 - Thesis 599-1 to 6 Thesis.

ECE600 - Doctoral Dissertation 600-1 to 24 (1 to 16 per semester) Doctoral Dissertation. Dissertation research. Hours and credit to be arranged by director of graduate studies. Graded S/U only. Restricted to Admission to PhD program in Electrical and Computer Engineering.
ECE601 - Continuing Enrollment 601-1 per semester Continuing Enrollment. For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only.

Electrical and Computer Engineering Faculty

Ahmed, Shaikh, Professor, Ph.D., Arizona State University, 2005.
Anagnostopoulous, Iraklis, Assistant Professor, Ph.D., National Technical University of Athens, 2014.
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Chen, Ying, Associate Professor, Ph.D., Duke University, 2007.
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Gupta, Lalit, Professor, Ph.D., Southern Methodist University, 1986.
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Haniotakis, Themistoklis, Associate Professor, Ph.D., University of Athens, 1998.
Harackiewicz, Frances J., Professor, University of Massachusetts at Amherst, 1990.
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Komaee, Arash, Assistant Professor, Ph.D., University of Maryland, College Park, 2008.
Lu, Chao, Assistant Professor, Ph.D., Purdue University, 2012.
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Singh-Gupta, Vidya, Senior Lecturer, Ph.D., Southern Illinois University, 1988.
Smith, James G., Professor, Emeritus, Ph.D., University of Missouri at Rolla, 1967.
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Wang, Haibo, Professor, Ph.D., University of Arizona, 2002.
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