# Fall 2018 ECE Course Descriptions

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>EE 14</td>
<td>Microprocessor Architecture &amp; Applications w/Lab</td>
<td>F+</td>
<td>ES 99, some programming experience</td>
<td>TR 12:00 – 1:15</td>
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<tr>
<td></td>
<td>Lab</td>
<td>L+T</td>
<td></td>
<td>T 4:30 – 5:45</td>
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<tr>
<td></td>
<td>Lab</td>
<td>E+F</td>
<td></td>
<td>F 10:30 – 11:45</td>
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Introduction to the microprocessor with a comparative analysis of some popular forms; memory devices, interface devices, and other support circuitry; machine language and assembly language programming. Microprocessor use in dedicated applications. The course includes a laboratory devoted to software and hardware design.

**Recommendation:** ES 4, some programming experience

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<tbody>
<tr>
<td>EE 22</td>
<td>Electronics II w/Lab</td>
<td>N+</td>
<td></td>
<td>TR 6:00 – 7:15</td>
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</table>

Integrated circuit realizations of MOS transistor circuits, current mirrors, active loads; Bipolar Junction Transistors, (BJT), device operation, small signal model and analysis, elementary BJT amplifier configuration; differential amplifiers, multi-stage amplifiers; frequency response of amplifiers; feedback and stability in analog circuits, nyquist stability criteria, frequency compensation; RC oscillators, LC oscillators, and waveform generators; output structures; power amplifiers; AM/FM circuits.

**Recommendation:** EE 21 - Students may not take both EE 22 and EE 12 for credit.

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<tbody>
<tr>
<td>EE 23</td>
<td>Linear Systems</td>
<td>I+</td>
<td></td>
<td>MW 3:00 – 4:15</td>
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</table>

Vector spaces, orthogonality, the continuous and discrete bi-lateral and uni-lateral Fourier transform, the bi-lateral and uni-lateral Laplace transform, convolution, and correlation; Introduction to discrete Fourier transform and Fast Fourier transform via MatLab; the Z transform.; matrices, eigenvectors, and eigenvalues; numerical methods for linear systems through stability and causality for control systems for analog applications and up-sampling an down-sampling for discrete systems.

**Recommendation:** EE 21 and MATH 51 Students may not take both EE 23 and EE 102 for credit.

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<tbody>
<tr>
<td>EE 97</td>
<td>Senior Design Project</td>
<td>E+F</td>
<td></td>
<td>F 10:30–11:45</td>
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A comprehensive design project undertaken during the senior year, individually or as a team, under the guidance of a faculty supervisor. The work is spread over two terms.

**Prerequisites:** EE 31 or equivalent, or permission of instructor

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<tbody>
<tr>
<td>EE 31</td>
<td>Undergraduate Internship in EE</td>
<td>ARR</td>
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Supervised internships at suitable locations in industry and government, term paper required. Credit not given retroactively.

**Prerequisites:** Permission of Advisor & prior arrangements required

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<tr>
<td>EE 104</td>
<td>Probabilistic System Analysis</td>
<td>D+</td>
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<td>TR 10:30 – 11:45</td>
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</table>

Advanced analysis in probabilistic systems with strong emphasis on theoretical methods. Development of analytical tools for the modeling and analysis of random phenomena with application to problems across a range of engineering and applied science disciplines. Probability theory, sample and event spaces, discrete and continuous random variables, conditional probability, expectations and conditional expectations, and derived distributions. Sums of random variables, moment generating functions, central limit theorem, laws of large numbers. Statistical analysis methods including hypothesis testing, confidence intervals and nonparametric methods.

**Recommendation:** Math 42 or equivalent. Sr or Grad standing or consent of instructor.

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<tbody>
<tr>
<td>EE 105</td>
<td>Feedback-control Systems</td>
<td>M+</td>
<td></td>
<td>MW 6:00 – 7:15</td>
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</table>

Modern control and fundamentals of state-feedback including matrix differential equations, controllability, state transformations, canonical forms, and control matrix design. Classical control and output-feedback with topics including transfer functions, s-plane analysis, stability criteria, PID controllers, root locus, controller design using op-amps, and compensation networks.

**Prerequisites:** EE 23 and Math 70; or graduate standing

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<tbody>
<tr>
<td>EE 107</td>
<td>Communication Systems</td>
<td>J+</td>
<td></td>
<td>TR 3:00–4:15</td>
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<tr>
<td></td>
<td>Lab</td>
<td>K+</td>
<td></td>
<td>M 4:30–5:45</td>
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<tr>
<td></td>
<td>Lab</td>
<td>E+</td>
<td></td>
<td>F 10:30–11:45</td>
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Fundamentals of analog and digital communication systems. Analog and digital modulations, including AM, FM, pulse code modulation, PAM, PSK, QAM techniques. Effects of noise and transmission medium on communication performance via the signal-to-noise ratio, bit error rate and inter-symbol interference. Concept of channel capacity. Associated laboratory work and design project.

**Prerequisites:** EE 23, EE 24
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<tbody>
<tr>
<td>EE 114</td>
<td>Physics of Solar Cells</td>
<td>H+</td>
<td>TR 1:30-2:45</td>
</tr>
<tr>
<td>EE 117</td>
<td>Introduction Microwaves</td>
<td>N+</td>
<td>TR 6:00-7:15</td>
</tr>
<tr>
<td>EE 119</td>
<td>Microwave System Engineering</td>
<td>P+</td>
<td>MW 7:30-8:45</td>
</tr>
<tr>
<td>EE 125</td>
<td>Digital Signal Processing</td>
<td>G+</td>
<td>MW 1:30-2:45</td>
</tr>
<tr>
<td>EE 126</td>
<td>Computer Engineering with Lab</td>
<td></td>
<td>TR 9:00-10:15</td>
</tr>
<tr>
<td>EE 128</td>
<td>Operating Systems</td>
<td>K+</td>
<td>MW 4:30-5:45</td>
</tr>
<tr>
<td>EE 129</td>
<td>Computer Communication Networks</td>
<td>L+</td>
<td>TR 4:30-5:45</td>
</tr>
<tr>
<td>EE 170</td>
<td>Power Systems</td>
<td>F+</td>
<td>TR 12:00-1:15</td>
</tr>
<tr>
<td>EE 191</td>
<td>Electrical Engineering Seminar</td>
<td>G+F</td>
<td>+F 1:30-2:45</td>
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**Physics of photovoltaic cells including physics of semiconductors in photovoltaic devices, physical models of solar cell operation, characteristics and design of common types of solar cells, and approaches to increasing solar cell efficiency.**

**Recommendation:** MATH 42, MATH 51, EE 18, PHYS 42/43 or instructor permission

**Transmission and reflection of guided waves. The Smith chart and matching. Scattering parameters and flow graphs. Biological effects. Laboratory measurement of power, frequency, attenuation, Q-factor, and time-domain reflectometry.**

**Recommendation:** EE 18, or EE 13 & permission of instructor

**Planning and deploying microwave systems and networks. Design and construction of system components, design and management of microwave networks. Cellular systems. Best network topologies and paths for lowest possible operations and maintenance costs. System components: oscillators, attenuators, phase shifters, modulators, mixers, filters, amplifiers, and antennas, A to D and D to A converters. Transmitter and receiver characteristics, Transceiver Design, System Gain, Satellite Communications, Radio Thermal Noise, signal to noise ratio SIN, receiver sensitivity, modulation and SIN, design principles, antenna system considerations.**

**Prerequisite:** EE 117 and EE 107

**Data communications concepts. Communications networking techniques: switching and broadcast networks, access protocols, local networks. Design issues, overview of current products. Computer communications architecture: hardware/software issues, protocols and architecture, layered approach and hierarchical approach.**

**Prerequisite:** EE 14

**Fundamental issues in operating system design. Concurrent processes: synchronization, sharing, deadlock, scheduling. Relevant hardware properties of uniprocessor and multiprocessor computer systems.**

**Recommendation:** COMP 15 and either COMP 40 or EE 14

**Data communications concepts. Communications networking techniques: switching and broadcast networks, access protocols, local networks. Design issues, overview of current products. Computer communications architecture: hardware/software issues, protocols and architecture, layered approach and hierarchical approach.**

**Recommendation:** Sr or Grad EE degree candidate or permission of instructor

**Analysis and design of AC transmission and distribution systems, transmission lines, transformers and generators. Understanding, modeling, operating and controlling such systems; basics of voltage control and power flows in electricity networks. Graduate students are expected to complete and present an additional class project.**

**Recommendation:** EE 22 or graduate student standing

**A course devoted to the study of special problems in electrical engineering.**

**Tracey/Vu**
**EE 193-01**  
**Special Topics: Software Engineering**  
N+  
TR 6:00 - 7:15

Software engineering is an engineered discipline in which the aim is the production of software products, delivered on time and within a set budget, that satisfies the client’s needs. It covers all aspects of software production ranging from the early stage of product concept to design and implementation to post-delivery maintenance. This course covers the major concepts and techniques of software engineering including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools so that students can prepare for their future careers as software engineers. The course will combine a strong technical focus with a project providing the opportunity to obtain hands-on experiences on entire phases and workflow of the software process.

**Prerequisites:**  
Comp 40, or Com 15 or equivalent

**EE 193-03**  
**Special Topics: Hardware-Software Image Processing**  
H+  
TR 1:30 – 2:45

Cameras and displays may seem straightforward, but it takes an amazing amount of engineering to go from light striking a camera lens to an image on a screen. We begin this journey by studying the fascinating abilities (and surprising inabilities) of the human visual system and the fundamentals of light and color. Then we enter the lens of a camera and travel down the image-processing pipeline, discussing how pixels are created, processed, and compressed. Finally, we discuss systems for transmitting and displaying images on screens of all kinds. Based on this foundation, we conclude with a survey of cutting-edge topics in imaging, including computational cameras, image forensics, and virtual reality.

**Prerequisites:**

**EE 193-04**  
**Special Topics: Synthetic Biology**  
J+  
TR 3:00 – 4:15

Synthetic biology involves the designing and building/engineering organisms for desired applications. This course will cover topics in the origin, techniques, and current status of this engineering field and its application to chemical, pharmaceutical, energy, environmental, and agriculture industries. The course will also investigate tools of synthetic biology including, protein engineering, metabolic engineering, genome engineering and genetic circuits. A special emphasis starting in 2018 will include model-guided design and analysis of genetic circuits.

**Prerequisites:**  
Bio 41, Bio 152/Chem 171, Basic knowledge of MATLAB

**EE 200**  
**Graduate Internship in EE**  
H+  
TR 3:00 – 4:15

Programming in C and C++ with coverage of data structures (linked lists, binary trees, hash tables, graphs), abstract data types (stacks, queues, maps, sets) and algorithms (sorting, graph search, minimal spanning tree). Efficiency of these structures and algorithms is compared via Big-O analysis. Brief coverage of concurrent (multi-threaded) programming. Object-oriented design: inheritance, templates and virtual methods. Embedded, high-performance and close-to-hardware applications. Defensive coding and use of standard UNIX development tools.

**Prerequisites:**  
Graduate Standing

**EN 01-02**  
**Applications in Engineering: Music & Art in Engineering**  
E+  
MW 10:30 – 11:45

Physics of sound, audio engineering, and electronic music synthesis. Pitch, tone, filters, distortion, noise, amplification, sampling, and digital filtering. Introduction to electronic components, oscilloscopes, function generators, and electrical diagnostics. Introduction to MATLAB as a computation tool for engineering problems with examples focused on the digital synthesis of sound. The final design project may combine both hardware and software approaches to music synthesis. Discussion of engineering ethics in the context of audio electronics and digital music. Overview of the engineering roadmap and the electrical and computer engineering curricula.

**Limited to first-year students**

**EN 01 – 03**  
**Applications in Engineering: Intro to Renewable Energy**  
E+  
MW 10:30 – 11:45

We will examine renewable energy generation technologies with a critical eye; including, the examination of the way the media portrays energy technologies. While going off the grid sounds like a great idea, it is a complex problem to be solved. Solar and wind energy sources require a lot of land; additionally, they are not constant with time, and efficient energy storage technology does not exist. We will explore the renewable energy technology of today as well as future prospects. We will look at the natural resource requirements of energy systems as well as their environmental and economic impacts. Labs will give the student a hands-on sense for the energy generation process and its complexity.

**Limited to first-year students**
Definitions of circuit elements, fundamental laws, selected network theorems, controlled sources, introduction to the oscilloscope, energy and power, natural response and complete response of first order circuits, steady state sinusoidal behavior, algebra of complex numbers, phasors, impedance, average and reactive power, introduction to analog and digital systems, frequency response and filters, measurements and instrumentation, introduction to computer applications for circuit analysis and design. Associated laboratory project work.

**Recommendation**

**Must be preceded or accompanied by MATH 34.**

**EE 293**  
*Master's Project*  
Guided individual study of an approved topic suitable for a master's design project.  

**Prerequisites:** Permission of Advisor

**EE 295**  
*Master's Thesis*  
Guided individual study of an approved topic suitable subject for a master's thesis.  

**Prerequisites:** Permission of Advisor

**EE 297**  
*Doctoral Thesis*  
Guided individual study of an approved topic suitable for a doctoral dissertation  

**Prerequisites:** Permission of Advisor

**EE 401**  
*Master's Degree Continuation*  
Part Time - For those individuals who have completed all their course work and are finishing a project or thesis.  

**Prerequisites:** Permission of Advisor

**EE 402**  
*Master's Degree Continuation*  
Full Time - For those individuals who have completed all their course work and are finishing a project or thesis.  

**Prerequisites:** Permission of Advisor

**EE 405**  
*Grad Teaching Assistant*  
For graduate teaching assistants

**EE 406**  
*Grad Research Assistant*  
For graduate research assistants

**EE 501**  
*Doctoral Degree Continuation*  
Part Time - For those individuals who have completed all their course work and are finishing a project or thesis  

**Prerequisites:** Permission of Advisor

**EE 502**  
*Doctoral Degree Continuation*  
Full Time - For those individuals who have completed all their course work and are finishing a project or thesis  

**Prerequisites:** Permission of Advisor