

# EELE - Electrical Engineering

**EELE 101. Intro Electrical Fundamentals. 3 Credits.** (1 Lec, 1 Lab) F,S  
 PREREQUISITE: M 151Q or equivalent. Lecture/laboratory introduction to electrical fundamentals including Kirchhoff's and Ohm's Laws, using meters and oscilloscopes, time-varying signals in electric circuits, inductors and capacitors, series and parallel circuits, introduction to digital circuits, problem solving including computer applications, technical communications, team work.

**EELE 201. Circuits I for Engineering. 4 Credits.** (3 Lec, 1 Lab) F,S  
 PREREQUISITE: EELE 101, M 172Q. COREQUISITE: PHSX 222. Introduction to circuit analysis, Ohm's and Kirchhoff's Laws, nodal and mesh methods, network theorems; resistors, capacitors, inductors, dependent sources, ideal op-amps; the complete response of first order circuits; complex frequency and phasors; steady-state AC circuits, coupled inductors and ideal transformers.

**EELE 203. Circuits II for Engineering. 4 Credits.** (3 Lec, 1 Lab) S  
 PREREQUISITE: EELE 201, M 274. Natural and forced response of R-L-C circuits, frequency response of R-L-C circuits and Bode plots, frequency response, slew-rate and DC imperfections of real op-amps; Laplace Transform, Fourier series and Fourier Transform techniques in circuit analysis; basic R-L-C and op-amp filters; two port networks.

**EELE 217. The Science of Sound. 2 Credits.** (2 Lec) F  
 PREREQUISITE: M 121Q, M 132, or M 105Q, or the equivalent. Introduction to the principles of musical acoustics, sound systems, and audio technology for non-engineering students. This course is particularly geared toward students in the College of Arts and Architecture and in the Music Technology program.

**EELE 250. Circuits, Devices and Motors. 4 Credits.** (3 Lec, 1 Lab) F,S  
 PREREQUISITE: M 166Q or M 172Q and PHSX 207 or PHSX 222. Introduction for non-majors to electrical circuit principles, voltage and current laws, frequency response; introduction to electronic circuits including operational amplifiers, and power electronics; introduction to electromechanical energy conversion devices, DC and AC machines.

**EELE 261. Intro To Logic Circuits. 4 Credits.** (3 Lec, 1 Lab) F,S  
 An introductory course in the fundamental concepts of classical digital design. Course covers design and implementation of combinational logic circuits, synchronous sequential circuits and information storage circuits. Basic concepts of Hardware Description Languages(HDLs), design and simulation of digital systems using HDLs, and digital system implementation with programmable logic devices are presented.

**EELE 290R. Undergraduate Research. 1-6 Credits.** (1-6 Ind; max unlimited) F,S  
 Directed undergraduate research which may culminate in a written work or other creative project. Course will address responsible conduct of research. May be repeated.

**EELE 291. Special Topics. 1-4 Credits.** (1-4 Lec; 12 cr max) On Demand  
 PREREQUISITE: None required but some may be determined necessary by each offering department. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number.

**EELE 292. Independent Study. 1-3 Credits.** (1-3 Ind; 6 cr max) On Demand  
 PREREQUISITE: Consent of instructor and approval of department head. Directed research and study on an individual basis.

**EELE 308. Signals and Systems Analysis. 3 Credits.** (3 Lec) F  
 PREREQUISITE: EELE 203, M 273Q. Discrete and continuous time signals and systems. Properties, application, synthesis and analysis for the CT and DT Fourier Series, the Fourier transform, the DTFT, z and Laplace transform. Applications in differential and difference equations, sampling, feedback, and communications. Introduction to the DFT.

**EELE 317. Electronics. 4 Credits.** (3 Lec, 1 Lab) F  
 PREREQUISITE: EELE 203. This is an introductory course in electronics. It introduces diodes, bipolar junction transistors, field effect transistors and bipolar and MOS analog and digital circuits.

**EELE 321. Intro To Feedback Controls. 3 Credits.** (3 Lec) S  
 PREREQUISITE: EELE 308 or EMEC 303 or consent of instructor. Classical continuous-time, transfer function approach to control systems engineering. Approximations, linearization, and time response. Design and analysis via root-locus, Nyquist, and Bode methods. Proportional, dominant pole, lead, lag, PID, and minor loop compensation. Describing functions. Lab exercises incorporate a variety of hand-on control systems.

**EELE 334. Electromagnetic Theory I. 3 Credits.** (3 Lec) F  
 PREREQUISITE: PHSX 222, M 273Q. Basic electric and magnetic fields including transmission lines. The materials covered will include both static and dynamic fields, traveling waves, and transmission line concepts such as impedance, reflection coefficient, and transient response.

**EELE 354. Electric Power Applications. 3 Credits.** (2 Lec, 1 Lab) F  
 PREREQUISITE: M 166Q or M 171Q and PHSX 207 or PHSX 222. An applied study of electricity and electrical power circuits, with laboratory experience, for that person not expected to deal with electronics or advanced circuit techniques. Topics covered include electrical circuit laws; power and energy; alternating current circuits; residential, commercial and industrial wiring; wire sizing, three-phase circuits; and application of transformers and electric motors.

**EELE 355. Energy Conversion Devices. 4 Credits.** (3 Lec, 1 Lab) S  
 PREREQUISITE: EELE 203. Three-phase power; electromechanical energy conversion devices and motor drives; introduction of power electronic converters for power control and motor drive applications. Laboratory experience includes power measurements; experience with transformers and motor-generator operational characteristics and DC and AC motor drives operation.

**EELE 367. Logic Design. 4 Credits.** (3 Lec, 1 Lab) S  
 PREREQUISITE: EELE 261 Advanced combinational and sequential logic design. Hardware descriptive language (HDL) programming knowledge. Laboratory experience implementing advanced logic designs using FPGAs.

**EELE 371. Microprocess HW and SW Systems. 4 Credits.** (3 Lec, 1 Lab) F  
 PREREQUISITE: EELE 261 and knowledge of a programming language or consent of instructor. Introduction to the structure of microprocessors, arithmetic and logic units, processor control, interrupts, memories, and input/output. Laboratory experience in assembly level programming of microprocessor applications.

**EELE 394. Multidisciplinary Seminars. 1 Credit.** (1 Sem) F,S  
 PREREQUISITE: Junior standing. Students attend seminars presented by a variety of departments and disciplines to gain an appreciation of multidisciplinary environments leading to a greater understanding of the impact of engineering solutions in a global and societal context.

**EELE 407. Intro To Microfabrication. 3 Credits.** (2 Lec, 1 Lab) F  
 PREREQUISITE: Junior standing and PHSX 222 or PHSX 207. Provide an introduction to clean room safety protocol and micro fabrication. Lectures will introduce micro fabrication methods, models and equipment. Laboratories will perform the steps to produce and characterize a metal-oxide-semiconductor transistor.

**EELE 408. Photovoltaic Systems. 3 Credits.** (2 Lec, 1 Lab) S  
 PREREQUISITE: PHSX 222. Provide a basic understanding of the design, fabrication and operating principles of solar cells and how they are integrated into photovoltaic systems. Laboratories will perform the steps required to produce and characterize silicon solar cells.

**EELE 409. EE Material Science. 3 Credits.** (3 Lec) F  
 PREREQUISITE: EELE 317. Basic material properties of dielectrics, magnetic materials, conductors, and semiconductors. Practical applications of materials to semiconductor devices.

**EELE 411. Advanced Analog Electronics. 3 Credits.** (3 Lec) S  
 PREREQUISITE: EELE 317. This course covers differential and multistage amplifiers, frequency response, feedback, analog integrated circuits, filters, and tuned circuits, analog to digital and digital to analog conversion, noise in electronics, current topics.

**EELE 414. Intro to VLSI Design. 3 Credits.** (3 Lec) F  
 PREREQUISITE: EELE 261, EELE 317. Introduction to the fundamentals of CMOS VLSI circuit design. This course covers CMOS device characteristics and timing, CMOS fabrication, CAD tools, design rules, simulation and layout, CMOS combinational and sequential logic, SRAM and DRAM memory, and dynamic logic design.

**EELE 417. Acoustics/Audio Engineering. 3 Credits.** (3 Lec) F alternate years to be offered even years PREREQUISITE: PHSX 222. Introduction to the principles of acoustics, audio engineering, and audio signal processing. Propagation of sound in enclosures. Engineering analysis of loudspeakers, microphones, and recording devices. Human psychoacoustics.

**EELE 422. Intro to Modern Control. 3 Credits.** (3 Lec) F  
 PREREQUISITE: EELE 321. Introduction to techniques of modern control with emphasis on discrete time, including matrices, norms, state-space, and stochastic processes. Stability, Lyapunov functions, Lyapunov stability. Observability, controllability, reachability. State feedback and observers. Model based control. Performance and robustness.

**EELE 432. Applied Electromagnetics. 3 Credits.** (3 Lec) S

PREREQUISITE: EELE 334 or PHSX 423. Advanced study of electromagnetic wave propagation, including polarization, reflection and refraction at interfaces, and cavities and multilayer structures, to investigate a number of practical devices with applications related to electrical engineering and optics, such as waveguides, fiber optics, and antennas.

**EELE 445. Telecommunication Systems. 4 Credits.** (3 Lec, 1 Lab) S

PREREQUISITE: EELE 308, EELE 317. Introduction to analog and digital communication systems with lab. Topics include signals in communications; noise characterizations; bandwidth considerations; probability of error; analog and digital modulation; frequency domain analysis; matched filter applications. Experiments involve modulation, demodulation, A/Ds, sampling theory, and aliasing.

**EELE 447. Mobile Wireless Communications. 3 Credits.** (3 Lec) F

PREREQUISITE: EELE 445. Characteristics of the radio environment, propagation, cellular concepts, channel allocation, modulation techniques, multiple access techniques, Shannon's Capacity Theorem, error-correcting codes, data compression, spread spectrum modulation, current wireless communication systems.

**EELE 451. Power Electronics. 3 Credits.** (2 Lec, 1 Lab) S alternate years

to be offered even years PREREQUISITE: EELE 317, EELE 321, EELE 355. Introduction to solid-state power devices; topologies, operating principles, modeling and control, and design of basic power converters; magnetic design; applications of power converters in renewable energy source power systems, electric and hybrid electric vehicles, and other residential, commercial, and industrial systems; laboratory experience with basic power converters.

**EELE 454. Power Systems Analysis. 3 Credits.** (3 Lec) F

PREREQUISITE: EELE 355. Power system components, transmission system design, power flow studies, automatic generation control, symmetrical components, faulted power systems, protection, introduction to transient stability.

**EELE 455. Alternative Energy Power Gen. 3 Credits.** (3 Lec) S, alternate years

to be offered even years PREREQUISITE: EELE 355 or equivalent. Exploration and analysis of alternative power generation sources and systems such as wind, solar, microturbine, and fuel cells, combined sources and their design, power electronic interfacing, and energy storage systems. Co-convened with EELE 555.

**EELE 456. Power Sys Protection & Ctl. 3 Credits.** (3 Lec) S, alternate years

to be offered even years PREREQUISITE: EELE 454 or equivalent. Continuation of EELE 454. Symmetrical and unsymmetrical fault analysis, system protection, introduction to load frequency control, voltage control, economic dispatch, and introduction to power system stability.

**EELE 461. Digital System Design. 3 Credits.** (3 Lec) S, alternate years

to be offered even years PREREQUISITE: EELE 308 and EELE 334 and EELE 371. Analysis and design of high speed digital systems including chip-to-chip signal propagation, transmission lines, IC package interconnect, printed circuit board design, state-of-the-art simulation tools, and measurement techniques using Time Domain Reflectometry (TDR).

**EELE 465. Microcontroller Applications. 4 Credits.** (2 Lec, 2 Lab) S

PREREQUISITE: EELE 371. Lecture/laboratory exposure to micro controller hardware and software applications, serial and parallel I/O, timing, interrupts LCDs, keypads, A to D conversion, and a project realizing a real time control problem.

**EELE 466. Comp Computer Architecture. 4 Credits.** (3 Lec, 1 Lab) S

PREREQUISITE: EELE 475. Design of custom CPU's and embedded systems using FPGAs, emphasizing computational tasks such as audio and video processing. design and development of custom instruction sets. Engineering tradeoffs among fixed-point, floating point, and compressed representations of numerical data.

**EELE 475. Hardw/Softwr Eng Embedded Sys. 3 Credits.** (2 Lec, 1 Lab) F

PREREQUISITE: EELE 367 and CSCI 112. Topics in embedded system design, real-time operating systems, high level language programming of embedded systems, software and hardware tradeoffs, and laboratory experience with embedded systems.

**EELE 477. Digital Signal Processing. 4 Credits.** (3 Lec, 1 Lab) S

PREREQUISITE: EELE 308. Analysis and design of discrete-time systems, including frequency response. Sampling and reconstruction of continuous signals. Analysis, design, and applications of FIR and IIR digital filters. Properties and applications of the discrete Fourier transform. Laboratory experience implementing off-line and real time digital signal processing algorithms.

**EELE 481. Optical Design. 3 Credits.** (3 Lec) S alternate years

PREREQUISITE: EELE 482 or PHSX 327 Optical design using geometric optics and computer ray-tracing software. Introduces ray and wave front aberrations, control of aberrations in optical systems, designing for system requirements, and analytic tools including the modulation transfer function.

**EELE 482. Electro-Optical Systems. 3 Credits.** (2 Lec, 1 Lab) F

PREREQUISITE: EELE 334 or PHSX 423 or equivalent. Provides an overview of electro-optic systems and components. Lectures cover ray optics, scalar wave optics, laser and Gaussian beam optics, optical polarization and polarization devices, light sources, detectors, and electro-optic and acoustic-optic photonic devices. Laboratory experiments introduce basic photonic instrumentation and measurement techniques.

**EELE 484. Laser Engineering. 3 Credits.** (3 Lec) S alternate years

to be offered even years PREREQUISITE: PHSX 222. The laser engineering course provides a basic understanding of the design and operational principles of lasers. Discussions of design and operation of several types of lasers will be covered including solid state lasers, gas lasers, and semiconductor lasers.

**EELE 487. Prof, Ethics & Engr Practices. 1 Credit.** (1 Lec) S

PREREQUISITE: Junior standing. Engineers from industry and others give presentations on professionalism, ethics, and engineering practices. Included are specific well-known, historical engineering ethics cases and professional practices of engineering, intellectual property issues, and new developments.

**EELE 488R. Electric Engineering Design I. 2 Credits.** (2 Sem) F

PREREQUISITE: EELE 317 and EGEN 310R. Part I of a two consecutive semester senior capstone design sequence in Electrical Engineering. Students, under the guidance of a faculty supervisor, formulate a solution to a real-world design problem culminating in a critical design review. Co-convened with EELE 489R.

**EELE 489R. Electrical Engr Design II. 3 Credits.** (3 Sem) F,S

PREREQUISITE: EELE 488R. The second of a two consecutive semester senior capstone design sequence in Electrical Engineering. Students, under the guidance of a faculty supervisor, realize, assess and document the performance of their solution to a real-world design problem. Co-convened with EELE 488R.

**EELE 490R. Undergraduate Research. 1-6 Credits.** (1 Ind; 6 cr max) F,S,Su

Directed undergraduate research which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. May be repeated.

**EELE 491. Special Topics. 1-4 Credits.** (1-4 Lab; 12 cr max) On Demand

PREREQUISITE: Course prerequisites as determined for each offering. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number.

**EELE 492. Independent Study. 1-3 Credits.** (1-3 Ind; 6 cr max) On Demand

PREREQUISITE: Junior standing, consent of instructor and approval of department head. Directed research and study on an individual basis.

**EELE 498. Internship. 1-2 Credits.** (1 Ind; 12 cr max) F,S,Su

PREREQUISITE: Sophomore standing and consent of instructor. On-site, one semester practicum under guidance of employer designated mentor.

**EELE 499R. Capstone: Electrical Engr Dsgn. 3 Credits.** (2 Lab) F,S

PREREQUISITE: EGEN 310R. Senior capstone course. A design project culminates with the actual construction and demonstration of the results. Design teams report progress to the design supervisor periodically. Students are required to write a technical paper, participate in a Design Fair, and generate complete technical documentation for the project.

**EELE 503. Advanced Analog Circuit Design. 3 Credits.** (3 Lec) F alternate years

to be offered odd years PREREQUISITE: EELE 317. Solid state device models, p-spice and other computer simulations, single and multiple state amplifier design, current sources, operation amplification design, frequency response, feedback and feed forward amplifier analysis, noise and distortion in electronics.

**EELE 505. MEMS Sensors and Actuators. 3 Credits.** (2 Lec, 1 Lab) S alternate years

to be offered odd years PREREQUISITE: EELE 409. Micro fabrication of electrical and mechanical devices. Theory of various mechanical transducers and physical sensors including optical MEMS, RF MEMS, and Bio/Chemical MEMS.

**EELE 517. Acoustics/Audio Engineering. 3 Credits.** (3 Lec) F alternate years

to be offered even years PREREQUISITE: PHSX 222. Introduction to the principles of acoustics, audio engineering, and audio signal processing. Propagation of sound in enclosures. Engineering analysis of loudspeakers, microphones, and recording devices. Human psychoacoustics.

**EELE 522. Adaptive Control. 3 Credits.** (3 Lec) S alternate years to be offered even years PREREQUISITE: EELE 422. On-line parameter estimation, self tuning regulators, model reference adaptive controls. Robust control.

**EELE 525. System Identification. 3 Credits.** (3 Lec) F alternate years to be offered odd years PREREQUISITE: EELE 422. System identification with emphasis on off-line techniques. Stability of matrix decompositions used for identification. Recursive least squares, auto regressive techniques, hypothesis testing. Geometrical and statistical interpretations of least squares, maximum likelihood, and Bayesian estimation. Derivative and derivative-free iterative solutions. Modeling and model order selection. Analytical techniques including Lagrange multipliers.

**EELE 526. Sequential State Estimation. 3 Credits.** (3 Lec) F alternate years to be offered even years PREREQUISITE: EELE 422. Sequential state estimation, with emphasis on Kalman filtering and smoothing. Continuous and discrete time.

**EELE 528. Advanced Controls and Signals. 3 Credits.** (3 Lec; 6 cr max) On Demand  
Max 6 cr. PREREQUISITE: EELE 422 or equivalent. Reading, discussion and exploration of original source material on advanced control systems and signal processing. Topics selected to compliment current interest and existing courses; for example, computational statistical methods, estimation, modeling, compression, advanced analytical techniques, multi-dimensional systems, spectral analysis, and implementation.

**EELE 533. Antenna Engineering. 3 Credits.** (3 Lec) F alternate years to be offered even years PREREQUISITE: EELE 334 or equivalent. Introduction to the electromagnetic theory and practice of antenna design and analysis. Common antenna structures are studied, including dipoles, arrays, horns, and reflectors. Applications will be explored in wireless communication, remote sensing, and related fields. Numerical electromagnetic simulation techniques are used for antenna modeling.

**EELE 538. Adv Top Electromagnet & Optics. 3 Credits.** (3 Lec; 6 cr max)  
-- Advanced topics in applied electromagnetics and optics, chosen to represent current research in this field.

**EELE 541. Advanced Communication Theory. 3 Credits.** (3 Lec) F alternate years  
to be offered even years PREREQUISITE: EELE 445. Signal spectrum analysis, random processes, correlation functions, functional transformations of random variables, optimal linear filtering and estimation, statistical analysis of digital and analog modulation systems, orthogonality and related signals: time, bandwidth, and dimensionality.

**EELE 543. Advanced Telecom Systems. 3 Credits.** (3 Lec) F alternate years to be offered odd years PREREQUISITE: EELE 445. Digital and analog switching systems, packet and circuit telecommunication transmission networking and media selection (fiber optics, cable, microwave and satellite), network configuration, network technologies, equipment selection, system design examples and project.

**EELE 547. Ad Hoc Wireless Sensor Network. 3 Credits.** (3 Lec) S alternate years  
to be offered even years PREREQUISITE: EELE 447 and EELE 543. Stationary and mobile sensor network topologies, RF technologies, frequency selection, link layer and media access protocols, energy management techniques, mobility management, standards and applications.

**EELE 548. Advanced Communication Systems. 3 Credits.** (3 Sem; 6 cr max) S alternate years  
to be offered odd years Max 6 cr. PREREQUISITE: EELE 543 or equivalent. Reading and discussion of original source material on advanced communications systems topics including digital communications systems, optical technologies and systems, packet networks, IP networking, wireless systems, ad hoc networks.

**EELE 552. Power System Analysis/Control. 3 Credits.** (3 Lec) On Demand PREREQUISITE: EELE 454. Representation of power system elements, fast-decoupled power flow, optimal power flow, voltage control, load-frequency control, control of active and reactive power flow, application of FACTS devices in power flow control, electrical faults and contingency calculations, transient stability, dynamic stability.

**EELE 555. Alt Energy Dist Gen Systems. 3 Credits.** (3 Lec) S alternate years to be offered even years PREREQUISITE: EELE 355. Exploration and analysis of alternative power generation sources and systems such as wind, solar, microturbine, and fuel cells, combined sources and their design, power electronic interfacing, and energy storage systems. Co-convened with EELE 455.

**EELE 556. Advanced Power Electronics. 3 Credits.** (3 Lec) F alternate years to be offered odd years PREREQUISITE: EELE 451. mathematical modeling of switching power converters, advanced power converter topologies, design constraints and control methods, design-oriented analysis techniques for applications in electro-mechanical systems, power systems, transportation systems, etc.

**EELE 558. Advanced - Electrical Power. 3 Credits.** (3 Lec; 6 cr max) On Demand  
Max 6 cr. PREREQUISITE: EELE 454 or equivalent. Reading, discussion and exploration of advanced electrical power topics including power system operation and control, power dynamics, power markets, protection, electric drives, or power electronics.

**EELE 561. Digital System Design. 3 Credits.** (3 Lec) S, alternate years to be offered even years PREREQUISITE: EELE 308 and EELE 334 and EELE 371. Analysis and design of high speed digital systems including chip-to-chip signal propagation, transmission lines, IC package interconnect, printed circuit board design, state-of-the-art simulation tools, and measurement techniques using Time Domain Reflectometry (TDR) and Vector Network Analyzers. Research of modern topics.

**EELE 565. Parallel Processing. 3 Credits.** (3 Lec) F alternate years to be offered odd years PREREQUISITE: EELE 466. Architecture and applications of parallel processors, major design issues, fault tolerant computing, performance measures of parallel systems, and issues in concurrent programming.

**EELE 575. Research/Prof Paper/Project. 3-6 Credits.** (3-6 Ind; 6 cr max) F,S,Su IND Maximum 6 cr. PREREQUISITE: Graduate standing. A research or professional paper dealing with a topic in the field. The topic must have been mutually agreed upon by the student and his or her major advisor and graduate committee. This course is required for students in the Electrical Engineering non-thesis (plan B) master's degree program.

**EELE 577. Adv Digital Signal Processing. 3 Credits.** (3 Lec) S alternate years to be offered odd years PREREQUISITE: EELE 477. Advanced topics in digital signal processing. Review of LTI discrete-time systems; signal and coefficient quantization; sample rate conversion and multirate filter structures; time-varying and adaptive systems; fast algorithms; system implementation alternatives; DSP applications in current research.

**EELE 578. Speech Signal Processing. 3 Credits.** (3 Lec) F alternate years to be offered even years PREREQUISITE: EELE 477. Digital signal processing techniques that are used to analyze, code, and manipulate speech signals will be covered. Topics include modification, coding, enhancement, and recognition of speech signals.

**EELE 581. Fourier Optics/Imaging Theory. 3 Credits.** (3 Lec) F alternate years to be offered odd years PREREQUISITE: EELE 334 or consent of instructor. Optical propagation and diffraction using scalar wave approach and Fourier Theory of imaging. Introduces concepts of pupil function, point and line spread function and optical transfer function, image formation with coherent and incoherent light, holography and diffractive optical elements.

**EELE 582. Optical Design. 3 Credits.** (3 Lec) S alternate years to be offered odd years PREREQUISITE: EELE 482 or PHSX 327. Optical design using geometric optics and computer ray-tracing software. Introduces ray and wave front aberrations, control of aberrations in optical systems, designing for system requirements, and analytic tools including the modulation transfer function for describing the imaging and beam-conditioning properties of typical optical systems, including lenses, mirrors, cameras, and telescopes.

**EELE 583. Remote Sensing Systems. 3 Credits.** (3 Lec) S alternate years to be offered even years PREREQUISITE: EELE 334 or PHSX 423 or equivalent. Design, analysis, and calibration of electromagnetic remote sensing systems. Combines an introduction to atmospheric radiative transfer and wave propagation principles with detailed coverage of radiometry and optical detectors to analyze remote sensing systems. The course considers the full electromagnetic spectrum, but emphasizes optical systems at ultraviolet, visible, and infrared wavelengths, including cameras, spectrometers, radiometers, polarimeters, multispectral and hyperspectral imagers, laser radars, etc.

**EELE 584. Laser Engineering. 3 Credits.** (3 Lec) S Alternate Years PREREQUISITE: PHSX 222. The laser engineering course provides a basic understanding of the design and operational principles of lasers. Discussions of design and operation of several types of lasers will be covered including solid state lasers, gas lasers, and semiconductor lasers.

**EELE 589. Graduate Consultation. 1-3 Credits.** (1-3 Ind; 3 cr max) F,S,Su  
TUT Maximum 3 cr. PREREQUISITE: Master's standing and approval of the Dean  
of Graduate Studies. This course may be used only by students who have completed  
all of their course work (and thesis if on a thesis plan) but who need additional  
faculty or staff time or help.

**EELE 590. Masters' Thesis. 1-10 Credits.** (1-10 Ind; max unlimited) F,S,Su  
PREREQUISITE: Master's standing.

**EELE 591. Special Topics. 1-4 Credits.** (1-4 Lab; 12 cr max)  
-- Special Topics.

**EELE 592. Independent Study. 1-6 Credits.** (1-6 Ind; 6 cr max)  
-- Independent study for electrical engineering students.

**EELE 598. Internship. 1-12 Credits.** (1-2 Ind) On Demand  
PREREQUISITE: Graduate standing, consent of instructor and approval of  
Department Head. An individual assignment arranged with an agency, business or  
other organizations to provide guided experience in the field.

**EELE 690. Doctoral Thesis. 1-10 Credits.** (1-10 Ind; max unlimited) F,S,Su  
PREREQUISITE: Doctoral standing.

### **Font Notice**

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Times was used instead of Adobe Garamond Pro.

The editor may contact Leepfrog for a draft with the correct fonts in place.