ELECTRICAL & COMP ENGINEERING (ELC)

ELC 4318 Avionics System Design (3)
Cross-listed as AVS 4318
Design of avionics systems for civil and military aircraft. Topics include avionics system technology and architectures; system engineering principles; radar, electro-optical, and radio frequency sensors; displays; and communication and navigation systems.

ELC 4320 Introduction to Optics (3)
Pre-requisite(s): C or better in ELC 3335
Geometrical optics, electromagnetic waves, diffraction, interference, polarization, Fourier optics, laser fundamentals, and optical communication basics. Laboratory sessions include semiconductor laser measurement, fiber optic coupling, and Michelson interferometer setup.

ELC 4330 Introduction to Robotics (3)
Cross-listed as ME 4330
Pre-requisite(s): C or better in MTH 2321; C or better in MTH 3325
Analysis of robot manipulators, including forward and inverse kinematics, rigid-body rotation parameterizations, velocity kinematics, path planning, nonlinear dynamics, single and multi-variable control.

ELC 4332 Automatic Control Systems (3)
Pre-requisite(s): C or better in ELC 3335
Analysis and design of linear feedback control systems. Laplace transforms, transfer functions, signal-flow graphs, electrical and mechanical system modeling, state variables, system stability, time-domain response, root-locus method, Nyquist criterion, and compensator design. Laboratory exercises to illustrate course concepts.

ELC 4340 Power Systems (3)
Pre-requisite(s): C or better in ELC 3335
Analysis of power systems, including energy sources, transmission lines, power flow, transformers, transmission and distribution systems, synchronous generators, stability, power system controls, short-circuit faults, and system protection.

ELC 4345 Power Electronics (3)
Pre-requisite(s): C or better in ELC 3314; C or better in 3114
Introduction to power electronic systems with emphasis on power control and switching circuits for AC/DC, DC/DC, and DC/AC converters. Associated laboratory component.

ELC 4350 Principles of Communication (3)
Pre-requisite(s): C or better in ELC 3335; C or better in STA 3381
Signal analysis, modulation techniques, random signals and noise, digital transmission, information theory, coding.

ELC 4351 Digital Signal Processing (3)
Pre-requisite(s): C or better in ELC 3335; C or better in STA 3381
Discrete-time signals and systems, sampling theory, z-transforms, spectral analysis, filter design, applications, and analysis and design of discrete signal processing systems. Credit cannot be earned for ELC 4351 if credit is earned for BME 4452.

ELC 4353 Image Formation and Processing (3)
Cross-listed as BME 4353
Pre-requisite(s): C or better in ELC 3335 or concurrent enrollment; C or better in STA 3381
Introduction to image formation systems that provide images for medical diagnostics, remote sensing, industrial inspection, nondestructive materials evaluation and optical copying. Image processing, including image enhancement, analysis, and compression. Student specialization through assignments and project.

ELC 4360 Software Systems (3)
Pre-requisite(s): C or better in ELC 3336
Software engineering methods and tools. Topics include the development lifecycle, requirements, specifications, design, implementation, verification, validation, and maintenance, project management and professional ethics.

ELC 4362 Wireless Sensor Networks (3)
Pre-requisite(s): C or better in ELC 3338; C or better in ELC 3314; or consent of instructor
Characterization and design of large-scale wireless sensor networks. Topics include wireless channel utilization, media access protocols, routing, energy management, synchronization, localization, data aggregation, and security. Laboratory exercises using wireless sensor devices, cross-development, and real-time operating systems.

ELC 4372 Bioinstrumentation (3)
Cross-listed as BME 4372
Pre-requisite(s): C or better in ELC 2330
Principles of biomedical instrumentation and their real-world applications. Emphasis on understanding the basic design principles and technologies used in bioelectrical, biomechanical, and clinical instrumentation.

ELC 4377 Solar Energy (3)
Cross-listed as ME 4377
Pre-requisite(s): C or better in ELC 2330; C or better in ME 2345
A first course in the principles of solar energy collection, conversion and storage. Topics include solar photovoltaic and thermal collectors, sun-earth geometry, ground and sky radiation models, and balance-of-system components including stratified tanks, pumps, and power inverters. Students will learn industry-standard TRNSYS energy modeling software.

ELC 4381 Antennas and Wireless Propagation I (3)
Pre-requisite(s): C or better in ELC 3337
Fundamentals of radiation and propagation, antenna parameters, linear antennas, linear and planar phased arrays, and microstrip antennas. Analysis and design principles, simulation and measurement.

ELC 4383 RF/Microwave Circuits I (3)
Pre-requisite(s): C or better in ELC 3337
Introduction to passive RF, microwave, and wireless circuit design. Topics include transmission line theory; network analysis; impedance matching techniques; design of resonators, couplers, and filters; diodes; mixers; and principles and techniques of microwave measurements.

ELC 4384 RF/Microwave Circuits II (3)
Pre-requisite(s): C or better in ELC 4383
This is a second course in radio-frequency and microwave circuits covering microwave amplifier and oscillator design. Topics include the ZY Smith chart, matching network design, gain calculations, design for amplifier stability, noise figure and low-noise amplifier design, gain matching, and negative resistance oscillator design. A final project will require the design, simulation, construction, and testing of an amplifier using microwave CAD tools and hands-on measurements.

ELC 4396 Special Topics in Electrical or Computer Engineering (3)
Pre-requisite(s): Consent of department chair
Study of advanced topics in electrical or computer engineering. This course may be repeated once under a different topic.

ELC 4438 Embedded Systems Design (4)
Pre-requisite(s): C or better in ELC 3336
Design and implementation of embedded computer systems using microcontrollers, sensors and data conversion devices, actuators, visual display devices, timers, and applications specific circuits. Software design using microprocessor cross-development systems and real-time operating system principles.

ELC 4V97 Special Projects in Electrical or Computer Engineering (1-6)
Pre-requisite(s): Consent of department chair
Advanced topics and/or special project activities in electrical or computer engineering.

ELC 5302 Engineering Analysis (3)
Cross-listed as EGR 5302, ME 5302
Pre-requisite(s): Graduate standing in Engineering
Selected topics in applied engineering mathematics. Topics include advanced linear algebra, signal theory, and optimization methods.

ELC 5311 Advanced Logic Design (3)
Pre-requisite(s): Graduate standing in Engineering
Computer-automated design of digital circuits. Functional specification; structural and behavioral modeling using hardware description languages; simulation for design verification and timing analysis; circuit synthesis for FPGA implementation; testing and fault diagnosis.

ELC 5313 Advanced Computer Architecture (3)
Pre-requisite(s): ELC 4438 or consent of instructor
Advanced topics in computer architecture, including instruction set design, instruction pipelines, super scaler and very-long instruction word processors, cache and virtual memory systems, multiprocessor systems, large data storage systems and computer networks.

ELC 5316 Real-Time Systems Design (3)
Pre-requisite(s): ELC 4438 or consent of instructor
Hardware and software characteristics of real-time concurrent and distributed reactive control systems; design methodologies; performance analysis; case studies and development projects.

ELC 5336 Advanced Engineering Electromagnetics (3)
Pre-requisite(s): ELC 3337 or consent of instructor
An in-depth study of electromagnetic fields and waves and their applications in modern wireless communication and sensor systems. Topics include Maxwell's equation for complex media, scalar and vector potentials, non-ideal transmission lines, cylindrical waveguides, general properties of guided waves, and antennas.

ELC 5337 Principles of Microwave Sensing and Measurement (3)
Fundamentals of microwave sensor design and applications. Emphasis on understanding the basic principles, fundamental electrical and magnetic properties of materials, and the sensor configurations of RF/microwave instruments used in industrial and biomedical application.

ELC 5338 High Frequency Electronics Design (3)
Design and analysis of solid-state electronic circuits at RF and microwave frequencies. Emphasis on operational characteristics and design procedures for two- and three-terminal semiconductor devices and the associated passive components and circuit fabrication techniques used for generating, amplifying, and processing signals in this frequency range.

ELC 5339 High Frequency Electronics II (3)
Pre-requisite(s): ELC 5338 or consent of instructor
The design of linear amplifiers and oscillators at microwave frequencies, including an emphasis on design procedures for optimum gain, stability, and noise performance of amplifiers and the negative resistance method for oscillators.

ELC 5340 Radar Engineering (3)
Pre-requisite(s): ELC 5336
Electromagnetics of radar, signal processing of radar, radar imaging, Doppler processing, and radar antenna arrays. Analysis and design principles, simulation, and measurement.

ELC 5351 Multidimensional Signal Analysis (3)
Cross-listed as BME 5351
Pre-requisite(s): ELC 4451
Introduction to the processing and analysis of images in higher dimensions, including images and video. Characterization of higher dimensional signals. Multidimensional Fourier analysis, FFT's, systems and convolution. Reconstruction of images from projections. Tomography, Abel transforms, Radon transforms. Synthesis and restoration of signals using projection methods. Alternating projections onto convex sets.

ELC 5353 Biomedical Signal Analysis (3)
Cross-listed as BME 5353
Pre-requisite(s): ELC 4451 or BME 4452
Applications of signal theory and digital signal processing concepts toward biomedical signals. Topics include filters, signal modeling, adaptive methods, spectral analysis and statistical signal processing methods.

ELC 5354 Random Signals and Noise (3)
Pre-requisite(s): ELC 3335 and consent of instructor
Foundational treatment of probability, random variables and stochastic processes used in the analysis of random signals and noise in many areas of engineering. Topics include the modeling and properties of probability, scalar and vector random variables, the central limit theorem, stochastic processes, stationarity, ergodicity, the Karhunen-Loeve expansion, power spectral densities, response of linear systems to random signals, and Markov chains.

ELC 5356 Statistical and Adaptive Signal Processing (3)
Pre-requisite(s): ELC 5354
Unified introduction to the theory, implementation, and applications of statistical and adaptive signal processing methods. Key topics focus on spectral estimation, signal modeling, adaptive filtering, and signal detection.

ELC 5357 Cardiovascular Engineering and Instrumentation (3)
Cross-listed as BME 5357, EGR 5357, ME 5357
See BME 5357 for course information.

ELC 5358 Introduction to Computational Intelligence (3)
Pre-requisite(s): Consent of instructor
Foundational knowledge of computational intelligence and its application to engineering problems. Discriminant analysis, artificial neural networks, perception training and inversion, fuzzy logic, fuzzy inference engines, evolutionary computation, particle swarms, intelligent agents, and swarm intelligence.

ELC 5360 Linear Systems (3)
Pre-requisite(s): ELC 4332 or equivalent
Analysis of linear systems, including system modeling, state-variable representations, discrete-time systems, linear algebra, linear dynamic equations, stability, observability, controllability, state-feedback and state-estimators, realization, and pole placement.

ELC 5362 Optimal Control (3)
Pre-requisite(s): ELC 5360 or equivalent
Optimal control problems, static optimization, optimal control of discrete-time systems, the variational approach to optimal control, linear quadratic regulator problems, the maximum principle, extensions of LQR problem, time-optimal control problems, dynamic programming.

ELC 5364 Intelligent Control (3)
Pre-requisite(s): ELC 4332 or 4335 or Graduate standing
Introduction to intelligent control and optimization using a control-engineering approach. Topics include decision-making techniques, neural network architectures for modeling and control, system identification, fuzzy systems, evolutionary algorithms, and swarm intelligence.

ELC 5365 Introduction to Deep Learning (3)
Includes deep learning principles, artificial neural networks, layered architecture, feature extraction and representation learning, nonlinear transformation, backpropagation and gradient descent, probabilistic inference, regularization and generalization, and transfer learning. It introduces convolutional neural networks, recurrent neural networks, attention mechanisms, generative adversarial networks, and deep reinforcement learning, all within the context of artificial intelligence applications.

ELC 5370 Introduction to Information Theory (3)
Pre-requisite(s): ELC 4350 or instructor approval
Topics include: information models, entropy measures, data compression, coding theory, error correcting codes, the Kraft inequality, optimal codes, Shannon coding theorem, Burg's theorem, evolutionary informatics, Kolmogorov complexity, algorithmic information theory, and Chaitin's number.

ELC 5381 Advanced Power Grid Interface Techniques (3)
Pre-requisite(s): ELC 4332 and either ELC 4340 or ELC 4345
Introduction to distributed power generation, power conversion topologies and their control, power factor correction circuits, harmonic concepts and power quality, modeling and control of grid-connected loads and filters, interconnection standards and control issues, and control systems for rotating machines.

ELC 5390 Research Methods and Project Formulation (3)
Cross-listed as BME 5390, EGR 5390
Pre-requisite(s): Approval of student's proposed master's thesis or project advisor
Designed for students in the process of selection of thesis or project topic. Students will gain experience in literature and/or laboratory research methods and formulation of a project appropriate for their area.

ELC 5396 Special Topics in Engineering (3)
See EGR 5396 for course information.

ELC 5397 Special Projects in Engineering (3)
Cross-listed as BME 5397, EGR 5397, ME 5397
See EGR 5397 for course information.

ELC 5V99 Master's Thesis (1-6)
Pre-requisite(s): Approval of student's master's thesis advisor
Students completing a master's program with a thesis must complete six hours of ELC 5V99.

ELC 6V00 Graduate Research (1-10)
Pre-requisite(s): Graduate standing
For research credit prior to admission to candidacy for an advanced degree. Credit will be given for the amount of work done. May be repeated for credit through 45 hours.

ELC 6V10 Doctoral Prospectus Research (1-6)
Pre-requisite(s): Instructor approval
Supervised research for developing a dissertation prospectus that will be the subject of the preliminary exam that will admit students to candidacy. A student may repeat this course for credit with a maximum of ten total hours. Registration for this course is sufficient for achieving full-time status.

ELC 6V99 Dissertation (1-12)
Pre-requisite(s): Consent of student's supervisory graduate committee and admission to doctoral candidacy
Required of all doctoral candidates. In no case will fewer than 12 semester hours be accepted for a dissertation. Students may not enroll for dissertation hours until they have been officially accepted into candidacy for the doctoral degree. After initial enrollment, students must register for at least one semester hour of dissertation every semester thereafter (summer semester excluded).