EEL: Engineering: Electrical Courses

Courses

**EEL 2948  Service Learning Field Study I**
College of Sci and Engineering, Department of Electrical & Computer Engineer
1-3 sh (may be repeated for up to 4 sh of credit)
Placement in community agency or other social organizational setting related to field of study. Supervision by faculty and agency. Students and faculty 'customize' courses to fit a full range of services that are available in the setting. Student must be able to draw correlation between the discipline and field study. Journal and reflective experience paper are required. With the agreement of the student's faculty sponsor, a minimum of 4-6 hours per week must be done at the field site per semester hour of credit. Permission is required.

**EEL 3111  Circuits I**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (PHY 2049/L AND (EGN 3204* OR EGM 3344*) AND ((EEL 3111L* AND MAC 2313))
Basic Analysis of DC and AC electric circuits.

**EEL 3111L  Electrical Circuits Laboratory**
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Prerequisite: EEL 3111*
Introductory electrical engineering laboratory in electrical instrumentation, devices, and systems. Material and supply fee will be assessed. Credit may not be received in both EEL 3117L and EEL 3303L.

**EEL 3112  Circuits II**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: ((EEL 3111 AND MAP 2302)) AND (EGM 4313* OR EGM 3344*)
Continuation of EEL 3111 with emphasis on circuit applications of convolution, the Fourier series, and the Laplace and Fourier transforms. A grade of ‘C-’ or better is required in the prerequisites.

**EEL 3135  Discrete-Time Signals and Systems**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (EEL 3112*) AND (EEL 4834 OR COP 3014 OR EGN 3203)
Difference equations, discrete convolutions, the z transform, discrete and fast Fourier transforms, digital processing of analog signals, sampling theorem, probability and random signals.

**EEL 3211  Basic Electric Energy Engineering**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: EEL 3111
Introduction to the fundamentals of energy conversion; Power transformers, DC machines, Poly-phase induction machines, synchronous machines, single phase motors and permanent magnet machines, Speed control of DC motors, Speed control of ac motors. A C is required in the prerequisites to this course.

**EEL 3211L  Electric Energy Engineering Laboratory**
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Co-requisite: EEL 3211
Hands on experience with fundamental devices of electric power systems such as transformers, electrical machines, power passive components, and power electronic converters as well as all measuring and recording instruments. Lab corresponds with EEL 3211.

**EEL 3472  Electromagnetic Fields and Applications I**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (PHY 2049 OR PHY 2049C) AND (MAC 2312)
Electric and magnetic fields and forces, Maxwell's equations in point and integral form, plane wave propagation, energy and power.

**EEL 3701  Digital Logic and Computer Systems**
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (MAC 2311 OR MAC 1114 OR MAC 2312) AND (EEL 3701L*)
Co-requisite: EEL 3701L
An overview of logic design, algorithms, computer organization, sequential circuit design, and computer engineering technology.

**EEL 3701L  Digital Logic and Computer Systems Laboratory**
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Prerequisite: EEL 3701*
Practical applications of digital logic. Material and supply fee will be assessed.

**EEL 3905  Directed Study**
College of Sci and Engineering, Department of Electrical & Computer Engineer
1-12 sh (may be repeated indefinitely for credit)
EEL 4213  Electric Energy Systems 1  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEL 3211  
System models for generators, transformers, transmission lines and large-scale power networks. Matrix formulations, power flow and analysis, symmetrical component theory, balanced and unbalanced fault analysis. A grade of ‘C’ or better is required in the prerequisite(s).

EEL 4242  Power Electronic Circuits  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEE 3308  
Circuit topologies, analysis, design, and simulation of electronic circuits such as power supplies and motor drives. A grade of ‘C’ or better is required in the prerequisite(s).

EEL 4276  Cyber Security of Industrial Control System  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
This course is used to teach and share in-depth defense strategies and up-to-date information on cyber threats and mitigations for vulnerabilities with the goal of improving cyber security preparedness in the industrial control systems community. This course provides an overview of operations security for industrial control systems and prepares the students for the risks and threats associated with electric grids and other centralized and distributed control systems. Offered concurrently with EEL 5277; graduate students will have additional work.

EEL 4283  Introduction to Renewable Energy  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: CHM 2045 AND ENC 1102 AND PHY 2049  
The main objective of this course is to study the different types of energy sources and storages, renewable energy systems, energy distribution, energy policy and management. Computer-aided analysis of renewable energy resource information and data for evaluating energy potential and energy costs.

EEL 4287  Future Energy Systems  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEL 3111  
Study and analyze renewable energy sources and their integration into the grid, microgrid, smart grid power management, plug in electric vehicles, modern energy storage technologies, energy efficient buildings, cyber security and other new technologies that are revolutionizing the power industry.

EEL 4290  Sustainable Power Systems  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEL 3111  
Key technical and economic characteristics of power systems and their interaction in the design and operation of markets that foster environmental, economic, and security stability in today’s complex power systems.

EEL 4514  Communication Systems and Components  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEL 3112 AND EEL 3135 AND EGM 4313  
Theory of communication, and applications to radio, television, telephone, satellite, cellular telephone, spread spectrum, and computer communication systems. A grade of ‘C’ or better is required in the prerequisite(s).

EEL 4514L  Communication Laboratory  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
1 sh (may not be repeated for credit)  
Prerequisite: EEE 3308L AND EEL 4514*  
Experiments with communication circuits and radio frequency instruments, devices, and measurements. Material and Supply Fee will be assessed.

EEL 4594  Introduction to Mobile Robotics  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: (EGM 4313 OR EGM 3344) AND (EEL 3111)  
This is an introductory course to mobile robotics with emphasis on mobile robot models, control, planning, and navigation. The course will cover proprioceptive and exteroceptive mobile robot sensors and their processing; basic concepts of localization and mapping; Kalman filtering; design and evaluation of path tracking algorithms; planning and obstacle avoidance; intelligent control architecture.

EEL 4603L  Introduction to KUKA Robotics  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
1 sh (may not be repeated for credit)  
Prerequisite: EEL 3111  
A hands on, laboratory based introductory course in programming robot operational tasks utilizing an industry standard controller and robot work cell. Upon completion of this course, students may choose to take the KUKA Robot Programming and Simulation exam and earn certification.

EEL 4657  Linear Control Systems  
College of Sci and Engineering, Department of Electrical & Computer Engineer  
3 sh (may not be repeated for credit)  
Prerequisite: EEL 3111 AND MAP 2302  
Theory and design of linear control systems.
EEL 4657L Linear Controls Laboratory
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Prerequisite: EEL 4657*
Practical applications of linear control theory.

EEL 4663 Elements of Robotics
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (MAP 2302) AND (EGM 4313 OR EGM 3344)
An introductory course in the multidisciplinary field of robotics with analysis and design of robots and robotic tasks. Includes class projects in robot programming and design. A grade of 'C-' or better is required in the prerequisite(s). Material and supply fee will be assessed.

EEL 4712 Digital Design
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (EEL 4834 OR COP 3014) AND (EEL 3701)
Co-requisite: EEL 4712L
Advanced modular logic design, design languages, finite state machines, and binary logic. A grade of 'C' or better is required in all prerequisites.

EEL 4712L Digital Design Laboratory
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Prerequisite: (EEL 4834 OR COP 3014) AND (EEL 3701*)
Design and applications of advanced digital logic using VHDL.

EEL 4713 Digital Computer Architecture
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: EEL 4712

EEL 4744 Microprocessor Applications
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (EEL 3701 AND EEL 4834) OR COP 3104
Elements of microprocessor-based systems; hardware interfacing and software design for their application. A grade of 'C' or better is required in the prerequisite(s).

EEL 4744L Microprocessor Applications Laboratory
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may not be repeated for credit)
Prerequisite: (EEL 4834 OR COP 3014) AND (EEL 3701L)
Co-requisite: EEL 4744
Practical applications of microprocessor-based systems, software and hardware interface. A grade of 'C' or better is required in the prerequisites. Material and supply fee will be assessed.

EEL 4759 Digital Image Processing
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: EEL 3112 AND EGN 3203
An introduction to digital images and digital image processing techniques, including frequency and spatial image enhancement, image restoration, wavelets and morphology.

EEL 4822 Pattern Recognition
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: EEL 4834 AND EGN 3203
An introduction to pattern recognition and classification techniques, including Bayesian classifiers, linear and non-linear classifiers, clustering, perceptrons, and feature generation/selection.

EEL 4834 Programming for Engineers
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: MAC 1114 OR MAC 2311* OR MAC 2312
Develop computer skills and art of writing good computer programs using a high level programming language like C. Examples and exercises relevant to Electrical Engineering are used.

EEL 4888 Software/Hardware Integration
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Prerequisite: (EEL 3701 AND EEL 4834) OR EEL 3111
The course is concerned with the learning of software and hardware systems integration. Students will design and implement digital and analog systems using Arduino Mega microcontrollers, C, and C Sharp programming.

EEL 4905 Individual Problems in Electrical Engineering
College of Sci and Engineering, Department of Electrical & Computer Engineer
1-12 sh (may be repeated indefinitely for credit)
May be repeated with a change of content up to a maximum of 4 credits. Selected problems or projects in the student's major field of engineering study. Permission is required.
EEL 4930 Special Topics in Electrical Engineering
College of Sci and Engineering, Department of Electrical & Computer Engineer
1-4 sh (may be repeated for up to 6 sh of credit)
May be repeated with change of content up to a maximum of 6 credits. Special courses covering selected topics in electrical engineering. Permission is required. A grade of 'C' or better is required in the prerequisite(s). (Contact the department for prerequisites).

EEL 4940 Engineering Internship
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may be repeated for up to 3 sh of credit)
Practical and significant discipline applicable engineering based work experience under approved industrial supervision. Graded on a satisfactory / unsatisfactory basis only. Permission from department co-op advisor is required.

EEL 4949 Co-Op Work Experience
College of Sci and Engineering, Department of Electrical & Computer Engineer
1 sh (may be repeated for up to 4 sh of credit)
Practical co-op work under approved industrial supervision. Grading is on satisfactory / unsatisfactory basis only. Permission is required.

EEL 5262 Smart Distribution System
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
Theory and practical application methods available in the industry for the protection of distribution systems and includes smart grid applications for protection and control. Covering a broad range of topics related to developments and trends in smart distribution technologies including automatic restoration, data management, cybersecurity, interoperability and standards, and future vision, this course will be taught as a multidisciplinary course and emphasis is placed on the importance of strong collaboration between academia, utility and industry.

EEL 5266 Power System Operation and Control
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
An overview of modern power systems operation and control problems and solution techniques, including the current and advanced technologies and trends in development that will shape future electrical power systems.

EEL 5277 Cyber Security of Industrial Control System
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
This course is used to teach and share in-depth defense strategies and up-to-date information on cyber threats and mitigations for vulnerabilities with the goal of improving cyber security preparedness in the industrial control systems community. This course provides an overview of operations security for industrial control systems and prepares the students for the risks and threats associated with electric grids and other centralized and distributed control systems. This course introduces students to new developments in cyber threats, breaches and incidents in electrical grid and other industrial control systems. The course also discusses issues and methods to improve industrial security on the automation platform. Offered concurrently with EEL 4276; graduate students will have additional work.

EEL 5616 Advanced Control Systems
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
This course is focused on the analysis, modeling, and design of advanced control systems in time and frequency domains. Implementation of control systems using continuous and digital techniques will also be covered.

EEL 5683 Introduction to Autonomous Systems
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
This course is focused on mobile robotics with emphasis on robot control, navigation, and motion planning using kinematics and dynamics. Topics include mobile robot sensors, sensor data processing, Kalman filtering, mobile robot localization, basic concepts of mapping, path planning and obstacle avoidance, and intelligent control architecture.

EEL 5905 Directed Study
College of Sci and Engineering, Department of Electrical & Computer Engineer
1-12 sh (may be repeated indefinitely for credit)

EEL 6245 Power Electronics and Utility Applications
College of Sci and Engineering, Department of Electrical & Computer Engineer
3 sh (may not be repeated for credit)
This course focuses on power electronics structures and interfaces as related to various utility applications.

EEL 6617 Multivariable Linear Control Systems
College of Sci and Engineering, Department of Intelligent Systems & Robotics
3 sh (may not be repeated for credit)
This course focuses on input-output and state space representation of linear continuous time dynamic systems. Topics include: analysis and synthesis techniques for multi-input/multi-output (MIMO) control systems, design and analysis of single and multi-variable feedback control systems in transform and time domain. Students will study the stability and robustness of feedback loops, while employing approaches for optimal and robust feedback control design, chiefly H2, H-infinity, and mu synthesis.
EEL 6692  Wearable Robotics
College of Sci and Engineering, Department of Intelligent Systems & Robotics
3 sh (may not be repeated for credit)
Prerequisite: EEE 6772

An applied investigation of wearable robotics. Physical assistive devices can take many forms, but all have a foundation in mechanical design, robotics, and biomechanics. This applied course will investigate the issues and approaches for assistance in the areas of mobility, rehabilitation, strength enhancement, and injury prevention. The student will review and present the state of the art in each of these areas.

* This course may be taken prior to or during the same term.