Electrical Engineering (EE)

College of Engineering and Mines
Department of Electrical and Computer Engineering (http://cem.uaf.edu/ece/)
907-474-7137

EE F102 Introduction to Electrical and Computer Engineering
3 Credits
Offered Spring
Basic modern devices, concepts, technical skills and instruments of electrical engineering.
Prerequisites: ES/MATH F186 (may be taken concurrently) or MATH F251X (may be taken concurrently).
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F203 Electric Circuits
4 Credits
Offered Fall
Introduces DC and AC circuit analysis techniques including transient analysis, steady state analysis, three phase circuits and ideal amplifiers.
Prerequisites: EE F102; (ES/MATH F186 or MATH F251X).
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F243 Digital Systems Design
4 Credits
Offered Fall
Fundamentals and practices of digital design. Analysis, design and implementation of combinational and sequential logic. CMOS implementation fundamentals. Basic building components of microprocessor architecture – FSM, ALU, registers, memories, counters, control. Design using schematic capture and hardware description language techniques; practical implementation using FPGA devices and discrete components.
Prerequisites: EE F102; ES F201 or CS F201 (either may be taken concurrently).
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F253 Circuit Theory
3 Credits
Offered Spring
Transfer functions, passive and active filters, Laplace transforms and applications, introduction to Fourier series and transforms and two port networks.
Prerequisites: EE F203; ES F201 or CS F201; MATH F252X.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F301 Analytical Methods for Electrical and Computer Engineers
3 Credits
Offered Spring
Discipline-specific analytical methods used in the electrical and computer engineering core subjects. Topics include matrix algebra, eigenanalysis, vector spaces, complex analysis, discrete structures and probability and statistics with examples from the electrical and computer engineering fields.
Prerequisites: MATH F252X.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F303 Electric Power Systems and Machines
4 Credits
Offered Fall
Introduction to electromechanical energy conversion principles, phasors and complex power, characteristics and applications of power transformers, network equations, synchronous machines, induction machines, DC machines, symmetrical components and sequence networks.
Prerequisites: EE F203 or ES F307.
Cross-listed with ERE F303.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F311 Engineering Electromagnetics I
3 Credits
Offered Fall
Electromagnetic theory and applications. Static electric fields in free space and material media; steady current systems and associated magnetic effects. Includes electrostatics, magnetostatics, Maxwell's equations, electromagnetic wave propagation, and transmission lines. Application of the wave equations to engineering systems.
Prerequisites: EE F253; MATH F302 (may be taken concurrently); MATH F253X; PHYS F212X.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F331 High-frequency Lab
1 Credit
Offered Fall
Laboratory experiments in transmission lines, impedances, bridges, scattering parameters, hybrids and waveguides.
Prerequisite: EE F311.
Lecture + Lab + Other: 0 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F333 Electronic Devices
4 Credits
Offered Fall
An introduction to the properties of semiconductors and the analysis of electronics and electrical devices including diodes, field effect transistors (FETs), bipolar junction transistors (BJTs). Large signal and small signal analysis techniques, and common electrical circuit topologies.
Prerequisites: EE F253; WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F334 Electronic Circuit Design
4 Credits
Offered Spring Odd-numbered Years
Application of semiconductor devices in circuit design in computation, automatic control and communication.
Prerequisites: EE F333.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F354 Engineering Signal Analysis
3 Credits
Offered Fall
Analog signals and Fourier transformations. Discrete time signals and DFT. Linear and time-invariant systems. Probability theory and random variables. Random signals and noise.
Prerequisites: EE F253; MATH F302.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F404 Electric Power Systems Analysis
4 Credits
Offered Spring
Introduction to electric power systems; phasors; complex power; network equations; power transformers; transmission line parameters; transmission lines steady-state operation; power flow with computer-aided analysis; power distribution and smart grids.
Prerequisites: EE F303.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F406 Electric Power Protection and Control Systems
4 Credits
Offered As Demand Warrants
Deregulation, economic operation of power systems, symmetrical and unsymmetrical faults, power system protection, dynamic power system stability, system controls, and computer-aided fault and transient stability analysis.
Prerequisites: EE F303, EE F404.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F408 Power Electronics Design
4 Credits
Offered As Demand Warrants
Analysis and design of power electronic conversion, control, and drive systems. Topics will include the theory and application of rectifiers, DC-DC converters, inverters, switching power supplies and variable-frequency drives. Laboratory exercises include simulation using PSpice and construction, measurement, and analysis of prototype power electronic circuits.
Prerequisites: EE F303; EE F333; EE F354.
Stacked with EE F608.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F409 Renewable and Sustainable Energy Systems
3 Credits
Offered Spring
Study of renewable energy systems focusing on grid integration of wind turbine generators, solar photovoltaics, geothermal, biomass, hydroelectric, hydrokinetics, and energy storage. Design and analysis for efficient, sustainable, reliable, and resilient grid operation with distributed renewable energy sources considering cogeneration, controls optimization, economic dispatch, emissions, interruptible loads, and waste-heat recovery.
Prerequisites: EE F303 or ERE F303.
Cross-listed with ERE F409.
Stacked with EE F609.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F412 Engineering Electromagnetics II
3 Credits
Offered As Demand Warrants
Use of Maxwell's equations in analysis of plane wave propagation, wave reflection, radiation and antennas, waveguides, cavity resonators, transmission lines and radio propagation.
Prerequisites: EE F311; EE F331; MATH F302.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F432 Electromagnetics Laboratory
1 Credit
Offered As Demand Warrants
Laboratory experiments with microwave sources, propagating electromagnetic waves, waveguides and antennas. Design, construction and testing of antenna systems.
Corequisites: EE F412.
Lecture + Lab + Other: 0 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F443 Computer Engineering Analysis and Design
4 Credits
Offered Spring
Advanced digital design, and principles and practices of computer engineering. Analysis and design of computer architecture and organization. Digital signal processing techniques and hardware. Microprocessor operation, control and interfacing. Design with traditional and hardware description language techniques. Implementation with both medium and large scale integrated chips and programmable logic devices.
Prerequisites: EE F243.
Special Notes: The syllabus contains a more detailed description for the students.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F444 Embedded Systems Design
4 Credits
Offered Spring
Issues surrounding design and implementation of microcontroller-based embedded systems. Topics include hardware architecture and glue logic, embedded programs design, analysis, and optimization, hardware/firmware partitioning, firmware architecture and design. Includes laboratory exercises using evaluation board and a complete embedded system design project. Emphasis on robust designs, energy efficiency and proper documentation.
Prerequisites: EE F243; ES F201 or CS F201.
Recommended: EE F443.
Stacked with EE F645.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F451 Digital Signal Processing
4 Credits
Offered Fall
Time, frequency and Z-transformation domain analysis of discrete time systems and signals; discrete Fourier transformation (DFT) and FFT implementations; FIR/IIR filter design and implementation techniques; discrete time random signals and noise analysis; quantization and round off errors; and spectral analysis. Includes applications to medical, speech, electromagnetic and acoustic signal analysis.
Prerequisites: EE F354.
Stacked with EE F651.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F461 Communication Systems and Networks
4 Credits
Offered Spring
Foundational information for data communications and computer networking. Data communications, network models, analog and digital signals, transmission media, network switching, wired and wireless networks, multimedia support, and network security considerations.
Prerequisites: EE F354.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F464 Advanced Communications Systems
4 Credits
Offered As Demand Warrants
Advanced communications systems topics: analog and digital modulation techniques, spectrum power and bandwidth utilization, system noise, multiplexing techniques, signal regeneration and recovery, data encryption and compression, signal processing, antennas and communications systems components. Special emphasis on emergent digital communications systems in space and aerospace applications.
Prerequisites: EE F354 (may be taken concurrently).
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F465 Space Mission and Spacecraft Design
3 Credits
Offered Spring
Course contains information relevant to plan space missions and design spacecraft for aerospace and related engineering disciplines: (1) space environment and common orbits; (2) spacecraft subsystems – structures, attitude determination and control, command and data handling, communications, electrical power systems, thermal control, propulsion and payloads; (3) system tradeoffs and design.
Prerequisites: EE F102; PHYS F211X.
Cross-listed with AERO F465.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F471 Automatic Control
3 Credits
Offered Spring
Linear system representation by transfer functions, signal flow graphics and state equations. Feedback, time and frequency response of linear systems. Stability analysis by Routh-Hurwitz criterion and frequency domain methods. Specifications of higher order linear systems. System design and compensation.
Prerequisites: EE F253; MATH F302.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F481 Electrical and Computer Engineering Design I
1 Credit
Offered Fall
Team-oriented design project with emphasis on practical electrical and computer engineering systems and components, which integrates engineering knowledge and skills that students have acquired. Design process principles, including project management, economics and ethics will be introduced in lecture. Each design team will generate and present a proposal for their design. Special Note: This is the first course in a new two-semester senior capstone design course sequence. The second course is EE F482. This course also meets the upper division effective communication requirement.
Prerequisites: COM F121X, COM F131X or COM F141X; EE F354; EE F444; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; senior standing.
Lecture + Lab + Other: 1 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F482 Electrical and Computer Engineering Design II
3 Credits
Offered Spring
Design teams will continue work towards completing their proposed design from the first semester using engineering design process techniques. Each design team will follow a design schedule to complete a simulation and/or prototype, including weekly meetings and progress reports, ending with a final design report and public presentation. The first course is EE F481. This course also meets the upper-division effective communication requirement.
Prerequisites: EE F481.
Special Notes: This is the second course in a new two-semester senior capstone design course sequence.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F488 Undergraduate Research
1-3 Credits
Offered Fall, Spring and Summer
Advanced research topics from outside the usual undergraduate requirements.
Prerequisites: Permission of instructor.
Recommended: A substantial level of technical/scientific background.
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus
Repeatable for Credit: May be taken 3 times for up to 3 credits

EE F607 Electric Motor Drives
3 Credits
Offered Spring
Drive elements and characteristics; four quadrants operation; transportation drive; fully controlled rectifier drives; dc-dc converters-controlled dc motors; three-phase induction motors control; voltage-source and current-source inverter drives; frequency-controlled induction motor drives; vector control of induction motor drives; field oriented control; sensor-less operation, permanent magnet and switched reluctance motor drives.
Prerequisites: EE F303.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F608 Power Electronics Design
4 Credits
Offered As Demand Warrants
Analysis and design of power electronic conversion, control, and drive systems. Topics will include the theory and application of rectifiers, DC-DC converters, inverters, switching power supplies and variable-frequency drives. Laboratory exercises include simulation using PSpice and construction, measurement, and analysis of prototype power electronic circuits.
Prerequisites: Graduate standing.
Stacked with EE F408.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F609 Renewable and Sustainable Energy Systems
3 Credits
Offered Spring
Study of renewable energy systems focusing on grid integration of wind turbine generators, solar photovoltaics, geothermal, biomass, hydroelectric, hydrokinetics, and energy storage. Design and analysis for efficient, sustainable, reliable, and resilient grid operation with distributed renewable energy sources considering cogeneration, controls optimization, economic dispatch, emissions, interruptible loads, and waste-heat recovery.
Prerequisites: EE F303 or ERE F303.
Stacked with EE F409; ERE F409.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F611 Waves
3 Credits
Offered As Demand Warrants
Introduction to waves and wave phenomena. Includes electromagnetic, acoustic, seismic, atmospheric and water waves and their mathematical and physical treatment in terms of Hamilton's principle. Discusses propagation, attenuation, reflection, refraction, surface and laminal guiding, dispersion, energy density, power flow, and phase and group velocities. Treatment limited to plane harmonic waves in isotropic media.
Prerequisites: MATH F302 or MATH F432.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F634 Microwave Design I
3 Credits
Offered As Demand Warrants
Analysis, design, fabrication and measurement of passive microwave components and circuits using microstrip construction techniques. Theoretical and computer-aided design of transmission lines, power dividers, hybrids, directional couplers and filters.
Prerequisites: EE F334; EE F412; EE F432.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F635 Microwave Design II
3 Credits
Offered As Demand Warrants
Analysis and design of solid-state microwave circuits. Amplifier and oscillator circuits are designed and fabricated using microstrip construction techniques and computer-aided design tools.
Prerequisites: EE F634.
Lecture + Lab + Other: 2 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F643 Advanced Architectures for Parallel Computing
3 Credits
Offered As Demand Warrants
This course covers massively parallel computer architectures and their application for computationally intensive engineering problems. Fundamental hardware concepts and issues in designing such systems are introduced. Compute Unified Device Architecture (CUDA), developed by NVIDIA for the compute engines in their graphic processing units (GPUs), will be used as an example and a practical platform for student assignments. Through assignments and a project students will learn simulation, computational engineering, convolution, correlation, filtering, and similar problems of particular interest to engineering students.
Prerequisites: CS F201 or ES F201; EE F443 graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F645 Embedded Systems Design
4 Credits
Offered Spring
Issues surrounding design and implementation of microcontroller-based embedded systems. Topics include hardware architecture and glue logic, embedded programs design, analysis, and optimization, hardware/firmware partitioning, firmware architecture and design. Includes laboratory exercises using evaluation board and a complete embedded system design project. Emphasis on robust designs, energy efficiency and proper documentation.
Prerequisites: Graduate standing.
Stacked with EE F444.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F646 Wireless Sensor Networks
3 Credits
Offered As Demand Warrants
The course will survey the area of networked sensors, with a special focus on low-power wireless sensor networks. Topics covered will include communication standards and protocols for sensor networks, embedded operating systems, applications, collaborative processing, data fusion, and system architecture. Students will undertake a theoretical or practical research project.
Prerequisites: CS F201 or ES F201; EE F243; graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F647 Data Compression
3 Credits
Offered As Demand Warrants
Study of algorithms and techniques that reduce information storage and transmission requirements. Both lossless and lossy techniques will be studied including: Hoffman coding, arithmetic coding, image compression, and transform techniques.
Prerequisites: ES F201 or CS F201.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F648 VLSI Design
3 Credits
Offered As Demand Warrants
Study of methods to integrate millions of transistors on a single chip and create optimized design. Topics include CMOS logic design, power and timing issues. VLSI architectures, and full custom layout. Students will use CAD tools to implement a VLSI design.
Prerequisite: EE F243.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F651 Digital Signal Processing
4 Credits
Offered Fall
Time, frequency and Z-transformation domain analysis of discrete time systems and signals; discrete Fourier transformation (DFT) and FFT implementations; FIR/IIR filter design and implementation techniques; discrete time random signals and noise analysis; quantization and round off errors; and spectral analysis. Includes applications to medical, speech, electromagnetic and acoustic signal analysis.
Prerequisites: Graduate standing.
Stacked with EE F451.
Lecture + Lab + Other: 3 + 3 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F654 UAS Systems Design
3 Credits
Offered Fall Even-numbered Years
Course covers the analysis of unmanned air vehicle subsystems, including support infrastructure elements comprising an unmanned air system. Course contains mission planning considerations, including flight planning and data requirements. Focus is on remote sensing missions which may be accomplished by appropriate UAS. Students participate in a UAS design/build/fly workshop.
Prerequisites: Graduate standing.
Cross-listed with AERO F654.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F655 Adaptive Filters
3 Credits
Offered As Demand Warrants
Study to self-designing filters which recursively update depending on the statistics of the input data for optimum performance. Topics will include foundational material in probability of stochastic processes, spectral analysis, linear optimum filtering. Wiener-Hopf filters, Yule-Walker equations, forward and backward linear predictors, method of steepest descent, least squares techniques, and auto- regressive filters.
Prerequisites: EE F451.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F656 Aerospace Systems Engineering
3 Credits
Offered Fall Odd-numbered Years
A multidisciplinary team of students will perform a preliminary design study of a major aerospace system. Design considerations will include requirements for project management, aerospace vehicle design, power, attitude control, thermal control, communications, computer control and data handling.
Prerequisites: Graduate standing.
Cross-listed with AERO F656; ME F656.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F658 Unmanned Aircraft Systems (UAS) Operations
3 Credits
Offered Spring
Covers application of unmanned aircraft systems (UAS) to satisfy scientific research or public service missions. Students analyze mission requirements and recommend appropriate UAS vehicles, subsystems, sensors and data analysis tools to accomplish a specified mission. Students design mission profiles, conduct representative missions, produce required data products and present mission results.
Prerequisites: Graduate standing.
Cross-listed with AERO F658; CS F658.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F660 Rocket Systems Design
3 Credits
Offered As Demand Warrants
A multidisciplinary team of students will perform the design, construction and flights of a simple rocket system. Design considerations will include requirements for project management, rocket vehicle design, performance, thrust, stability, recovery system, telemetry and payload data.
Prerequisites: Graduate standing in engineering or physics.
Cross-listed with AERO F660; CS F660; ME F660.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F662 Digital Communication Theory
3 Credits
Offered As Demand Warrants
Probability in communication systems, power spectral density, baseband formatting, bandpass modulation and demodulation, link analysis, coding and channel models. Sections of this course offered in Anchorage have an additional fee.
Prerequisites: EE F461.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F663 Computational Electromagnetics
3 Credits
Offered As Demand Warrants
Course covers basic computational techniques for numerical analysis of electromagnetics problems, including finite difference, finite element, and moment methods. Emphasis is placed on the formulation of physical problems into mathematical boundary-value problems, numerical discretization of continuous problems into discrete problems, and development of rudimentary computer codes for each technique.
Prerequisites: Graduate standing.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F671 Digital Control Systems
3 Credits
Offered As Demand Warrants
Study of digital control theory. Topics will include signal conversion, Z-transforms, state variable techniques, stability, time and frequency domain analysis and system design.
Prerequisites: EE F471.
Lecture + Lab + Other: 3 + 0 + 0
Grading System: Letter Grades with option of Plus/Minus

EE F698 Non-thesis Research/Project
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits

EE F699 Thesis
1-12 Credits
Lecture + Lab + Other: 0 + 0 + 0
Grading System: Pass/Fail Grades
Repeatable for Credit: May be taken unlimited times for up to 99 credits