### ELECTRICAL ENGINEERING (EE)

**EE F102**  **Introduction to Electrical and Computer Engineering**  
3 Credits  
Offered Spring  
Basic modern devices, concepts, technical skills and instruments of electrical engineering. Prerequisite or Co-requisite: MATH F251X.  
**Lecture + Lab + Other:** 2 + 3 + 0

**EE F203**  **Electrical Engineering Fundamentals I**  
4 Credits  
Offered Fall  
Analysis of alternating-current circuits using complex notation and phasor diagrams, resonance, transformers and three-phase circuits. Introduction to network and system analysis. Prerequisite or Co-requisite: MATH F252X.  
**Prerequisites:** MATH F251X; EE F102.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F204**  **Electrical Engineering Fundamentals II**  
4 Credits  
Offered Spring  
Electronics of solid state devices, amplifier design, digital circuits, electromechanics, control systems and instrumentation. Prerequisite or Co-requisite: MATH F253X.  
**Prerequisites:** EE F203; MATH F252X.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F303**  **Electrical Machinery**  
4 Credits  
Offered Fall  
Electromechanical energy conversion principles, characteristics and applications of transformers, synchronous and induction machines, DC machines, and special machines.  
**Prerequisites:** EE F204.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F331**  **Applied Engineering Electromagnetics**  
3 Credits  
Offered Fall  
**Prerequisites:** EE F204; MATH F253X; PHYS F212X.  
**Lecture + Lab + Other:** 3 + 0 + 0

**EE F333**  **Physical Electronics**  
4 Credits  
Offered Fall  
Basic properties of semiconductors. Principles of semiconductor devices, diodes, transistors and integrated circuits.  
**Prerequisites:** EE F204; WRTG F111X; WRTG F211X or WRTG F213X; or permission of instructor.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F334**  **Electronic Circuit Design**  
4 Credits  
Offered Spring  
Application of semiconductor devices in circuit design in computation, automatic control and communication.  
**Prerequisites:** EE F333.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F335**  **Circuit Theory**  
3 Credits  
Offered Fall  
Analysis by Laplace transform, state variable, and Fourier methods, convolution, frequency selective networks, and two-port circuits. Prerequisite or Co-requisite: MATH F202.  
**Prerequisites:** EE F204; ES F201 or CS F201; MATH F253X.  
**Lecture + Lab + Other:** 3 + 0 + 0

**EE F341**  **Digital and Computer Analysis and Design**  
4 Credits  
Offered Fall  
Modular structure of computer systems. Analysis, design and implementation of combinational and sequential logic machines. Introduction to microprocessor architecture and microprocessor programming. Design with traditional and hardware description language techniques.  
**Prerequisites:** CS F201; one year of college physics.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F343**  **Digital Systems Analysis and Design**  
4 Credits  
Offered Fall  
Fundamental principles and practices of digital design. Analysis, design and implementation of combinational and sequential logic machines. Introduction to microprocessor architecture and microprocessor programming. Analysis of digital data transmission techniques and microprocessor interfacing. Design with traditional and hardware description language techniques. Implementation with both medium and large scale integrated (M/LSI) chips and programmable logic devices (PLDs). Note: EE F333 may be taken concurrently.  
**Prerequisites:** ES F201 or CS F201; EE F204; EE F333.  
**Lecture + Lab + Other:** 3 + 3 + 0

**EE F353**  **Engineering Signal Analysis**  
3 Credits  
Offered Fall  
**Prerequisites:** EE F353; MATH F202.  
**Lecture + Lab + Other:** 3 + 0 + 0
EE F404  Electrical Power Systems  
4 Credits  
Offered Spring  
Electrical power transmission and distribution systems, power flow, symmetrical faults, and economic dispatch with computer-aided analysis.  
Prerequisites: EE F303.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F406  Electrical Power Engineering  
4 Credits  
Offered Fall  
Economic operation of power systems, symmetrical and unsymmetrical faults, power system protection, dynamic power system stability, and computer-aided fault and transient stability analysis.  
Prerequisites: EE F404 or equivalent.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F408  Power Electronics Design  
(O, W)  
4 Credits  
Offered Spring  
Analysis and design of power electronic conversion, control and drive systems. Topics will include the theory and application of thyristors, rectifiers, DC-DC converters, inverters, resonant converters, AC and DC switches and regulators, power supplies, DC drives and adjustable-speed drives, including variable-frequency drives. Includes laboratory exercises using power electronic converter boards, PSPICE, and a complete power electronics design project.  
Prerequisites: WRTG F111X; WRTG F211X or WRTG F213X; COJO F141X or COJO F141X; EE F303; EE F334; EE F354; senior standing; or permission of instructor.  
Stacked with EE F608.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F412  Electromagnetic Waves and Devices  
3 Credits  
Solution of Maxwell's equations for the interaction of electromagnetic waves with conducting and dielectric media. Theory and design of antennas and waveguides.  
Prerequisites: EE F311; EE F331; MATH F302.  
Lecture + Lab + Other: 3 + 0 + 0  

EE F432  Electromagnetics Laboratory  
1 Credit  
Laboratory experiments with microwave sources, propagating electromagnetic waves, waveguides and antennas. Design, construction and testing of antenna systems. Co-requisites: EE F412.  
Lecture + Lab + Other: 0 + 3 + 0  

EE F434  Instrumentation Systems  
(O, W)  
4 Credits  
Offered Spring  
Analysis and design of instrumentation systems. Static and dynamic characteristics; accuracy, noise and reliability; sensors; signal conditioning; typical measurement systems and microprocessor applications.  
Prerequisites: COJO F131X or COJO F141X; EE F334; EE F343; EE F354; WRTG F111X; WRTG F211X or WRTG F213X; senior standing; or permission of instructor.  
Lecture + Lab + Other: 3 + 3 + 0  

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 (M/LSI) chips and programmable logic devices (PLDs).  
Prerequisites: EE F341 or EE F343.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F444  Embedded Systems Design  
(O, W)  
4 Credits  
Offered Spring  
Issues surrounding the 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: COJO F131X or COJO F141X; EE F343 or EE F341; EE F354; EE F443; WRTG F111X; WRTG F211X or WRTG F213X; senior standing; or permission of instructor.  
Recommended: CS F301.  
Stacked with EE F645.  
Lecture + Lab + Other: 3 + 3 + 0  

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 or equivalent.  
Stacked with EE F651.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F461  Communication Systems  
4 Credits  
Offered Fall  
Theory, design and implementation of communication systems. Measurement of modulation, noise, channel spectrum, satellite link budget and microwave path design.  
Prerequisites: EE F354; senior standing.  
Lecture + Lab + Other: 3 + 3 + 0  

EE F463  Communication Networks  
3 Credits  
Offered Spring  
Prerequisites: EE F354 and Senior standing.  
Lecture + Lab + Other: 3 + 0 + 0
EE F464  Communication Networks Design  (O, W)
4 Credits
Offered Spring
Prerequisites: COJO F131X or COJO F141X; EE F354; WRTG F111X; WRTG F211X or WRTG F213X; senior standing; or permission of instructor.
Lecture + Lab + Other: 3 + 3 + 0

EE F471  Fundamentals of Automatic Control
3 Credits
Offered Spring
Prerequisites: EE F353; MATH F302.
Lecture + Lab + Other: 3 + 0 + 0

EE F488  Undergraduate Research
1-3 Credits
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

EE F608  Power Electronics Design  (O, W)
4 Credits
Offered Spring
Analysis and design of power electronic conversion, control and drive systems. Topics will include the theory and application of thyristors, rectifiers, DC-DC converters, inverters, resonant converters, AC and DC switches and regulators, power supplies, DC drives and adjustable-speed drives, including variable-frequency drives. Includes laboratory exercises using power electronic converter boards, PSPICE, and a complete power electronics design project.
Prerequisites: WRTG F111X; WRTG F211X or WRTG F213X; COJO F131X or COJO F141X; EE F303; EE F334; EE F354; senior standing; or permission of instructor.
Stacked with EE F408.
Lecture + Lab + Other: 3 + 1 + 0

EE F611  Waves
3 Credits
Offered Spring Odd-numbered Years
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 laminar 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 F421 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

EE F634  Microwave Design I
3 Credits
Offered Fall Odd-numbered Years
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; or permission of instructor.
Lecture + Lab + Other: 2 + 3 + 0

EE F635  Microwave Design II
3 Credits
Offered Spring Even-numbered Years
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 or permission of instructor.
Lecture + Lab + Other: 2 + 3 + 0

EE F643  Advanced Architectures for Parallel Computing
3 Credits
Offered Fall Odd-numbered Years
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 or permission of the instructor.
Lecture + Lab + Other: 3 + 0 + 0

EE F645  Embedded Systems Design
4 Credits
Offered Spring
Issues surrounding the 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 firmware design. Includes laboratory exercises using evaluation board and a complete embedded system design project. Emphasis on robust designs, energy efficiency, and proper documentation. Stacked with EE F444
Prerequisites: Graduate standing or permission of instructor.
Lecture + Lab + Other: 3 + 3 + 0

EE F646  Wireless Sensor Networks
3 Credits
Offered Fall Even-numbered Years
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 F343 or EE F341; graduate standing or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0
EE F647 Data Compression
3 Credits
Offered Spring Even-numbered Years
Study of algorithms and techniques that reduce information storage and transmission requirements. Both lossless and lossy techniques will be studied including: Huffman coding, arithmetic coding, image compression, and transform techniques.
Prerequisites: ES F201 or CS F201 or equivalent.
Lecture + Lab + Other: 3 + 0 + 0

EE F648 VLSI Design
3 Credits
Offered Spring Odd-numbered Years
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 F343 or equivalent.
Lecture + Lab + Other: 3 + 0 + 0

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 or permission of instructor.
Stacked with EE F451.
Lecture + Lab + Other: 3 + 3 + 0

EE F655 Adaptive Filters
3 Credits
Offered Spring Even-numbered Years
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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

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. The students will present their final design in a written report and a public seminar.
Prerequisites: Graduate standing or permission of instructor.
Cross-listed with ME F656.
Lecture + Lab + Other: 3 + 0 + 0

EE F662 Digital Communication Theory
3 Credits
Offered Fall Even-numbered Years
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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

EE F667 Satellite Communications
3 Credits
Offered Fall Odd-numbered Years
Satellite orbital parameters, satellite hardware, link budgets, modulations and multiple access techniques, operational considerations, operating and proposed satellite communication systems.
Prerequisites: EE F461; graduate standing; or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

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 or permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

EE F673 Modern Control Engineering
3 Credits
Offered Fall Even-numbered Years; As Demand Warrants
Introduction to state space systems in the study of dynamical systems; brief review of modeling and basic concepts of classical control theory and matrix algebra; stability analysis of feedback systems; design of output and state feedback control systems; controllability and observability of dynamical systems; state feedback; state observers; robust control; optimal control. Analysis and design using MATLAB and SIMULINK; demonstrations on PUMA 560 and Hardware-in-the-Loop simulator test-beds.
Prerequisites: EE F471 or equivalent; permission of instructor.
Lecture + Lab + Other: 3 + 0 + 0

EE F675 Robot Modeling and Control
3 Credits
Offered As Demand Warrants
Introduction to basic concepts in robotics; homogeneous transformations; Denavit-Hartenberg parameters, forward and inverse kinematics; velocity kinematics, Jacobians; dynamics and modeling; robot control: independent joint control, multivariable control, Lyapunov stability, PD+, computed torque, inverse dynamics control with the use of Matlab/Simulink, kinematics and control related demonstrations on the PUMA 560 manipulator.
Prerequisites: EE F471, PHYS F212X or equivalent courses in automatic control systems, and mechanics.
Recommended: EE F303 or equivalent electrical machinery courses and some experience with MATLAB.
Lecture + Lab + Other: 3 + 0 + 0

EE F698 Non-Thesis Research/Project
1-6 Credits
Lecture + Lab + Other: 0 + 0 + 0

EE F699 Thesis
1-12 Credits
Lecture + Lab + Other: 0 + 0 + 0