**ELECTRICAL AND COMPUTER ENGINEERING**


**ECE 1010 Robots in Business and Society 3 (3)**
Explores the significant role that robotics and automation play in society. Students gain an appreciation of the ethics, economics, psychology, politics and technologies that must be considered in the use of robots. Includes hands-on exercises using Legos to explore robot construction and intelligence. Open only to non-engineering majors.

**ECE 1990 Creative Inquiry—Electrical and Computer Engineering 1-4 (1-4)**
In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Preq: Consent of faculty member/mentor.

**ECE 2020 Logic and Computing Devices 2 (2)**
Introduction to Boolean algebra and digital logic. Topics include number systems and representation of information; Boolean operators and algebra; expression minimization; combinational circuits, including adders, comparators, decoders and multiplexors; sequential logic, including flip-flops, shift registers, counters and memory. Includes Honors sections. Preq: MATH 1080 and PHYS 1220, each with a C or better.

**ECE 2020 Electric Circuits 1 3 (3)**
Study of DC and AC circuits and nodal analysis, Thevenin’s and Norton’s sections. Expression minimization; combinational circuits, topics include number systems and representation of information; Boolean operators and algebra; expression minimization; combinational circuits, including adders, comparators, decoders and multiplexors; sequential logic, including flip-flops, shift registers, counters and memory. Includes Honors sections. Preq: MATH 1080 and PHYS 1220, each with a C or better. Preq or concurrent enrollment: ECE 2070 with a C or better.

**ECE 2090 Logic and Computing Devices Laboratory 1 (2)**
Laboratory to accompany ECE 2020. Basic digital circuits and instrumentation. Preq or concurrent enrollment: ECE 2070.

**ECE 2090 Logic and Computing Devices Laboratory 1 (2)**
Introduction to designing, building, simulating and testing digital logic circuits. Topics include SSI and MSI ICs; general combinational circuits; adders, decoders and multiplexors; general sequential circuits; shift registers, counters and memory. Includes Honors sections. Preq or concurrent enrollment: ECE 2070 with a C or better.

**ECE 2110 Electrical Engineering Laboratory I 1 (2)**
Principles of measurement and instruments used to measure parameters and dynamic variables in electric circuits, steady state and transient measurements in DC and AC circuits, and data analysis methods are included. Preq or concurrent enrollment: ECE 2020 with a C or better.

**ECE 2120 Electrical Engineering Laboratory II 1 (2)**
Emphasizes measurement techniques in AC steady-state circuits and comparison to theoretical predictions. Two-port network methodology and transfer functions are studied experimentally and related to analysis using transform techniques. Preq: ECE 2020 and ECE 2110, each with a C or better. Preq or concurrent enrollment: ECE 2620 with a C or better.

**ECE 2220 Systems Programming Concepts for Computer Engineering 3 (3)**
Development of computer systems programming and code reading techniques. Tools, programming languages, libraries, operating systems, and hardware. Code reading is emphasized. Programming projects reinforce course topics. Preq: CPSC 1110 with a C or better.

**ECE 2230 Computer Systems Engineering 3 (3)**
Analysis of implementation techniques for systems software. Applying engineering principles including code reading to the design of data structures and algorithms for low level computer systems, embedded systems, and hardware/software systems. Includes coverage of address translation, memory management, file systems, and process management. Preq: ECE 2220 with a C or better.

**ECE 2620 Electric Circuits II 3 (3)**
Continuation of the study of electric circuits, including three-phase circuits, complex frequency and network functions, frequency response, two-port parameters, magnetically-coupled circuits, Laplace transforms, and introduction to Fourier series and transforms. Includes Honors sections. Preq: ECE 2020 and MATH 2060 and PHYS 2210, each with a C or better. Preq or concurrent enrollment: ECE 2620 with a C or better.

**ECE 2630 Circuit Analysis Problems II 1 (3)**
Analysis of basic AC circuit analysis techniques to analyze the transient and steady-state behavior of both simple and complex circuits. Preq or concurrent enrollment: ECE 2620 and MATH 2080, each with a C or better.

**ECE 2720 Computer Organization 3 (3)**
Introductory course in computer organization and architecture. Topics include CPUs, memory, I/O, processor families, buses, peripherals, microarchitectures, and instruction sets. Includes Honors sections. Preq: ECE 2010 and CPSC 1110, each with a C or better.

**ECE 2730 Computer Organization Laboratory 1 (2)**
Laboratory to accompany ECE 2720. Basic digital devices and circuits; operational amplifiers, distortion in amplifiers, oscillators and circuits analysis of active digital devices. Preq: ECE 3200 with a C or better.

**ECE 2990 Creative Inquiry—Electrical and Computer Engineering I 1-4 (1-4)**
In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Includes Honors sections. Preq: Consent of faculty member/mentor.

**ECE 3000 Junior Honors Seminar 1 (2)**
Acquaints students enrolled in the Departmental Honors Program with current research activities in the Department. Faculty provide seminars where research interests are summarized. Seminars are planned to prepare students in choosing research topics for their senior theses.

**ECE 3080 Fundamentals of Electrical Engineering 3 (3)**
A first course in electrical engineering to provide non-Electrical Engineering majors with a knowledge of DC and AC circuits, AC power distribution, numerous electrical devices, digital systems, instrumentation and measurement systems, electronics, electromechanics, and electric motors. Credit may not be received for both ECE 2070 and 3080. Preq: MATH 2060 and PHYS 2210.

**ECE 3101 Electrical Engineering Laboratory I 1 (2)**
Measurements and characteristics of electronic devices and circuits; use of manual and automated instruments to acquire data; oral and written engineering reports. Preq: ECE 2120 and ECE 2620 and MATH 2080 and PHYS 2210, each with a C or better. Preq or concurrent enrollment: ECE 3200 with a C or better.

**ECE 3120 Electrical Engineering Laboratory IV 1 (2)**
Design and characterization of functional circuits using solid-state devices; use of manual and automated instruments for measurements; statistical analysis of data; preparation of engineering reports. Preq: ECE 3110 and ECE 3200, each with a C or better. Preq or concurrent enrollment: ECE 3210 with a C or better.

**ECE 3170 Random Signal Analysis 3 (3)**
Introduction to engineering problems of a probabilistic nature. Systems transformations, statistical averages, simulation, and estimation of system parameters. Includes Honors sections. Preq: ECE 2620 and MATH 2080, each with a C or better. Preq or concurrent enrollment: ECE 3300 with a C or better.

**ECE 3200 Electronics I 3 (3)**
Introduction to electronic materials and devices; principles of design; design of DC and AC circuits using diodes, bipolar junction transistors, field-effect transistors and use of transistors in digital circuits. Includes Honors sections. Preq: ECE 2620 and MATH 2080 and PHYS 2210, each with a C or better.

**ECE 3210 Electronics II 3 (3)**
Analysis and design of discrete amplifier circuits at low and high frequencies; operational amplifiers, distortion in amplifiers, oscillator design, and circuit analysis of active digital devices. Preq: ECE 3200 with a C or better.
ECE (CPSC) 3220 Introduction to Operating Systems 3 (3) Detailed study of management techniques for the control of computer hardware resources. Topics include interrupt systems, primitive level characteristics of hardware and the management of memory, processor, devices, and data. May also be offered as CPSC 3220. Prq: CPSC 2120 and CPSC 2310, each with a C or better; or ECE 2230 and ECE 2720, each with a C or better.

ECE 3270 Digital Computer Design 3 (3) Design of high-speed ALUs, control and timing circuitry, memory systems and I/O circuitry; microprogrammed computer design using bit-slice microprocessors; current hardware topics related to computer design; hands-on design experience; and use of logic analyzer for system debugging. Prq: ECE 3710 with a C or better.

ECE 3290 Computer Systems Structures 3 (3) Fundamental structures and issues that arise in the analysis and implementation of computer systems. Topics include operating systems structures and data structures and their relationship to computer organization. Engineering science background for computer systems design. Prq: ECE 2230 and ECE 2720, each with a C or better.

ECE 3300 Signals, Systems, and Transforms 3 (3) Study of systems models, analysis of signals, Fourier series and transforms, sampling and Z transforms, discrete Fourier transforms. Includes Honors sections. Prq: ECE 2620 and MATH 2080, each with a C or better.

ECE (CPSC) 3520 Programming Systems 3 (3) Second course in programming languages and systems. Topics include assemblers, compilers, and syntactical methods; string manipulation and list processing; concepts of executive programs and operating systems; introduction to time-sharing systems. May also be offered as CPSC 3520. Prq: ECE 2230; or CPSC 2120 and CPSC 2150, each with a C or better. Prq or concurrent enrollment: CPSC 2070 or MATH 4190, each with a C or better.

ECE 3600 Electric Power Engineering 3 (3) Presents the basic principles of electromagnetic induction and electromagnetic forces developed. Topics include synchronous machines, power transformers, electric power transmission, and distribution systems, DC motors, and induction motors. Prq: ECE 2620 and PHYS 2210, each with a C or better.

ECE 3710 Microcontroller Interfacing 3 (3) Discusses the programming and interfacing of microcontrollers in order to control their integrated devices and external peripherals. Topics include memory and I/O; interrupts, counters and timers; ADCs and DACs; PWMs; and parallel and serial communication. Prq: ECE 2620 and PHYS 2210, each with a C or better. Prq or concurrent enrollment: ECE 3202 with a C or better.

ECE 3720 Microcontroller Interfacing Laboratory 1 (3) Discusses the programming and interfacing of microcontrollers in order to control their integrated devices and external peripherals. Topics include memory and I/O; interrupts, counters and timers; ADCs and DACs; PWMs; and parallel and serial communication. Prq or concurrent enrollment: ECE 3710 with a C or better.

ECE 3800 Electromagnetics 3 (3) Introduction to electric fields and potentials, dielectrics, capacitance, resistance, magnetic field, forces, work and energy, inductance, time-varying fields, and Maxwell’s equations. Prq: ECE 2620 and MATH 2060 and PHYS 2210, each with a C or better.

ECE 3810 Fields, Waves, and Circuits 3 (3) Covers foundation of circuit theory, transmission lines and circuits, plane-wave propagation, fiber optics, radiation and antennas, and coupled circuits. Prq: ECE 3800 and MATH 2080, each with a C or better.

ECE 3990 Creative Inquiry—Electrical and Computer Engineering 1-4 (1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Includes Honors sections. Prq: Consent of faculty member/mentor.

ECE 4040* Semiconductor Devices 3 (3) Consideration of the principles of operation, external characteristics, and applications of some of the more important semiconductor devices presently available. Prq: ECE 3200 with a C or better. Prq or concurrent enrollment: MATH 3110 or MATH 4340, each with a C or better.

ECE 4050 Design Projects in Electrical and Computer Engineering 1-3 (1-3) Individually defined projects oriented toward providing experience in establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. Develops student creativity through the solution of open-ended problems. Includes individual instruction in design methodology. May be repeated for a maximum of three credits. Prq: ECE 3300 or ECE 4090, each with a C or better; and consent of project supervisor.

ECE 4060* Introduction to Microelectronics Processing 3 (3) Microelectronic processing, MOS and bipolar monolithic circuit fabrication, thick and thin film hybrid fabrication, applications to linear and digital circuits, fundamentals of device design. Prq: ECE 3200 with a C or better. Prq or concurrent enrollment: MATH 3110 or MATH 4340, each with a C or better.

ECE 4070 Continuous and Discrete Systems Design 3 (3) Introduction to classical linear control systems. Topics include continuous and discrete descriptions of systems, time and frequency response, stability, system specification, system design of continuous and discrete systems. Prq: ECE 3300 with a C or better.

ECE 4120 Electrical Machines Laboratory 1 (2) Selected experiments to familiarize students with characteristics of transformers, DC and AC motors and generators. Measurement techniques and component modeling are included. Prq or concurrent enrollment: MATH 4340 with a C or better; and ECE 3600 or ECE 4090, each with a C or better.

ECE 4170* Elements of Software Engineering 3 (3) Foundations of software design, reasoning about software, the calculus of programs, survey of formal specification techniques and design languages. Prq: ECE 3220 and ECE 3520 and MATH 4190, each with a C or better.

ECE 4180* Power System Analysis 3 (3) Study of power system planning and operational problems. Topics include load flow, economic dispatch, fault studies, transient stability, and control of problems. System modeling and computer solutions are emphasized through class projects. Prq: ECE 3600 and ECE 3800, each with a C or better.

ECE 4190* Electric Machines and Drives 3 (3) Performance, characteristics, and modeling of AC and DC machines during steady-state and transient conditions. Introduction to power electronics devices and their use in adjustable speed motor drives. Prq: ECE 3210 and ECE 3600 and ECE 3800, each with a C or better. Prq or concurrent enrollment: MATH 4340 with a C or better.

ECE 4200* Renewable Energy Penetration on the Power Grid 3 (3) Introduces the basic definition of electrical power, interfacing primary sources, generator/load characteristics, and renewable energy resources. Topics include solar energy grid interfacing, wind energy grid interfacing, battery charging/management, harmonic distortion, voltage sag, and national standards. Prq: ECE 2070 or ECE 3200, each with a C or better.

ECE 4220* Electronic System Design I 3 (2) Emphasizes the application of theory and skills to the design, building, and testing of an electronic system with both analog and digital components. Application varies each semester. Computer software tools are used extensively in the design process. Prq: ECE 3210 and ECE 3300 and ECE 3600 and ECE 3710 and ECE 3810, each with a C or better. Coreq: ECE 4221.

ECE 4223* Electronic System Design I Laboratory 0 (2) Non-credit laboratory to accompany ECE 4220. Coreq: ECE 4220.

ECE 4270 Communications Systems 3 (3) Study of communication systems design and analysis. Topics include signals and spectra, baseband signaling and detection in noise, digital and analog modulation and demodulation techniques, communications link budget analysis. Prq: ECE 3170 and ECE 3300, each with a C or better.

ECE 4290* Organization of Computers 3 (3) Computer organization and architecture. Topics include a review of logic circuits, bus structures, memory organization, interrupt structures, arithmetic units, input-output structures, state generation, central processor organization, control function implementation, and data communication. Registered Transfer Language (RTL) for description and design of digital systems. Prq: ECE 2720 with a C or better.

ECE 4300* Digital Communications 3 (3) Introduction to modern digital communication systems, emphasizing modulation and detection, taking into account the effects of noise. Includes Honors sections. Prq: ECE 3170 and ECE 3300, each with a C or better; and consent of instructor. Consent is not required for honors students.
ECE 4320* Instrumentation 3 (3) Theory and analysis of transducers and related circuits and instrumentation. Generalized configurations and performance characteristics of instruments are considered. Transducer devices for measuring physical parameters such as motion, force, torque, pressure, flow, and temperature are discussed. Preq: ECE 3210 with a C or better. Preq or concurrent enrollment: MATH 3110 or MATH 4340, each with a C or better.

ECE 4350* Grounding and Shielding 3 (3) Introduction to electromagnetic compatibility concepts and techniques for students who will be designing or working with electronic systems when they graduate. Topics include electromagnetic interference and noise control, crosstalk and signal integrity, grounding, filtering, shielding, circuit board layout, lighting and electrostatic discharge protection. Preq: ECE 3810 with a C or better.

ECE 4360* Microwave Circuits 3 (3) Analysis of microwave networks comprising transmission lines, waveguides, passive elements, interconnects, and active solid state microwave circuits. Use of modern CAD tools to design RF/Microwave passive/active networks. Fabrication of typical circuits. Preq: ECE 3810 with a C or better. Preq or concurrent enrollment: MATH 3110 or MATH 4340, each with a C or better.

ECE 4370* Microelectromechanical Systems 3 (3) Introduction to the basic materials in current microelectromechanical systems (MEMS), as well as the fundamental sensing and actuation mechanisms therein. Students also learn the basic fabrication techniques for bulk and surface micromachining, discuss the primary forces in MEMS devices, and study the basic micro mechanical structures and microfluidics. Preq: CH 1020 and PHYS 1220.

ECE 4380* Computer Communications 3 (3) Digital data transmission techniques, modern communications channels, communications software and protocols, multiprocessors and distributed processing; concurrency and cooperation of dispersed processors. Preq: Senior standing in Electrical or Computer Engineering or Computer Science.

ECE 4390* Fiber Optics 3 (3) Covers the underlying principles of design for optical fibers in practical systems. Examines optical fiber as a wave-guide using wave optics and ray optics. Discusses design criteria for using mono- and multi-mode fibers. Other topics include fabrication, measurement. Preq: ECE 3810 with a C or better. Preq or concurrent enrollment: MATH 4340 with a C or better.

ECE 4400* Performance Analysis of Local Computer Networks 3 (3) Introduction to the design and performance analysis of local computer networks. Emphasizes performance analysis of representative multi-access procedures. Three common types of networks are considered in detail. Preq: ECE 2720 and ECE 3170, each with a C or better.

ECE 4420* Knowledge Engineering 3 (3) Introduction to the theoretical and practical aspects of knowledge engineering or applied artificial intelligence. Topics include symbolic representation structures and manipulation, unification, production systems and structures, rule-based and expert systems, planning and AI system architectures; system design in PROLOG and LISP. Project is required. Preq: ECE 3220 and ECE 3520, each with a C or better.

ECE 4460* Antennas and Propagation 3 (3) Study of the theoretical and practical aspects of antenna design and utilization, input impedances, structural considerations, and wave propagation. Preq: ECE 3300 and ECE 3810; and one of MATH 3110 or MATH 4340, each with a C or better.

ECE 4490* Computer Network Security 3 (1) Hands-on practicum in the administration and security of modern network service emphasizing intrusion prevention techniques, detection, and recovery. Preq: Senior standing in Computer Engineering or Electrical Engineering. Coreq: ECE 4491.

ECE 4491* Computer Network Security Laboratory 0 (4) Non-credit laboratory to accompany ECE 4490. Coreq: ECE 4490.

ECE 4530 Software Practicum 3 (1) Students design and implement a software system that satisfies both a requirements and specifications document. The resulting system is tested for compliance. Preq: ECE 3220 and ECE 3520, each with a C or better. Coreq: ECE 4531.

ECE 4531 Software Practicum Laboratory 0 (6) Non-credit laboratory to accompany ECE 4530. Coreq: ECE 4530.

ECE 4550* Robot Manipulators 3 (3) Analysis of robot manipulator systems with special focus on interaction of these technologies with society. Emphasis is on rigid-link robot manipulator systems. Topics include history of robot technology, kinematics, dynamics, control, and operator interfaces. Case studies reinforce impact of robot technology on society and vice versa. Preq: MATH 2060 and MATH 3110, each with a C or better.

ECE (ME) 4570* Fundamentals of Wind Power 3 (3) Introduces wind turbine systems, including wind energy potential and application to power generation. Topics include wind energy principles, wind site assessment, wind turbine components, power generation machinery control systems, connection to the electric grid, and maintenance. May also be offered as ME 4570. Preq: ECE 2070 or ECE 3200 with a C or better.

ECE 4600* Computer-Aided Analysis and Design 3 (3) Principles and methods suited to the solution of engineering problems on the digital computer. Topics include widely used methods for the solution of the systems of algebraic and/or differential equations which arise in modeling of engineering systems, data approximation and curve fitting, continuous system simulation languages, and design-oriented programming systems. Preq: ECE 2620 and MATH 3110 and MATH 4340, each with a C or better.

ECE 4610* Fundamentals of Solar Energy 3 (3) Introduces solar energy conversion systems. Topics include environmental benefits of solar energy, solar thermal systems, concentration solar power, photovoltaic (PV) cell design and manufacturing, sizing of PV system, hybrid photovoltaic/thermal systems, energy storage, and urban/rural applications. Preq: ECE 3200 with a C or better.

ECE 4670* Introduction to Digital Signal Processing 3 (3) Introduction to characteristics, design, and applications of discrete time systems; design of digital filters; introduction to the Fast Fourier Transform (FFT); LSI hardware for signal processing applications. Preq: ECE 3300 with a C or better.

ECE 4680* Embedded Computing 3 (2) Principles of using computing in the larger context of a system. Topics include bus and processor design types (e.g. microprocessor, microcontroller, DSP), codecs, digital circuit power management, real time scheduling, and embedded operating systems. Lab work consists of projects on embedded hardware (e.g. PIC-104+). Preq: ECE 2230 and ECE 3710, each with a C or better. Coreq: ECE 4681.

ECE 4681* Embedded Computing Laboratory 0 (2) Non-credit laboratory to accompany ECE 4680. Coreq: ECE 4680.

ECE 4700* Vehicle Electronics 3 (3) Introduction to vehicle electronic systems and networks. Topics include a review of electronic systems in automotive and aerospace applications; vehicle components, sensors and actuators; communication buses; electric power generation and distribution in vehicle systems; vehicle diagnostics; reliability; and trends in vehicle system design. Preq: ECE 3200 with a C or better.

ECE 4710 Electric Vehicles and Energy Storage 3 (3) Introduction to hybrid electric propulsion systems and energy storage systems. Topics include a review of fundamentals of electric vehicles and hybrid electric vehicles architectures covering reasons for hybridization, energy analysis of architecture and components; overview of energy storage systems (batteries and supercapacitors); modeling of components; vehicle simulation; and supervisory control. Preq: ECE 3200 with a C or better.

ECE 4730* Introduction to Parallel Systems 3 (3) Introduces parallel computer architectures and their programming. Includes an introduction to MPI and OpenMP and a number of engineering problems, including numerical simulations. Introduces scalability analysis. Preq: ECE 3220 or ECE 3290, each with a C or better.
ECE (CPSC) 4780* General Purpose Computation on Graphical Processing Units 3 (3) Instruction in the design and implementation of highly parallel, GPU-based solutions to computationally intensive problems from a variety of disciplines. The OpenCL language with interoperable OpenCL components is used. Applications to models of physical systems are discussed in detail. May also be offered as CPSC 4780. Prereq: CPSC 2120 or ECE 2240.

ECE 4910 Undergraduate Honors Research 1-6 (1-6) Individual research projects conducted under the direct supervision and guidance of a faculty member. May be repeated for a maximum of six credits.

ECE 4920* Special Problems 1-3 (1-3) Special assignment in electrical or computer engineering. Some typical assignments include computer programs, term papers, technical literature searches, hardware projects, and design project leadership. May be taken only once for credit.

ECE 4930* Selected Topics 1-3 (1-3) Classroom study of current and new technical developments in electrical and computer engineering. May be repeated for a maximum of six credits, but only if different topics are covered. Prereq: Consent of instructor.

ECE 4950 Integrated System Design I 2 (1) Considers engineering design of systems in a continuous process of project definition, planning, execution, and evaluation. This process includes consideration of both technical and non-technical factors in design. Strong emphasis is placed on the development of effective technical communications skills, particularly oral communications competency. Prereq: Electrical Engineering major and ECE 3200 and ECE 3300 and ECE 3600 and ECE 3800, each with a C or better; or Computer Engineering major and ECE 3200 and ECE 3220 and ECE 3300 and ECE 3520 and ECE 3710, each with a C or better. Coreq: ECE 4951.

ECE 4951 Integrated System Design I Laboratory 0 (3) Non-credit laboratory to accompany ECE 4950. Coreq: ECE 4950.

ECE 4960 Integrated System Design II 2 (6) Project-oriented course which brings together electrical and computer engineering students of dissimilar training in teams or project groups. Group assignments are designed to develop an appreciation for individual and creative thinking, as well as team effort. Prereq: Electrical Engineering major and ECE 3210 and ECE 3710 and ECE 3810 and ECE 4090 and ECE 4950, each with a C or better; or Computer Engineering major and ECE 4090 and ECE 4950, each with a C or better.

ECE 4990 Creative Inquiry—Electrical and Computer Engineering 1-4 (1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Includes Honors sections. Prereq: Consent of faculty member/mentor.

ECONOMICS


ECON 2000 Economic Concepts 3 (3) One-semester survey of basic economic concepts that offers an overview of both microeconomics and macroeconomics. Not intended for business majors or other students seeking a comprehensive introduction to economic analysis and its applications. Credit will not be given to students who have received credit for ECON 2110 or 2120.

ECON 2110 Principles of Microeconomics 3 (3) Introduction to economic reasoning and its application to the study of the behavior of consumers and business firms. Topics include competition, monopoly, international trade, and the impact of selected public policies. Intended as the first of a two-semester sequence in the foundations of economics. Includes Honors sections.

ECON 2120 Principles of Macroeconomics 3 (3) Continuation of ECON 2110 in which fundamental economic concepts are applied to the study of aggregate economic performance. Topics include the forces determining the rates of inflation, unemployment, and economic growth, with particular emphasis on the influence of fiscal and monetary policies through financial markets. Includes Honors sections. Prereq: ECON 2110.

ECON 3010 Economics of Labor 3 (3) Introduces students to the economics of the labor market and labor relations. Considers the theories of wages and employment, determination, unemployment, investment in human capital, discrimination, and public policy toward the labor market. Also considers the role of labor unions. May not be used to satisfy requirements for a degree in Economics. Prereq: ECON 2110.

ECON 3020 Money and Banking 3 (3) Considers the function of money and banking in both the product and financial markets. Special emphasis is placed on monetary theory and current problems of monetary policy. May not be used to satisfy requirements for a degree in Economics. Prereq: ECON 2110.

ECON 3030 Economics and Sports 3 (3) Economic analysis of sports teams, leagues, and institutions. Analyzes basic economic issues using sports data. May not be used to satisfy requirements for a degree in Economics. Credit will not be given to students who have completed ECON 4260. Prereq: ECON 2110.

ECON 3050 Economics and Sports 3 (3) Economic analysis of sports teams, leagues, and institutions. Analyzes basic economic issues using sports data. May not be used to satisfy requirements for a degree in Economics. Credit will not be given to students who have completed ECON 4260. Prereq: ECON 2110.

ECON 3070 Arbitration 3 (3) Analyzes dispute settlement procedures emphasizing mediation, fact-finding, and arbitration as they are used to resolve labor-management disputes in the public and private sectors. Prereq: Consent of instructor.

ECON 3090 Government and Business 3 (3) Relationships between government and business, including, among other topics, government efforts to enforce competition; to regulate public utilities; and to protect the special interest of laborers, farmers, and consumers. May not be used to satisfy requirements for a degree in Economics. Prereq: ECON 2110.

ECON 3100 International Economy 3 (3) Studies of the process of international commerce. Covers basic theory of trade and exchange rates, institutional and legal environment, current policy issues. Not open to students who have taken ECON 4120. May not be used to satisfy requirements for a degree in Economics. Prereq: ECON 2110 and ECON 2120.

ECON 3140 Intermediate Microeconomics 3 (3) Analytical study of basic concepts of value and distribution under alternative market conditions. Includes Honors sections. Prereq: ECON 2110.

ECON 3150 Intermediate Macroeconomics 3 (3) Macroeconomic problems of inflation and unemployment are focal points. Includes statistics (measures of real output and the price level) and theory (covering the sources of short-run fluctuations and long-run growth). Analyzes appropriate public policies addressing these issues. Includes Honors sections. Prereq: ECON 2120.

ECON 3190 Environmental Economics 3 (3) Study of the application of economic logic to issues surrounding environmental management and policy. Examines individual, firm, and collective decision making as well as the evolution of regulatory approaches for controlling environmental use. Prereq: ECON 3140.

ECON (ELE) 3210 Economics of Innovation 3 (3) Examines the nature of entrepreneurship and the contribution of innovation to economic growth. Investigates the organizational and institutional sources of innovation in different firms and different countries as well as the work of economic theorists concerning the role entrepreneurs play in bringing new products to market. May also be offered as ELE 3210. Prereq: ECON 3060 or ECON 3140.

ECON 3250 Personnel Economics 3 (3) Study of various compensation and personnel practices firms employ. Explains when each of those practices should be followed to elicit the desired employee effort and labor force quality. Topics include piece-rate and time-rate systems, seniority-based incentive schemes, promotion contests, evaluation systems, mandatory retirement, and up-or-out rules. Prereq: ECON 2110.

ECON 3400 Behavioral Economics 3 (3) Introduces the economic, sociological, and psychological aspects of decision making under uncertainty. Presents the psychology of prediction, intuitive prediction, biases and corrective procedures. Topics also include framing, choice with costly information, and social influences on individual behavior. Prereq: ECON 2110.