

ENGINEERING (EGR)

EGR 110. Introduction to Human-Centered Engineering Design. (4 h)

Introduction to the study and practice of engineering, systems thinking, human-centered design, research, creative and analytical problem-solving practices, and engineering for humanity. With laboratory. This course is targeted at students who are not interested in majoring nor minoring in Engineering. Credit for both EGR 110 and EGR 111 is not allowed. (D)

EGR 111. Introduction to Engineering Design. (4 h)

Introduction to the study and practice of engineering, systems thinking, design, research, creative and analytical problem-solving practices, and engineering for humanity. With laboratory. This course is targeted at students who are interested in majoring or minoring in Engineering. Credit for both EGR 110 and EGR 111 is not allowed. (D)

EGR 112. Introduction to Engineering Experimentation. (4 h)

Exploration of tools, processes, and quantitative and qualitative analysis for modern engineering practice. With laboratory.

EGR 113. Integrated Sciences. (4 h)

An integrated basic science course covering topics in the biological, chemical, and physical sciences. With laboratory.

EGR 211. Materials and Mechanics. (4 h)

Fundamentals of materials and mechanics (statics and dynamics) for engineering applications. With laboratory. P-CHM 111/111L, EGR 111, 112, MST 111, PHY 113. P or C-MST 112.

EGR 212. Transport Phenomena. (4 h)

An integrated course in the fundamentals of thermodynamics, fluid mechanics, and heat transfer with emphasis on principles of conservation and transport of mass, energy, and momentum. With laboratory. P-CHM 111/111L, EGR 111, 112, MST 111, 112, PHY 113. P or C-MST 113.

EGR 213. Mechanical Computer Aided Design I. (2 h)

Introduction to Computer Aided Design (CAD) for mechanical assemblies including design planning additive and subtractive manufacturing techniques. P-EGR 111.

EGR 214. Embedded Microcontroller Systems. (2 h)

Examination of the structure of digital electronic systems with specific focus on microcontroller architectures for embedded system applications, as well as interfacing with analog and digital peripherals. With laboratory. P-EGR 111 or EGR 112 and CSC 111.

EGR 215. Digital Electronics. (2 h)

Design and hardware implementation of digital electronic systems using basic Boolean logic gates and other common digital logic tools such as multiplexers, decoders, flip-flops, shift registers, and counters. With laboratory. P-EGR 111 or 112.

EGR 280. Projects with Engineering for Non-Majors. (1-4 h)

Specialized and focused learning via experiential projects. With laboratory. May be repeated for credit.

EGR 281. Introductory Projects with Engineering for Majors. (1-4 h)

Specialized and focused learning via experiential projects. Does not count towards engineering technical elective credit. With laboratory. May be repeated for credit.

EGR 301. Special Topics in Engineering. (1-4 h)

Seminar and/or lecture and/or project-based and/or laboratory courses in selected topics. Does not count towards engineering technical elective credit unless a designation of "Technical Elective" is noted. May be repeated if the course title changes.

EGR 311. Control Systems and Instrumentation. (4 h)

Fundamentals of circuits and semiconductor electronics as applied to the analysis and design of engineering instrumentation and control systems. With laboratory. P-EGR 211, 212, and MST 113. P or C-MST 205 (or MST 121 and MST 251).

EGR 312. Computational Modeling in Engineering. (4 h)

Fundamentals of computational problem solving tools (programming, systems modeling, numerical methods) for diverse engineering applications, with consideration of the economic and ethical outcomes of decisions that are made using such techniques. With laboratory. P-EGR 211, 212, MST 113, 205 (or MST 121 and MST 251). (STA 111 highly encouraged but not required).

EGR 313. Capstone Design I. (1 h)

The first course of the capstone design experience. C-EGR 311, 312.

EGR 314. Capstone Design II. (4 h)

The second course of the capstone design experience. With laboratory. P-EGR 311, 312, and EGR 313.

EGR 315. Capstone Design III. (4 h)

The third course of the capstone design experience. With laboratory. P-EGR 314.

EGR 316. Mechanical Computer Aided Design II. (2 h)

Advanced Computer Aided Design (CAD) for mechanical systems and stress/strain analysis with consideration of material properties and their role in manufacturability. With laboratory. P-EGR 211.

EGR 317. Renewable Energy Systems. (2 h)

Fundamentals of renewable energy systems, including wind, solar, biomass, and hydroelectric with economics evaluation and understanding technological innovations. With laboratory. P-EGR 212.

EGR 318. Biomimetic Engineering. (2 h)

Fundamentals of bioinspired design, functional modeling, and reverse engineering principles towards innovative solutions. With laboratory. P-EGR 211, 212.

EGR 319. Environmental Engineering. (2 h)

Fundamentals of environmental systems, including water supply, water quality, water treatment, air pollution, soil remediation, environmental risk assessment, and climate variation. Explore how engineers both leverage and sustain these systems and inform environmental and public health policies. With laboratory. P-EGR 211 and 212.

EGR 320. Biomedical Engineering Applications. (2 h)

An overview of biomedical engineering applications such as cardiovascular fluid mechanics, biomechanics, biomaterials, tissue engineering, signal processing and instrumentation, and biomedical ethics. With laboratory. P-EGR 211, 212, and MST 205.

EGR 321. Chemical Engineering Separations. (2 h)

Theory and design of chemical separation processes, and related flow diagrams, by applying material and energy balances and chemical equilibria fundamentals. Includes distillation, liquid-liquid extraction, ion exchange, and gas absorption. With laboratory. P-EGR 212, MST 205, CHM 122 and 280.

EGR 322. Materials Engineering and Characterization. (2 h)

Relationships between atomic structure, microstructure, and observable properties of metallic, ceramic, and polymeric materials. Measurement and modification of material properties. With laboratory. P-EGR 211, MST 112, CHM 111 and 111L.

EGR 323. Chemical Reaction Engineering. (2 h)

Rates of homogeneous, catalytic, and biological reactions; reactor design and analysis, and related flow diagrams. With laboratory. P-EGR 212, MST 205, CHM 122 and 280.

EGR 324. Hydrologic and Hydraulic Engineering. (2 h)

Fundamentals of the hydrologic cycle, estimating hydrologic fluxes, watershed-scale modelling, and open channel hydraulics. With laboratory. P-EGR 212.

EGR 325. Medical Product Design. (2 h)

Fundamentals of innovative and user-centered product design processes. Use of clinical observations and client interviews to derive new medical device designs and analysis for improving system performance. With laboratory. P-EGR 211 and 212.

EGR 326. Human Factors Engineering. (2 h)

A systems approach to understanding human-machine interfaces, psychology of design, ergonomics, human error and system reliability. With laboratory. P-EGR 211 and 212.

EGR 327. Microengineering. (2 h)

An overview of microengineering systems and an exploration of how size affects critical scaling law parameters, material properties, fabrication techniques, design and use. With laboratory. P-EGR 211 and 212.

EGR 328. Inverse Problems in Engineering. (2 h)

Fundamental approaches and techniques in solving inverse problems using mathematical, numerical, and statistical formulations. Applications include satellite remote sensing of the earth and environment, medical imaging, image and signal processing, and machine learning. With laboratory. P-EGR 211, MST 113 and 205, and STA 111.

EGR 329. Functional Advanced Materials Characterization. (2 h)

Relationships between atomic structure, microstructure, and observable properties of functional and advanced materials. measurement and modification of material properties. With laboratory. P-EGR 211, MST 113, CHM 111 and 111L.

EGR 330. Infrastructure Systems Design. (2 h)

Explore principles of infrastructure systems through experiential learning and application of concepts to design or redesign a local system with consideration of technical, social, environmental, and economic factors. With laboratory. P-EGR 211 and 212.

EGR 331. Thermal Fluid Systems. (2 h)

Applying fundamentals of fluid mechanics, heat transfer, and thermodynamics across diverse engineering applications in the analysis and design of thermal fluid systems. With laboratory. P-EGR 212 and MST 205.

EGR 332. Structural Engineering I. (2 h)

An introduction to structural engineering systems and materials such as steel, wood, and concrete. Emphasis on understanding the load path within real structures and how that impacts their design. With laboratory. P-EGR 211.

EGR 333. Tissue Engineering. (2 h)

Fundamentals of biomaterials, stem cells, and imaging technologies to analyze novel tissue engineering applications. With laboratory. P-EGR 211, 212, BIO 111 or 150, CHM 111 and 111L or POI.

EGR 334. Mobile Robotics. (2 h)

Introduction to mobile robotics, from hardware (energy, locomotion, sensors) and software (signal processing, control, localization, trajectory planning, high-level control). With laboratory. P-EGR 211, 212 and 311.

EGR 335. Field Programmable Gate Array (FPGA) Design and Implementation. (2 h)

An introduction to field programmable gate array (FPGA) design and implementation. With laboratory. P-EGR 311.

EGR 336. Healthcare Engineering. (2 h)

Beyond biomedical engineering, engineers play a critical role in bettering healthcare systems via big data analytics, next generation technologies, translational science and engineering, precision medicine, and diagnostic AI. With laboratory. P-EGR 312.

EGR 337. Biofluid Mechanics. (2 h)

Introduction to Bioengineering principles applied to the cardiovascular system. Specifically, this course will apply relevant theories in Fluid Mechanics and Solid Mechanics to the cardiovascular system. With laboratory. P-EGR 211 and 212.

EGR 338. Bioprinting and Biofabrication. (2 h)

Engineering principles applied to bioprinting and biofabrication with fundamentals of biomaterials, tissue engineering, and tissue construct design principles. With laboratory. P-EGR 211.

EGR 339. Engineering Reynolda. (2 h)

A historical engineering perspective with the historic Reynolda House as a case study. Fundamentals of reverse engineering and research in the context historical structures and systems. Introduction to design as it relates to existing structures. With laboratory. P-EGR 211 and 212.

EGR 340. Acoustics. (2 h)

Fundamentals in acoustics involving concepts of wave phenomena and sound perception, governing principles and mathematical modeling of acoustics applications. With laboratory. P-EGR 212.

EGR 341. 3D Modeling and Additive Manufacturing. (2 h)

Fundamentals of a variety of 3D printing techniques for rapid prototyping, 3D modeling of standard machine elements, creation of engineering drawings and animations. With laboratory. P-EGR 211.

EGR 342. Design of Machine Elements. (2 h)

Application of design theories to practical machine elements and selection of machine components for diverse applications. With laboratory. P-EGR 211.

EGR 343. Biomaterials. (2 h)

Fundamentals of different types of biomaterials and their application across a diverse set of biomedical scenarios. With laboratory. P-EGR 211.

EGR 344. Mechanics of Intelligent Material Systems. (2 h)

Fundamentals of material systems as actuator, sensors, and energy harvesters across diverse applications, including artificial muscle electroactive polymer technologies, with an emphasis on materials science and engineering design. With laboratory. P-EGR 211.

EGR 345. System Engineering and Control Theory. (2 h)

Fundamentals of system engineering and control theory across diverse applications, including mechanical, electrical, environmental, biological, and socio-economic systems. With laboratory. P-EGR 311 and 312.

EGR 346. Engineering Analysis of Vibrations. (2 h)

Modeling and solution of free and forced vibrating dynamic systems, including single and multiple degree of freedom systems, as well as continuous systems. Applications includes earthquake modeling, beam and membrane vibrations, etc. With laboratory. P-EGR 211. P or C-MST 112.

EGR 347. Finite Element Analysis of Engineering Systems. (2 h)

Fundamentals of finite element methods and commercial finite element codes for solid mechanics, heat transfer, and fluid mechanics applications in one, two, and three dimensions. With laboratory. P-EGR 312.

EGR 348. Advanced Fluid Mechanics. (2 h)

Advanced fluid kinematics, finite control volume analysis, and differential analysis of fluid flows. Includes applications of inviscid and viscous flows, similitude, dimensional analysis, open channel flows, compressible flows and flow in turbomachines. With laboratory. P-EGR 212. P or C-MST 113.

EGR 349. Biomechanics of Human Movement. (2 h)

Fundamentals of human (and animal) movement and modeling of skeletal, muscular, and neurological motion. Kinematic analysis of human and animal movement, and kinetics (forces) required to generate movement. With laboratory. P-EGR 211.

EGR 350. Advanced Electronics. (2 h)

Exploration and applications of operational amplifiers and other analog linear integrated circuits. With laboratory. P-EGR 311.

EGR 351. Biomechanics of Animal Locomotion. (2 h)

Biological and mechanical principles of animal movement on both solid ground and through fluids, including flying, swimming, running, jumping, climbing, etc. Considers force production and patterns of movement including muscular action and vortex behavior. With laboratory. P-EGR 211 and 212.

EGR 380. Fundamentals of Engineering Exam Prep. (1 h)

Review of engineering fundamentals in preparation for Fundamentals of Engineering exam. P or C-EGR 311 and 312.

EGR 381. Engineering Research. (1-4 h)

Engineering research project conducted under the guidance of a research mentor. Does not count towards engineering technical elective credit unless a designation of "Technical Elective" is indicated. Upon completion and review of project deliverables, engineering technical elective credit may be granted. With laboratory. May be repeated for credit.