Bachelor of Science in Engineering: Engineering Design

The School of Engineering offers undergraduates a unique opportunity to earn an engineering degree tailored to their interests with an emphasis on innovation and design with the Bachelor of Science in Engineering degree in Engineering Design (BSEED). This program stresses engineering design and product development and includes hands-on, project-based experiences throughout a curriculum designed to help students develop and practice these skills. The program is intended for students whose academic/scientific interests are not aligned with an existing engineering discipline or limited to one engineering discipline offered at UAB. The ideal student will be highly adaptable, prepared to work in interdisciplinary teams, and adept at hands-on learning.

Students in the program will choose from a list of approved engineering minors (http://catalog.uab.edu/undergraduate/schoolofengineering/#minorstext) in consultation with their advisor and in consideration of their career goals. The program allows a maximum of 24 hours of general elective credit, which can be used to complete an additional minor or a certificate in Engineering or another program, School, or College at UAB. To help students clarify their goals, academic and career advising are provided within the School of Engineering.

Qualified, motivated undergraduate students may be eligible for participation in the engineering honors program.

Please refer to the School of Engineering overview for policies regarding admission; change of major; transfer credit; transient status; dual degree programs; reasonable progress; academic warning, probation, and suspension; reinstatement appeals; and graduation requirements.

Student Outcomes

Upon completion of the BSE degree program, our graduates will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Experiential Learning

The program encourages students to participate in experiential learning opportunities, such as industry co-ops, engineering internships, and research with department faculty. These opportunities enhance a student’s education and provide the real-world experience employers are seeking. The School of Engineering assists students in pursuing these opportunities.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Core Curriculum for Engineering Majors</td>
<td>36</td>
</tr>
<tr>
<td>Area I: Written Composition (6 hrs)</td>
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<tr>
<td>Area II: Humanities and Fine Arts (9 hrs)</td>
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<tr>
<td>Area III: Natural Sciences and Mathematics (12 hrs)</td>
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<tr>
<td>Area IV: History, Social, and Behavioral Sciences (9 hrs)</td>
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</tbody>
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Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>CE 210</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>CE 220</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>CH 115</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 115R</td>
<td>General Chemistry I Recitation</td>
<td></td>
</tr>
<tr>
<td>&amp; CH 116</td>
<td>General Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>CH 117</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 117R</td>
<td>General Chemistry II Recitation</td>
<td></td>
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<tr>
<td>&amp; CH 118</td>
<td>General Chemistry II Laboratory</td>
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<tr>
<td>EE 312</td>
<td>Electrical Systems</td>
<td>3</td>
</tr>
<tr>
<td>or EE 314</td>
<td>Electrical Circuits</td>
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<tr>
<td>EGR 110</td>
<td>Introduction to Engineering I</td>
<td>2</td>
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<tr>
<td>&amp; EGR 111</td>
<td>Introduction to Engineering II</td>
<td>2</td>
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<tr>
<td>or EGR 200</td>
<td>Introduction to Engineering</td>
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<tr>
<td>EGR 117</td>
<td>Engineering Innovation I: Design Thinking</td>
<td>3</td>
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<tr>
<td>EGR 150</td>
<td>Computer Methods in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EGR 265</td>
<td>Math Tools for Engineering Problem Solving</td>
<td>4</td>
</tr>
<tr>
<td>EGR 217</td>
<td>Engineering Innovation III: Project Lab</td>
<td>3</td>
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<td>EGR 498</td>
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<td>3</td>
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<tr>
<td>EGR 499</td>
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<td>3</td>
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<tr>
<td>MA 126</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MA 260</td>
<td>Introduction to Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>ME 102</td>
<td>Engineering Graphics</td>
<td>2</td>
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</tbody>
</table>
Total credit hours: 128

Core Curriculum Area II or IV 3
Core Curriculum Area II or IV 3
EGR 498 Capstone Design I 3
Elective/Certificate Course 4

Total Hours 128

1 Students wishing to pursue an Electrical Engineering minor must successfully complete EE 314.
2 Transfer students may substitute EGR 200 for EGR 110/EGR 111.
3 Students may also replace EGR 265 and a math/science elective with MA 227 and MA 252.
4 Could be used to complete an additional minor or certificate.
5 The following courses do not fulfill this requirement: CE 200, CE 344, EE 254, EE 300, EE 318, EE 485, ME 364.
6 Must include courses to complete the chosen engineering minor

**BME-Biomedical Engineering Courses**

BME 011. Undergraduate Coop/Internship in BME. 0 Hours.
Engineering workplace experience in preparation for the student's intended career.

BME 210. Engineering in Biology. 3 Hours.
Application of engineering to the study of biology on the cellular and molecular level. Engineering solutions in genomics, proteomics, and nanotechnology to investigate cellular and molecular process.
Prerequisites: BY 123 [Min Grade: C] and PH 222 [Min Grade: C] (Can be taken Concurrently) and BY 210 [Min Grade: C] (Can be taken Concurrently)

BME 289. Undergraduate Research in Biomedical Engineering I. 1 Hour.
Undergraduate research experiences in biomedical engineering. Must have sophomore standing.
Prerequisites: EGR 200 [Min Grade: C] or EGR 111 [Min Grade: C] or HC 111 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C] (Can be taken Concurrently)

BME 310. Biomaterials. 3 Hours.
Introduction to wide range of materials used for biomedical applications. Physical, chemical and mechanical properties of biomaterials.
Prerequisites: MSE 280 [Min Grade: C] and BME 210 [Min Grade: C]

BME 311. Biomaterials for Non-Majors. 3 Hours.
Wide range of materials used for biomedical applications. Physical, chemical and mechanical properties of biomaterials.
Prerequisites: MSE 280 [Min Grade: C]

BME 312. Biocomputing. 3 Hours.
Introduction to computational techniques used in biomedical engineering.
Prerequisites: (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C]) and (EGR 265 [Min Grade: C] or MA 227 [Min Grade: C] or MA 252 [Min Grade: C]) and MA 260 [Min Grade: C] (Can be taken Concurrently)

BME 313. Bioinstrumentation. 3 Hours.
An introduction to instrumentation used to make biological and physiological measurements. Techniques include acquisition and analysis of bioelectric signals and several imaging modalities.
Prerequisites: EE 312 [Min Grade: C] and MA 227 [Min Grade: C] and MA 252 [Min Grade: C] or EGR 265 [Min Grade: C]

BME 333. Biomechanics of Solids. 3 Hours.
Application of mechanics of solids principles to biomedical engineering problems; stress-strain of bone, viscoelasticity and constitutive equations of tissues, mechanics of the cell, introduction to molecular mechanics.
Prerequisites: EGR 265 [Min Grade: C] (Can be taken Concurrently) or MA 227 [Min Grade: C] (Can be taken Concurrently) and MA 252 [Min Grade: C] (Can be taken Concurrently) and ME 215 [Min Grade: C] (Can be taken Concurrently)
BME 340. Bioimaging. 3 Hours.
Overview of diagnostic imaging including major imaging modalities such as X-Ray/CT, Nuclear Imaging, Ultrasound, Magnetic Resonance and in vivo molecular imaging approaches. Physical principles of image formation, image interpretation and patient safety.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and BME 210 [Min Grade: C] and EE 312 [Min Grade: C](Can be taken Concurrently)

BME 350. Biological Transport Phenomena. 3 Hours.
Basic mechanisms and mathematical analysis of transport processes with biological and biomedical applications. Analysis of flow, transport and reaction processes for biological fluids and biological molecules with applications towards development of artificial organs, drug delivery systems and tissue engineering products.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and BME 210 [Min Grade: C](Can be taken Concurrently) and BY 409 [Min Grade: C](Can be taken Concurrently) and ME 215 [Min Grade: C](Can be taken Concurrently)

BME 389. Undergraduate Research in Biomedical Engineering II. 1 Hour.
Undergraduate research experiences in biomedical engineering. Must have junior standing.
Prerequisites: BME 210 [Min Grade: C]

BME 401. Undergraduate Biomedical Engineering Seminar. 1 Hour. 
Undergraduate seminar.

BME 420. Implant-Tissue Interactions. 3 Hours.
An overview of implant biocompatibility including tissue histology, histopathology of implant response and the regulatory process for medical devices. Emphasis placed on ethical issues related to design, development, and implementation of biomedical implants. Ethics and Civic Responsibility are significant components of this course.
Prerequisites: BME 310 [Min Grade: C] or BME 311 [Min Grade: C]

BME 423. Living Systems Analysis and Biostatistics. 3 Hours.
Basic concepts and techniques of measurement processing and analysis of data from living systems. Statistics, analysis of variance and regression analysis. Emphasis is placed on writing lab reports in a style similar to research papers. BME 423L must be taken concurrently.
Prerequisites: BME 312 [Min Grade: C]

BME 424. Current Topics in Stem Cell Engineering. 3 Hours.
This course is designed for students interested in the field of stem cells, regenerative medicine, and tissue engineering using stem cells and stem cell derived cells. The course will introduce the role of stem cells in tissue growth and development, the theory behind the design and in vitro construction of tissue and organ replacements, and the applications of biomedical engineering principles to the treatment of tissue-specific diseases. Students will have hands on experience on culturing and analyzing stem cells, stem cell differentiation, analysis of functional and physiological properties of differentiated cells, and fabricating basic engineered-tissues.
Prerequisites: BY 123 [Min Grade: C] and BY 210 [Min Grade: C]

BME 435. Tissue Engineering. 3 Hours.
Principles underlying strategies for regenerative medicine such as stem-cell based therapy, scaffold design, proteins or genes delivery, roles of extracellular matrix, cell-materials interactions, angiogenesis, tissue transplantation, mechanical stimulus and nanotechnology.
Prerequisites: BME 310 [Min Grade: C] or BME 311 [Min Grade: C]

BME 443. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] or MA 252 [Min Grade: C]) and PH 222 [Min Grade: C]

BME 450. Computational Neuroscience. 3 Hours.
This course examines the computational principles used by the nervous system. Topics include: biophysics of axon and synapse, sensory coding (with an emphasis on vision and audition), planning and decision-making, and synthesis of motor responses. There will be an emphasis on systems approach throughout. Homework includes simulations.
Prerequisites: BME 312 [Min Grade: C]

BME 461. Bioelectric Phenomena. 3 Hours.
Quantitative methods in electrophysiology of neural, cardiac, and skeletal muscle systems.
Prerequisites: PH 222 [Min Grade: C] and BME 312 [Min Grade: C]

BME 462. Cardiac Electrophysiology. 3 Hours.
Experimental and computational method on cardiac electrophysiology, ionic current, action potentials, electrical propagation, the electrocardiogram, electromechanical coupling, cardiac arrhythmias, effects of electric fields in cardiac tissue, defibrillation and ablation.
Prerequisites: BME 312 [Min Grade: C]

BME 471. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansi strain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and (BME 333 [Min Grade: C] or CE 220 [Min Grade: C])

BME 472. Industrial Bioprocessing and Biomanufacturing. 3 Hours.
This course will introduce students to the growing industries related to biomedical, biopharmaceutical and biotechnology. It is targeted to offer the students marketable skills to work in a vital area of economic growth and also convey some of the challenges and opportunities awaiting.
Prerequisites: BME 310 [Min Grade: C] or BY 330 [Min Grade: C](Can be taken Concurrently) or BY 330 [Min Grade: C]or CH 460 [Min Grade: C](Can be taken Concurrently)

BME 489. Undergraduate Research in Biomedical Engineering. 1-3 Hour.
Undergraduate research experiences in biomedical engineering.
Prerequisites: BME 210 [Min Grade: C]

BME 490. Special Topics in Biomedical Engineering. 1-3 Hour.
Special Topic in Biomedical Engineering.

BME 491. Individual Study in Biomedical Engineering. 1-6 Hour.
Individual Study in Biomedical Engineering.

BME 494. Honors Research I. 1-3 Hour.
Research experiences for undergraduates enrolled in the departmental honors program. The student should write a proposal and make a presentation based on the proposal.
Prerequisites: EGR 301 [Min Grade: C] or STH 201 [Min Grade: C]
BME 495. Honors Research II. 1-3 Hours.
Research opportunities for undergraduate students in the Biomedical Engineering Honors Program. Research areas include cardiac electrophysiology, brain imaging, biomedical implants, and tissue engineering.
Prerequisites: BME 494 [Min Grade: C]

BME 496. Biomedical Engineering Honors Seminar. 1 Hour.
Must be enrolled in an Honors Program.

BME 498. Capstone Design I Product Development. 3 Hours.
Design and development of medical-products. Through experiential learning, students go through the early phases of engineering design innovation for medical products, starting with clinical immersion to determine a critical health-care need. Engineering students work in multi-disciplinary teams that include students from the School of Business to develop design concepts for both a client-based prototype and a commercializable version. Designs take into account client needs as well as legal, regulatory, and marketing requirements. Business ethics are also covered. Emphasis is placed on communication in both oral and written format to targeted audiences.
Prerequisites: BME 310 [Min Grade: C](Can be taken Concurrently) and BME 312 [Min Grade: C](Can be taken Concurrently) and BME 313 [Min Grade: C](Can be taken Concurrently) and BME 333 [Min Grade: C](Can be taken Concurrently)

BME 499. Capstone Design II. 3 Hours.
Capstone design project; a continuation of BME 498. Through experiential learning, student teams consisting of engineering and business students complete the engineering design process for their client-based prototype incorporating engineering standards and realistic constraints. Student teams develop a business plan to present to potential business partners and product development teams from established companies. Additional skills learned in this part of the design process include: development of business proposals, project planning and scheduling, project execution and resource scheduling, communication of design, and interim and final design reviews. Emphasis is placed on communication of design and design justification in both an oral and written format to targeted audiences.
Prerequisites: BME 498 [Min Grade: C] and ME 102 [Min Grade: C]

CE-Civil Engineering Courses

CE 011. UG Coop/Internship in CE. 0 Hours.
Engineering workplace experience in preparation for the student's intended career.

CE 200. Engineering Geology. 2 Hours.
The course covers the fundamentals and advanced topics of plate tectonics, mineral formation, sedimentary / igneous / metamorphic rocks, structural deformations, weathering and erosion, groundwater migration, and slope stability.

CE 210. Statics. 3 Hours.
Prerequisites: EGR 200 [Min Grade: C](Can be taken Concurrently) or HC 111 [Min Grade: C] or EGR 111 [Min Grade: C](Can be taken Concurrently) and (MA 126 [Min Grade: C] or MA 126 [Min Grade: P] or MA 226 [Min Grade: C]) and (PH 221 [Min Grade: C] or PH 221 [Min Grade: P])

CE 220. Mechanics of Solids. 3 Hours.
Prerequisites: CE 210 [Min Grade: C]

CE 221. Mechanics of Solids Laboratory. 1 Hour.
Standard tensile, torsion, bending, and column tests. Strain gage installation and applications. Measurement of forces, displacements, strains, and other variables. Writing is a significant component of this course.
Prerequisites: CE 220 [Min Grade: D](Can be taken Concurrently)

CE 222. Civil Engineering Materials Laboratory. 1 Hour.
Materials testing laboratory evaluating properties of materials of construction such as cement, aggregates, concrete, asphalt, and masonry. Design of Portland cement concrete mixes. Writing is a significant component of this course.
Prerequisites: CE 220 [Min Grade: D](Can be taken Concurrently)

CE 223. Plane Surveying. 3 Hours.
Care and use of surveying instruments, surveying methods. error theory, traversing, stadia, mapping techniques, circular and parabolic curves, areas, and volumes. CE 223L must be taken concurrently.
Prerequisites: MA 125 [Min Grade: C]

CE 230. Plane Surveying Laboratory. 0 Hours.
To provide an introduction to route surveying, and the principles of horizontal and vertical curves. Companion to CE 230 and must be taken concurrently.

CE 230L. Plane Surveying Laboratory. 0 Hours.
Laboratory equipment and methods. Chemical and physical tests to determine characteristics of water and wastewater. Companion lab to CE 236 and must be taken concurrently.

CE 236. Environmental Engineering. 3 Hours.
Air/water pollution and solid waste. Quality of environment. Environmental health. Regulations and legal considerations. Ethics and Civic Responsibility are significant components of this course.
Prerequisites: MA 125 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C](Can be taken Concurrently) and CH 117 [Min Grade: C]

CE 236L. Environmental Engineering Laboratory. 0 Hours.
Laboratory equipment and methods. Chemical, and physical tests to determine characteristics of water and wastewater. Companion to CE 236 and must be taken concurrently.

CE 332. Soil Engineering. 4 Hours.
Soil identification and properties, stress concepts, permeability settlement analysis, soil compaction, bearing capacity, shear strength of soil, and slope stability. CE 332L must be taken concurrently.
Prerequisites: CE 200 [Min Grade: D] and CE 220 [Min Grade: D]

CE 332L. Soil Engineering Laboratory. 0 Hours.
Soil classification, strength tests, permeability and consolidation tests. Companion to CE 332 and must be taken concurrently.

CE 337. Hydraulics. 3 Hours.
Fundamentals of hydraulics including properties of water; hydrostatic forces and pressures; flow, head losses, and related phenomena in pipes; river hydrograph routing; statistical hydrology; flow in open channels; culvert design; applied hydraulic modeling. Must have a grade of C or better to complete the course.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]
CE 344. Civil Engineering Analysis I. 3 Hours.
Inspection and treatment of data using exploratory data analysis. Introduction to probability. Basic data analysis using comparisons and regression, hypothesis testing, and analysis of variance. Quality control and reliability analyses. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

CE 345. Transportation Engineering. 3 Hours.
Function, influence, characteristics and operation of transportation systems and facilities, focusing primarily on highway systems. Geometric design, operations, and transportation planning are covered.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C]

CE 360. Structural Analysis. 3 Hours.
Reactions, shears, moments, and axial forces in determinate and indeterminate structures. Influence lines; moment area and energy methods of computing deflections; methods of truss and frame analysis. Computer applications. Must have a grade of C or better to complete the course.
Prerequisites: CE 220 [Min Grade: D]

CE 371. Professional Preparation. 2 Hours.
Introduces engineering students to skills necessary for their professional development. Topics include forms of technical writing and oral communication, report writing and organization, professional practice, and ethics.
Prerequisites: EH 102 [Min Grade: C] and (EGR 111 [Min Grade: C] or EGR 200 [Min Grade: C])

CE 395. Engineering Economics. 3 Hours.
Fundamental concepts of engineering economy. Introduction to cost and revenue estimating and cash flow analysis for engineering projects. Choosing between alternatives taking into account the time value of money, depreciation, inflation, income taxes and risk factors.
Prerequisites: MA 125 [Min Grade: C] or MA 225 [Min Grade: C]

CE 395R. Engineering Economics Recitation. 0 Hours.
An applications-based course designed to reinforce concepts from CE 395.

CE 401. FE Review for Civil Engineers. 0 Hours.
Review concepts of the engineering core and civil engineering in preparation for the Fundamentals of Engineering (FE) exam.

CE 415. Building Information Modeling (BIM). 3 Hours.
This class will be an introduction to the virtual world of design and construction. Topics covered will include uses for technology, what is BIM, and will have a focus on AutoCAD and Revit Software. An emphasis will be placed on the use of these tools and their practical applications to the real world environment. Students will be provided with the software through the Autodesk Student community and will be required to complete a Multi-Step term Project.
Prerequisites: ME 102 [Min Grade: C]

CE 420. Advanced Mechanics. 3 Hours.
Variation of stress at point including determination of principal and maximum shear stresses. Basic problems involving symmetrical deformation; thickwall cylinders and spheres. Torsions of noncircular sections. Curved beams. Failure Theories. Unsymmetrical bending and shear center.
Prerequisites: CE 220 [Min Grade: D]

CE 426. Foundation Engineering. 3 Hours.
Application of principles of soil mechanics to: determine bearing capacity and settlement of spread footings, mats, single piles and pile groups; site investigation, evaluate data from field and tests; estimation of stresses in soil masses; lateral resistance of piles and pile group; retaining walls, sheetpiles, and coffer-dams.
Prerequisites: CE 332 [Min Grade: D] and CE 455 [Min Grade: D]

CE 430. Water Supply/Drainage Design. 3 Hours.
Water requirements; wastewater characteristics. Hydraulics and design of sewers; distribution and reuse of water. Development of water supplies; design considerations.
Prerequisites: CE 337 [Min Grade: C]

CE 431. Energy Resources. 3 Hours.
Overview of the various energy resources: oil, natural gas, coal, nuclear, hydro, solar, geothermal, biomass, wind, and ocean energy resources, in terms of supply, distribution, recovery and conversion, environmental impacts, economies, policy, and technology. Advantages and limitations of various energy resources. Concepts and opportunities for energy conservation; including electric power generation, changing role of electric utilities, transportation applications, and energy use in developing countries. Field trips.
Prerequisites: CE 236 [Min Grade: D]

CE 433. Solid and Hazardous Wastes Management. 3 Hours.
Overview of waste characterizations, regulations, and management options. The course covers fundamentals of landfill design, recycling, incineration, emerging disposal technologies, federal and state laws, and hazardous waste treatment, and ultimate disposal of hazardous waste.
Prerequisites: CE 236 [Min Grade: D]

CE 434. Air Quality Modeling and Monitoring. 3 Hours.
Atmospheric pollutant effects, reactions and sources. Air dispersion modeling. Ambient monitoring.
Prerequisites: ME 251 [Min Grade: C]

CE 440. Civil Engineering Honors Research. 3 Hours.
Departmental honors students work closely with faculty researchers and graduate students in departmental concentration specialties to develop research skills. Enrollment is limited to undergraduate students enrolled in CCEE Departmental Honors Program.

CE 441. Civil Engineering Honors Seminar. 1 Hour.
Seminar focusing on student research and guest presentations of various topics of interest to civil and environmental engineering students.

CE 443. Pavement Design and Construction. 3 Hours.
Analysis of stresses and strains in pavement systems. Design and construction of flexible and rigid pavements, base courses, and subgrades. Effects of loading on pavement life.
Prerequisites: CE 345 [Min Grade: D]

CE 450. Structural Steel Design. 3 Hours.
Tension members, columns, beams, and beam columns. Simple connections. Load Resistance Factor Design (LRFD) approaches.
Prerequisites: CE 360 [Min Grade: C]

CE 453. Design of Wood Structures. 3 Hours.
This course will give students an understanding of structural wood materials, both sawn lumber and a number of engineered wood materials. The main objective of the course is to learn how to design wood structures using these materials, including the design of beams, columns, connections, roof diaphragms, and shear walls. The requirement of the National Design Specification for Wood Structures will be addressed.
Prerequisites: CE 360 [Min Grade: C]
CE 454. Design of Masonry Structures. 3 Hours.
Design and detailing of masonry structures. Nomenclature, properties, and specifications for components. Design of assemblages, simple masonry structures, unreinforced and reinforced elements, and complex masonry structures. 
Prerequisites: CE 360 [Min Grade: C]

CE 455. Reinforced Concrete Design. 3 Hours.
Behavior, strength, and design of reinforced concrete structural members (beams, columns, one-way slabs, and continuous beams) subjected to moment, shear, and axial forces according to the American Concrete Institute Building Code Requirements for Structural Concrete (ACI 318). Crack control and serviceability considerations. Introduction to the design of reinforced concrete structures.
Prerequisites: CE 360 [Min Grade: C]

CE 456. Prestressed Concrete Design. 3 Hours.
Principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexural, shear, bond, and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures.
Prerequisites: CE 455 [Min Grade: D]

CE 460. Structural Mechanics. 3 Hours.
Elastic beam deflections, beam columns, lateral torsional buckling, column stability, plastic design, plate bending, and yield line theory. 
Prerequisites: CE 360 [Min Grade: C]

CE 461. Introduction to the Finite Element Method. 3 Hours.
Prerequisites: CE 360 [Min Grade: C]

CE 462. Advanced Structural Analysis. 3 Hours.
Analysis of indeterminate structures utilizing both classical and matrix methods. Use of large-scale computer programs. 
Prerequisites: CE 360 [Min Grade: C]

CE 464. Structural Dynamics. 3 Hours.
Prerequisites: CE 360 [Min Grade: C] and ME 215 [Min Grade: C]

CE 467. Wind and Seismic Loads. 3 Hours.
Methods for calculating loads on structures caused by extreme winds and earthquakes. Calculation of wind loads on various types of structures according to theory and codes. Determination of earthquake loads on structures using structural dynamics and codes. 
Prerequisites: CE 360 [Min Grade: C]

CE 468. Bridge Engineering. 3 Hours.
Bridge loads, steel beam bridges, composite beam bridges, bridge bearings, reinforced and prestressed concrete slab and T-beam bridges, bridge evaluations and ratings, and upgrade methodologies; computer applications. 
Prerequisites: CE 450 [Min Grade: D] and CE 455 [Min Grade: D](Can be taken Concurrently)

CE 470. International Research Experience. 3 Hours.
The International Research Experience for Students (IRES) program provides the opportunity for undergraduate and graduate students to participate in hands-on engineering research in an international setting. Students perform research on an approved topic related to civil engineering design in an international environment. Students select a topic, perform a detailed literature review, and work with mentors from UAB and the international host institution to develop research objectives and a detailed research plan. The course will culminate in a 6-8 week visit to the international host institution, during which time students will conduct hands-on research with their mentors and prepare final reports. 

CE 475. Construction Safety and Health Management. 3 Hours.
This course covers various causes of construction accidents and the adopted strategies to prevent worksite injuries and illnesses. Other topics covered include workers' compensation, OSHA standards for the construction industry, economics of construction safety management, temporary structures, system safety, ergonomic applications, health hazards, and the development of a safety program. 
Prerequisites: CE 497 [Min Grade: C]

CE 480. Introduction to Water and Wastewater Treatment. 3 Hours.
Physical unit operations and chemical/biological unit processes for water and wastewater treatment. Design of facilities for treatment. Treatment and disposal of sludge.
Prerequisites: CE 236 [Min Grade: D]

CE 485. Engineering Hydrology. 3 Hours.
Hydrologic principles including the hydrologic cycle, precipitation data and stream-flow measurements. Applications to engineering problems: stream-flow analysis, and watershed management.
Prerequisites: CE 337 [Min Grade: C]

CE 489. Undergraduate Engineering Research. 0 Hours.
Undergraduate research experiences in civil, construction and/or environmental engineering. 
Prerequisites: (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C]) or EGR 200 [Min Grade: C] or HC 111 [Min Grade: C] or EGR 100 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C](Can be taken Concurrently)

CE 490. Special Topics in Civil Engineering. 1-3 Hours.
Special Topics in Civil Engineering.

CE 491. Individual Study in Civil Engineering. 1-6 Hour.
Individual Study in Civil Engineering.

CE 497. Construction Engineering Management. 3 Hours.
Study of construction management services that include: project planning, scheduling, estimating, budgeting, contract administration, agreements and ethics. Emphasis is made on the management of manpower, materials, money and machinery. 
Prerequisites: CE 395 [Min Grade: D]

CE 498. Capstone Design Project Lab. 0 Hours.
Review of engineering, math, and science topics in preparation for the FE exam. The importance of professional licensure and professional development are also covered. Students must register for and take the FE exam in order to receive credit for this course. CE 499 must be taken concurrently.
CE 499. Capstone Design Project. 3 Hours.
Students work in teams to complete a capstone design project that incorporates the major aspects of civil engineering design including structural, geotechnical, environmental, transportation, and construction management components. The course also includes lecturing and assignments related to professionalism including engineering ethics, leadership, and management. Normally taken during last term before graduation. CE 498 is a companion lab and must be taken concurrently.
Prerequisites: CE 332 [Min Grade: D] and CE 337 [Min Grade: C] and CE 345 [Min Grade: D] and (CE 450 [Min Grade: D] or CE 455 [Min Grade: D]) and CE 430 [Min Grade: D](Can be taken Concurrently) or CE 480 [Min Grade: D](Can be taken Concurrently) and CE 497 [Min Grade: D](Can be taken Concurrently)

EE-Electrical Computer Egr Courses

EE 011. Coop/Internship in EE. 0 Hours.
Engineering workplace experience in preparation for the student's intended career.

EE 210. Digital Logic. 3 Hours.
Number systems and codes. Boolean algebra and combinational logic. Arithmetic and logic circuits. Memory elements. Synchronous sequential logic. Lecture and computer laboratory.
Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 255 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C](Can be taken Concurrently)

EE 233. Engineering Programming Methods. 3 Hours.
Program design techniques, data structures, coding and documentation standards. File I/O. Product design and life cycles. Testing and software tools. Lecture and computer laboratory.
Prerequisites: (MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 255 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C](Can be taken Concurrently) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

EE 254. Applied Numerical Methods. 3 Hours.
Selected mathematical and computational topics appropriate to the numerical solution of engineering problems.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D]) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

EE 300. Engineering Problem Solving II. 3 Hours.
Selected mathematical and computational topics appropriate to the solution of engineering problems, including probability and statistics.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D]) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

EE 305. Fundamentals of Electrical Engineering. 3 Hours.
Survey of topics fundamental to field of electrical engineering. For non-engineering majors. Not available for credit toward engineering major.
Prerequisites: MA 109 [Min Grade: C]

EE 312. Electrical Systems. 3 Hours.
Introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, ideal transformers, and electrical safety. For non-EE majors.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 314. Electrical Circuits. 3 Hours.
Introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, and electrical safety. For EE Majors.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 314R. Electrical Circuits Recitation. 0 Hours.
An application based course designed to reinforce concepts from EE 314.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 316. Electrical Networks. 4 Hours.
Analysis of circuits using classical differential/integral techniques, Laplace transforms, and two-port network parameters. Circuit solution using simulation. EE 316L must be taken concurrently. Quantitative Literacy is a significant component of this course.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and (MA 125 [Min Grade: C] and PH 221 [Min Grade: C] and EE 314 [Min Grade: C]) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

EE 316L. Electrical Networks Laboratory. 0 Hours.
Electrical Networks laboratory component. EE 316 must be taken concurrently.

EE 318. Signals and Systems. 3 Hours.
Time-domain and frequency-domain methods for modeling and analyzing continuous and discrete-time signals and systems. Fourier, Laplace, and Z transform methods.
Prerequisites: EE 300 [Min Grade: D] and EE 316 [Min Grade: C]

EE 333. Engineering Programming Using Objects. 3 Hours.
Software development emphasizing object-oriented methods. Design and develop programs using existing classes and newly created classes. A graphical user interface framework will be used as extensive example of Object Oriented System. Develop skills in project management, written and oral communication, teams, and an introduction to ethics and intellectual property issues.
Prerequisites: EE 233 [Min Grade: D]

EE 337. Introduction to Microprocessors. 4 Hours.
Application of microcomputers to engineering problems such as data acquisition and control. Topics include CPU architecture, assembly language, and input/output interfacing. EE 337L must be taken concurrently.
Prerequisites: EE 210 [Min Grade: C] and EE 233 [Min Grade: D]

EE 337L. Introduction to Microprocessors Laboratory. 0 Hours.
Introduction to Microprocessors laboratory component. EE 337 must be taken concurrently.

EE 341. Electromagnetics. 3 Hours.
Mathematical techniques used to solve electromagnetics problems. Fundamental concepts and applications for dynamic and static problems. Electromagnetic wave propagation and transmission. Transmission lines.
Prerequisites: EE 300 [Min Grade: D](Can be taken Concurrently) and EE 316 [Min Grade: C]

EE 351. Electronics. 4 Hours.
Solid-state electronics, bipolar junction and field-effect transistor (FET) properties, biasing, frequency response, single and multistage amplifier circuits. EE 351L must be taken concurrently.
Prerequisites: EE 210 [Min Grade: C] and EE 316 [Min Grade: C]
**EE 351L. Electronics Laboratory. 0 Hours.**
Electronics laboratory component. EE 351 must be taken concurrently.

**EE 361. Machinery I. 4 Hours.**
Fundamentals and applications of polyphase circuits, magnetic circuits, transformers, polyphase synchronous and asynchronous machines. EE 361L must be taken concurrently.
**Prerequisites:** EE 316 [Min Grade: C] and PH 222 [Min Grade: D] or EE 351 [Min Grade: D] and (EGR 150 [Min Grade: C] or EE 134 [Min Grade: D])

**EE 361L. Machinery I Laboratory. 0 Hours.**
Machinery I laboratory component. EE 361 must be taken concurrently.

**EE 412. Practical Computer Vision. 3 Hours.**
Fundamentals and applications of computer vision: image preprocessing, detection, segmentation, registration, classification and recognition, texture and color, visual tracking.
**Prerequisites:** EE 316 [Min Grade: C] and EE 318 [Min Grade: D]

**EE 418. Wireless Communications. 3 Hours.**
Wireless communication system topics such as propagation, modulation techniques, multiple access techniques, channel coding, speech and video coding, and wireless computer networks.
**Prerequisites:** EE 316 [Min Grade: D]

**EE 421. Communication Systems. 3 Hours.**
**Prerequisites:** EE 318 [Min Grade: D]

**EE 423. Digital Signal Processing. 3 Hours.**
Digital filter analysis and design. FFT algorithms. Applications of digital signal processing in engineering problems such as data acquisition and control. Lecture and computer laboratory.
**Prerequisites:** EE 318 [Min Grade: D]

**EE 426. Control Systems. 3 Hours.**
**Prerequisites:** EE 318 [Min Grade: D]

**EE 427. Controls and Automation. 3 Hours.**
Power control devices and applications. Relay logic and translation to other forms. Programmable logic controllers. Proportional-integral-derivative and other methods for process control. Modern laboratory instrumentation and man-machine interface software. Lecture and laboratory.
**Prerequisites:** EE 233 [Min Grade: D] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D] and (EE 351 [Min Grade: D] and EE 351 [Min Grade: C] or EE 130 [Min Grade: C] or EE 318 [Min Grade: D] or EE 318 [Min Grade: D] or EE 318 [Min Grade: D])

**EE 431. Analog Integrated Electronics. 4 Hours.**
Advanced analysis and design using op-amps, with emphasis on error analysis and compensation. Applications include signal conditioning for instrumentation, instrumentation amplifiers, nonlinear and computational circuits. Butterworth and Chebyshev filter design, power amplifier design, voltage regulator design, and oscillators. A-to-D and D-to-A conversion methods. Laboratory exercises emphasize design techniques. Lecture and laboratory.
**Prerequisites:** EE 210 [Min Grade: C] and EE 318 [Min Grade: D] (Can be taken Concurrently) and EE 351 [Min Grade: D]

**EE 432. Introduction to Computer Networking. 3 Hours.**
Computer networking and engineering standards related to networking. Networking hardware, software, and protocols including TCP/IP protocol suite. Internetworking, LANS, and typical applications.
**Prerequisites:** EE 233 [Min Grade: D]

**EE 433. Engineering Software Solutions. 3 Hours.**
Project planning, specification, design, implementation, and testing of software solutions for engineers. Waterfall model of development and agile development methods. Lecture and computer laboratory.
**Prerequisites:** EE 233 [Min Grade: D] and EE 333 [Min Grade: D] and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C] or EE 130 [Min Grade: C] or ME 130 [Min Grade: C] or ME 130 [Min Grade: C] or EE 134 [Min Grade: C])

**EE 434. Power Semiconductor Electronics. 3 Hours.**
Fundamentals of integrated circuit design for radio-frequency and power converter circuits. Course contents include basics of RF circuit theory, matching networks, high frequency MOS model, low-noise-amplifier, voltage controlled oscillator, fundamentals of power electronics, power semiconductor switches, steady-state equivalent circuit modeling, DC transformer model, basic AC equivalent circuit modeling, linearization and perturbation, etc. Students will require accomplishing a computer aided design, simulation and chip layout of an integrated circuit design project.
**Prerequisites:** EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D]

**EE 437. Introduction to Embedded Systems. 3 Hours.**
Applications of microprocessors in engineering problems such as data acquisition, control, and real-time input/output. Lecture and laboratory.
**Prerequisites:** (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C] or EE 130 [Min Grade: C] or ME 130 [Min Grade: C] or EE 210 [Min Grade: C] and EE 233 [Min Grade: C] and EE 337 [Min Grade: D])

**EE 438. Computer Architecture. 3 Hours.**
Advanced microprocessor topics including cache design, pipelining, superscalar architecture, design of control units, microcoding, and parallel processors. Comparison of advanced, contemporary microprocessors from Intel and IBM. EE 337 (Introduction to Microprocessors) is a recommended prerequisite for this course.
**Prerequisites:** EE 210 [Min Grade: C] and EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

**EE 444. Real-Time Process & Protocols. 3 Hours.**
Hands-on laboratory course covering topics in real-time computer systems such as algorithms, state-machine implementations, communication protocols, instrumentation, and hardware interfaces.
**Prerequisites:** EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

**EE 447. Internet/Intranet Application Development. 3 Hours.**
Development of models and applications using Internet/Intranet technologies such as JavaScript, Dynamic HTML, server side scripting, multi-tier models, and XML. Lecture and computer laboratory.
**Prerequisites:** EE 233 [Min Grade: D]

**EE 448. Software Engineering Projects. 3 Hours.**
Object-oriented concepts and design. Unified Modeling Language and design patterns. Provides a project environment for implementation of systems using object-oriented techniques. Lecture and computer laboratory.
**Prerequisites:** EE 233 [Min Grade: D] and EE 333 [Min Grade: D]

**EE 452. Digital Systems Design. 3 Hours.**
Digital system design, verification, and simulation using VHDL. Lecture and laboratory.
**Prerequisites:** EE 337 [Min Grade: D]
EE 458. Medical Instrumentation. 3 Hours.
Fundamental operating principles, applications, and design of electronic instrumentation used in measurement of physiological parameters.
Prerequisites: EE 351 [Min Grade: D]

EE 461. Machinery II. 3 Hours.
Physical principles of DC machines. Mathematical analysis of generator designs using equivalent circuits and magnetization curves. Calculation of motor speed, torque, power, efficiency, and starting requirements. Solid-state speed control systems.
Prerequisites: EE 361 [Min Grade: D]

EE 471. Power Systems I. 3 Hours.
Components of power systems. Performance of modern interconnected power systems under normal and abnormal conditions. Calculation of inductive and capacitive reactances of three-phase transmission lines in steady state.
Prerequisites: EE 361 [Min Grade: D]

EE 472. Power Systems II. 3 Hours.
Prerequisites: EE 471 [Min Grade: D]

EE 473. Protective Relaying of Power Systems. 3 Hours.
Operating principles of protective relays. Protection of transmission lines, generators, motors, transformers, and buses.
Prerequisites: EE 361 [Min Grade: D]

EE 485. Engineering Operations. 3 Hours.
Economic, procedural, planning, and control aspects of engineering projects. Ethics and Civic Responsibility are significant components of this course.
Prerequisites: (EGR 111 [Min Grade: C] or EGR 200 [Min Grade: C]) and EE 210 [Min Grade: C] and (EE 314 [Min Grade: C] or EE 312 [Min Grade: C])

EE 489. Undergraduate Engineering Research. 0 Hours.
Undergraduate research experiences in electrical engineering.
Prerequisites: PH 221 [Min Grade: C] [Can be taken Concurrently] or (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C]) or EGR 200 [Min Grade: C] or EGR 100 [Min Grade: C] or HC 111 [Min Grade: C]

EE 490. Special Topics in Electrical Engineering. 1-3 Hour.
Special Topic in Electrical Engineering.

EE 491. Individual Study in Electrical Engineering. 1-6 Hour.
Special Topic in Electrical Engineering.

EE 492. Honors Research I. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 301 [Min Grade: C] [Can be taken Concurrently]

EE 493. Honors Research II. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 301 [Min Grade: C]

EE 498. Team Design Project I. 3 Hours.
Senior Design Team Project Course Part I. Analysis and design of assigned team project, including design review and documentation. Must have an approved Application for Degree on file and must be in final year of his/her program.
Prerequisites: EE 318 [Min Grade: D] and EE 337 [Min Grade: D] and EE 485 [Min Grade: D] [Can be taken Concurrently] and EE 351 [Min Grade: D] [Can be taken Concurrently]

EE 499. Team Design Project II. 3 Hours.
Senior Design Team Project Course Part II. Capstone design project: design and implementation of assigned team project, including design review, demonstration, and documentation. Must have an approved Application for Degree on file and must be in final year of his/her program.
Prerequisites: EE 498 [Min Grade: D] and EE 333 [Min Grade: D] [Can be taken Concurrently] and EE 341 [Min Grade: D] [Can be taken Concurrently] and EE 361 [Min Grade: D] [Can be taken Concurrently] and EE 421 [Min Grade: D] [Can be taken Concurrently] and EE 426 [Min Grade: D] [Can be taken Concurrently] and EE 431 [Min Grade: D] [Can be taken Concurrently]

EGR-Engineering Courses

EGR 102. Engineering LLC Seminar. 0 Hours.
The Engineering Living Learning Community (LLC) is designed to strengthen students’ first year of college while fostering a sense of community. The living-learning community extends learning from the classroom into the residence hall where students participate in structured programs built around academics, common interests, and shared goals. This program will provide scholars with a solid foundation for the successful completion of an engineering degree. Programming within the LLC is a partnership between the Office of Student Housing and Residence Life and the UAB School of Engineering.

EGR 110. Introduction to Engineering I. 1 Hour.
Introduction to engineering as a profession, ethics and safety, engineering specialties, educational requirements, and team work; and present and future societal demands on profession. This is the first course in a two-course sequence for first-year students.
Prerequisites: MA 105 [Min Grade: C] [Can be taken Concurrently] or MA 106 [Min Grade: C] [Can be taken Concurrently] or MA 107 [Min Grade: C] [Can be taken Concurrently] or MA 125 [Min Grade: C] [Can be taken Concurrently] or MA 225 [Min Grade: C] [Can be taken Concurrently]

EGR 111. Introduction to Engineering II. 1 Hour.
Introduction to engineering specialties; career opportunities in engineering; introduction to engineering design, technical communication, and team work; and present and future societal demands on profession. This is the second course in a two-course sequence for first-year students.
Prerequisites: EGR 110 [Min Grade: C]
EGR 117. Engineering Innovation I: Design Thinking. 3 Hours.
Learn to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact. This project based course gives students the ability to understand, contextualize, and analyze engineering designs and systems. By learning and applying design thinking, students will more effectively solve problems in any domain. Lectures focus on teaching a tested, iterative design process as well as techniques to sharpen creative analysis. Guest lectures from all disciplines illustrate different approaches to design thinking. This course develops students' skills to conceive, organize, lead, implement, and evaluate successful projects in any engineering discipline. Additionally, students learn how to give compelling in-person presentations.
Prerequisites: MA 106 [Min Grade: C](Can be taken Concurrently) and EGR 110 [Min Grade: C]

EGR 125R. Engineering Applications of Calculus I. 0 Hours.
An application based course designed to reinforce concepts from MA 125.

EGR 126R. Engineering Applications of Calculus II. 0 Hours.
An application based course designed to reinforce concepts from MA 126.

EGR 150. Computer Methods in Engineering. 3 Hours.
An introduction to engineering computation using MATLAB language and Excel. Basic programming skills using built-in functions is emphasized. Generation and manipulation of vectors and matrices, operations on vectors/matrices, plotting, iterations calculations. If/else and other logical constructs, and data input/output are covered. Engineering applications are used throughout the course.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C])

EGR 200. Introduction to Engineering. 2 Hours.
Introduction to the profession of engineering, ethics and safety, engineering specialties, career opportunities, and educational requirements; introduction to engineering design, team work, and technical communication; and present and future societal demands on profession.
Prerequisites: (MA 102 [Min Grade: C] or MA 105 [Min Grade: C] (Can be taken Concurrently) or MA 106 [Min Grade: C] (Can be taken Concurrently) or MA 107 [Min Grade: C] (Can be taken Concurrently) or MA 125 [Min Grade: C] (Can be taken Concurrently) or MA 225 [Min Grade: C] (Can be taken Concurrently)

EGR 265. Math Tools for Engineering Problem Solving. 4 Hours.
Designed to allow engineering majors to utilize the terminology and problem-solving approaches inherent to engineering, while completing their mathematical preparation.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

EGR 301. Honors Research I. 1 Hour.
Introduces students to research methodology, ethics, data analysis, and technical communication. Students must be invited into program in order to enroll.
Prerequisites: (MA 227 [Min Grade: C] or EGR 265 [Min Grade: C])

EGR 317. Engineering Innovation III: Project Lab. 3 Hours.
Student teams engineer devices based on client needs. The project team will collaborate with the client to establish an appropriate engineering design to meet user needs. Students are trained in product development, product design, engineering validation and will develop training and documentation market analysis, business plan and a go-to-market strategy as appropriate for the project.
Prerequisites: EGR 217 [Min Grade: C] and (EGR 265 [Min Grade: C] or MA 227 [Min Grade: C]) and CE 210 [Min Grade: C]

EGR 481. Interdisciplinary Project Lab. 3 Hours.
Multidisciplinary student teams (engineering, business, arts) engineer devices based on client needs. The project team will collaborate with the client to establish an appropriate engineering design to meet user needs. Students are trained in product development, product design, engineering validation and will develop training and documentation market analysis, business plan and a go-to-market strategy as appropriate for the project.
Prerequisites: (ME 102 [Min Grade: C] and CE 210 [Min Grade: C] and EE 312 [Min Grade: C] or CE 360 [Min Grade: C] or EE 337 [Min Grade: D] and EE 351 [Min Grade: D]) or (ME 322 [Min Grade: C] and ME 371 [Min Grade: C]) or MSE 281 [Min Grade: D]

EGR 490. Special Topics in Engineering. 1-3 Hour.
Special Topics in Engineering.

EGR 491. Individual Study in Engineering. 1-6 Hour.
Individual Study in Engineering.

ME-Mechanical Engineering Courses

ME 011. Coop/Internship in ME. 0 Hours.
Engineering workplace experience in preparation for the student's intended career.

ME 102. Engineering Graphics. 2 Hours.
Basic concepts in technical sketching, computer-aided drawing and design, projections, sections, and dimensioning.
Prerequisites: MA 105 [Min Grade: C](Can be taken Concurrently) or MA 106 [Min Grade: C](Can be taken Concurrently) or MA 107 [Min Grade: C](Can be taken Concurrently) or MA 125 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C]

ME 103. Drawing, Design and Measurement for Industrial Distribution. 3 Hours.
Technical sketching and reading of engineering drawings and analysis of systems involving human performance. For non-engineering majors. Not available for credit toward engineering major.

ME 215. Dynamics. 3 Hours.
Prerequisites: CE 210 [Min Grade: C]

ME 215R. Dynamics Recitation. 0 Hours.
An application-based course designed to reinforce concepts from ME 215.

ME 241. Thermodynamics I. 3 Hours.
Thermodynamic definitions, properties of a pure substance, ideal, and real gases, work, and heat. Fundamental laws of thermodynamics, entropy, reversible cycles, and irreversibility.
Prerequisites: PH 221 [Min Grade: C] and CH 115 [Min Grade: C] and (CH 116 [Min Grade: C] or CH 114 [Min Grade: C]) and MA 126 [Min Grade: C] (Can be taken Concurrently) or MA 226 [Min Grade: C] (Can be taken Concurrently)

ME 241R. Thermodynamics Recitation. 0 Hours.
An application-based course designed to reinforce concepts from ME 241.
ME 242. Thermodynamics II. 3 Hours.
Application of thermodynamic principles to engineering systems; vapor
power cycles; gas turbine cycles; Otto and Diesel cycles; refrigeration
cycles; mixtures of ideal gases; psychrometrics.
**Prerequisites:** ME 241 [Min Grade: C] and (BME 150 [Min Grade: C] or
EGR 150 [Min Grade: C])

ME 251. Introduction to Thermal Sciences. 2 Hours.
Introduction to thermodynamics and heat transfer for non-mechanical
engineering majors.
**Prerequisites:** (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and
PH 221 [Min Grade: C]

ME 302. Overview of Mechanical Components. 3 Hours.
An introduction to statics, dynamics, strength of materials, and
engineering design. Transformation of energy, thermodynamics, heat
transfer, and fluid mechanics. For non-engineering majors. Not available
for credit toward engineering major.

ME 321. Introduction to Fluid Mechanics. 3 Hours.
Fluid properties, fluid statics, fluid in motion (control volume method),
pressure variation in flowing fluids (Bernoulli equation), principles of
momentum and energy transport, dimensional analysis and similitude,
internal flow and external flow.
**Prerequisites:** ME 241 [Min Grade: C] and (MA 227 [Min Grade: C] and
MA 252 [Min Grade: C] or EGR 265 [Min Grade: C]) and CE 210 [Min
Grade: C] and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

ME 322. Introduction to Heat Transfer. 3 Hours.
Fundamentals of heat transfer and their application to practical problems,
including steady and transient heat conduction, external and internal
forced convection, natural convection and radiation.
**Prerequisites:** ME 321 [Min Grade: C]

ME 360. Introduction to Mechatronic Systems Engineering. 3 Hours.
Control systems, feedback, and transfer function concepts. Laplace
transform of mechatronic systems. Stability, steady state, and transient
response. Systems modeling and analysis in time and frequency domain.
Root locus and Nyquist Bode plots. Actuators, sensors, and controllers
for various engineering applications. Fundamentals of mechanical and
electrical/electronic component integration with controls and mechatronic
system design.
**Prerequisites:** ME 215 [Min Grade: C] and ME 364 [Min Grade: C]

ME 361. Thermo-Fluids Systems. 3 Hours.
Pressure, temperature, fluid flow, and heat transfer instrumentation
and their application to measurements of mass, heat, and momentum
transport, flow characterization, heat engine and refrigeration cycles,
and other thermal-fluids experiments. Experimental uncertainty analysis.
Writing proficiency is required. ME 361L must be taken concurrently.
**Prerequisites:** ME 242 [Min Grade: C](Can be taken Concurrently) and
ME 322 [Min Grade: C](Can be taken Concurrently)

ME 361L. Thermo-Fluids Systems Laboratory. 0 Hours.
Lab component for ME 361 Thermo-Fluids Systems. ME 361 must be
taken concurrently.

ME 364. Linear Algebra and Numerical Methods. 3 Hours.
Linear equations and matrices, real vector bases, matrix decompositions,
linear transformations; determinants; eigenvalues, eigenvectors;
 numerical methods for linear systems of equations, integration, ordinary
differential equations; approximation, interpolation, least squares fits.
**Prerequisites:** (MA 227 [Min Grade: C] and MA 252 [Min Grade: C] or
EGR 265 [Min Grade: C]) and (BME 150 [Min Grade: C] or EGR 150 [Min
Grade: C])

ME 370. Kinematics and Dynamics of Machinery. 3 Hours.
Displacement, velocity and acceleration analysis, synthesis and design
of linkages and mechanisms for various engineering applications on
the basis of motion requirements. Static and dynamic force analysis of
linkages, balancing of rotors and reciprocating machines. Significant
consideration is given to designing geometry of gear sets: spur, helical,
worm, and bevel gears. Analysis of planetary gear sets and drivetrains
completes the course. Computer workshops support the learning process
of main technical components.
**Prerequisites:** ME 102 [Min Grade: C] and ME 215 [Min Grade: C]

ME 371. Machine Design. 3 Hours.
Body stress, deflection and fatigue strength of machine components.
Failure theories, safety factors and reliability, surface damage.
Application to the design of gears, shafts, bearings, welded joints,
threaded fasteners, belts and chains, keys, pins, springs, as well as
mechanical design and selection of other machine components. Software
applications, design projects, and exposure to hardware and systems are
used to reinforce concepts.
**Prerequisites:** CE 220 [Min Grade: C] and (BME 150 [Min Grade: C] or
EGR 150 [Min Grade: C]) and ME 215 [Min Grade: C]

ME 411. Intermediate Fluid Mechanics. 3 Hours.
Applications of fluid dynamic principles to engineering flow problems
such as turbo-machinery flow and one-dimensional compressible flow.
Vorticity, potential flow, viscous flow, Navier-Stokes solutions, and
boundary layers.
**Prerequisites:** ME 321 [Min Grade: C] and ME 364 [Min Grade: C]

ME 421. Introduction to Computational Fluid Dynamics Basics. 3
Hours.
Governing equations for fluid flows, classifications of flow regimes, and
approaches to analyze fluid flow problems. Introduction to Computational
Fluid Dynamics (CFD), mesh generation, boundary conditions, numerical
solution of equations governing fluid flows, and visualization. Hands-on
exercises using a commercial CFD solver.
**Prerequisites:** ME 321 [Min Grade: C]

ME 430. Vehicular Dynamics. 3 Hours.
Introduction to the fundamentals of mechanics and analytical methods
for modeling vehicle dynamics and performance. Topics include tire-
road interaction modeling, vehicle longitudinal dynamics and traction
performance, lateral dynamics, handling, stability of motion and rollover,
as well as contribution of the drivetrain system, steering system and
suspension configurations to the dynamics of a vehicle. Software
applications, projects, and exposure to hardware and systems are used
to reinforce concepts.
**Prerequisites:** ME 215 [Min Grade: C]

ME 431. Introduction to Vehicle Drive Systems Engineering. 3 Hours.
Engineering fundamentals of mechanical and mechatronic, hybrid-
electric, and electric drive systems. Applications to passenger cars and
commercial vehicles. Drive system and component design, including
main clutches and torque converters, transmissions, transfer cases, and
drive axles. Introduction to plug-in hybrid-electric vehicles.
**Prerequisites:** ME 215 [Min Grade: C] and ME 370 [Min Grade: C](Can
be taken Concurrently)

ME 432. Introduction to Electric Vehicles. 3 Hours.
Introduction to fully electric and hybrid vehicle engineering. Mechatronic
system and component design. Batteries and energy storage devices.
Plug-in hybrid electric vehicles.
**Prerequisites:** ME 215 [Min Grade: C] and ME 360 [Min Grade: C](Can
be taken Concurrently)
ME 445. Combustion. 3 Hours.
Evaluation of the impact of fuel characteristics and operating conditions on the performance of coal-fired electric utility steam-raising plant and the prospects for continued reliance on coal as fuel for electric power generation. The phenomena emphasized are the behavior of turbulent jets; ignition, devolatilization and combustion of coal particles; radiative heat transfer and the effect of ash deposits on heat transfer; formation of air pollutants and their removal from combustion products; integrated gasification combined cycle; and capture and sequestration of carbon dioxide.
Prerequisites: ME 242 [Min Grade: C] and ME 322 [Min Grade: C]

ME 447. Internal Combustion Engines. 3 Hours.
Fundamentals of reciprocating internal combustion engines: engine types, engine components, engine design and operating parameters, thermochemistry of fuel-air mixtures, properties of working fluids, ideal models of engine cycles, engine operating characteristics, gas-exchange processes, fuel metering, charge motion within the cylinder, combustion in spark-ignition and compression ignition engines.
Prerequisites: ME 215 [Min Grade: C] and ME 242 [Min Grade: C]

ME 448. Internal Combustion Engines. 3 Hours.
Fundamentals of reciprocating internal combustion engines: engine types, engine components, engine design and operating parameters, thermochemistry of fuel-air mixtures, properties of working fluids, ideal models of engine cycles, engine operating characteristics, gas-exchange processes, fuel metering, charge motion within the cylinder, combustion in spark-ignition and compression ignition engines. Software applications, projects, and exposure to hardware and systems are used to reinforce concepts.
Prerequisites: ME 215 [Min Grade: C] and ME 242 [Min Grade: C]

ME 449. Power Generation. 3 Hours.
Application of thermodynamics, fluid mechanics, and heat transfer to conversion of useful energy. Includes terrestrial and thermodynamic limitations, fossil fuel power plants, renewable energy sources, and direct energy conversion.
Prerequisites: ME 242 [Min Grade: C]

ME 454. Heating, Ventilating and Air Conditioning. 3 Hours.
Fundamentals and practice associated with heating, ventilating, and air conditioning; study of heat and moisture flow in structures, energy consumption, and design of practical systems.
Prerequisites: ME 322 [Min Grade: C]

ME 455. Thermal-Fluid Systems Design. 3 Hours.
Comprehensive design problems requiring engineering decisions and code/Standard compliance. Emphasis on energy system components: piping networks, pumps, heat exchangers. Includes fluid transients and system modeling.
Prerequisites: ME 322 [Min Grade: C]

ME 456. Building Energy Modeling and Analysis. 3 Hours.
Computer modeling of energy use and thermal comfort in buildings using several software tools. Interpretation and analysis of the results. Implementing energy efficiency measures in the model and studying the effects on energy use.
Prerequisites: ME 242 [Min Grade: C] and ME 322 [Min Grade: C]

ME 461. Mechanical Systems. 3 Hours.
This course concentrates on main technical principles and aspects of mechanical systems design. The course also provides fundamental knowledge on test equipment and experimental techniques for experimenting on main technical principles of mechanical design. This course discusses data acquisition systems and signal conditioning, and design of experiments. Writing proficiency is required. ME 461L must be taken concurrently.
Prerequisites: CE 220 [Min Grade: C] and ME 215 [Min Grade: C]

ME 461L. Mechanical Systems Laboratory. 0 Hours.
Lab Component of ME 461 Mechanical Systems. ME 461 must be taken concurrently.

ME 464. Introduction to Finite Element Method. 3 Hours.
Prerequisites: CE 220 [Min Grade: C]

ME 470. Introduction to Continuum Mechanics. 3 Hours.
Fundamentals and application of mechanics principles to problems in continuous media. Matrix and tensor mathematics, fundamentals of stress, kinematics and deformation of motion, conservation equations, constitutive equations and invariance, linear and nonlinear elasticity, classical fluids, linear viscoelasticity.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and CE 220 [Min Grade: C]

ME 475. Mechanical Vibrations. 3 Hours.
Prerequisites: (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) or EGR 265 [Min Grade: C] and ME 215 [Min Grade: C]

ME 477. Systems Engineering. 3 Hours.
Exposure to the field of systems engineering, mission design, requirements development, trade studies, project life cycle, system hierarchy, risk analysis, cost analysis, team organization, design fundamentals, work ethics, compare and evaluate engineering alternatives, systems thinking.

ME 478. Automated Manufacturing. 3 Hours.
Introduction to automated manufacturing technology. Components of automated systems (controllers, sensors and actuators) and automated manufacturing sub-systems (3D printer, CNC, robot and computer vision) will be studied in a lecture/lab environment with hands on activities.
Prerequisites: ME 102 [Min Grade: C] and EGR 150 [Min Grade: C]

ME 480. Instrumentation and Measurements. 3 Hours.
Through exploration of fundamental measurement concepts and techniques for data acquisition and validation. Explanation of important selection criteria for the identification and configuration of commercially available data acquisition devices. Students will get hands-on experience following best practices for data acquisition (high speed vs low speed) relevant to their field of study or career. Many types of sensors, their underlying technology, and measurement techniques will be discussed (i.e. accelerometers, load cells, Digital Image Correlation, etc.) to demonstrate best practices for sensor selection for a wide range of specialized applications.
ME 489. Undergraduate Research in Mechanical Engineering. 0 Hours.
Undergraduate research experiences in mechanical engineering.
**Prerequisites:** (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C] or EGR 100 [Min Grade: C] or EGR 200 [Min Grade: C] or HC 111) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C](Can be taken Concurrently)

**ME 490. Special Topics in Mechanical Engineering. 1-3 Hour.**
Special Topics in Mechanical Engineering.

**ME 491. Individual Study in Mechanical Engineering. 1-6 Hour.**
Individual Study in Mechanical Engineering.

**ME 494. Mechanical Engineering Seminar. 1 Hour.**
Required for ME undergraduate Honors Program students. Presentations by students, faculty, and guests regarding current research.

**ME 496. Honors Research. 1-6 Hour.**
Research opportunities for undergraduate students in the Mechanical Engineering Honors Program.
**Prerequisites:** EGR 301 [Min Grade: C]

**ME 498. Capstone Design Project I. 3 Hours.**
Capstone design project: interdisciplinary design teams, ethics, materials selection, design process, development of proposal, project planning and scheduling, project execution and resource scheduling, and communication of design.
**Prerequisites:** (ME 322 [Min Grade: C] and ME 360 [Min Grade: C]) or (ME 322 [Min Grade: C] and ME 370 [Min Grade: C]) or (ME 322 [Min Grade: C] and ME 371 [Min Grade: C]) or (ME 360 [Min Grade: C] and ME 370 [Min Grade: C]) or (ME 360 [Min Grade: C] and ME 371 [Min Grade: C]) or (ME 370 [Min Grade: C] and ME 371 [Min Grade: C]) or (ME 401 [Min Grade: C]) (Can be taken Concurrently) or ME 405 [Min Grade: C] (Can be taken Concurrently)

**ME 499. Capstone Design Project II. 3 Hours.**
Continuation of ME 498. Capstone interim and final design reviews with written and oral reports. ME 498 must be taken the term immediately before ME 499.
**Prerequisites:** (ME 322 [Min Grade: C] or ME 360 [Min Grade: C] or ME 370 [Min Grade: C] or ME 371 [Min Grade: C]) and (ME 322 [Min Grade: C] or ME 360 [Min Grade: C] or ME 370 [Min Grade: C] or ME 371 [Min Grade: C]) and (ME 322 [Min Grade: C] or ME 360 [Min Grade: C] or ME 370 [Min Grade: C] or ME 371 [Min Grade: C]) and (ME 401 [Min Grade: C] or ME 371 [Min Grade: C]) and ME 498 [Min Grade: C]

**MSE-Material Science Egr Courses**

**MSE 011. Coop/Internship in MSE. 0 Hours.**
Engineering workplace experience in preparation for the student's intended career.

**MSE 280. Engineering Materials. 3 Hours.**
Fundamentals of materials engineering, including terminology, mechanical testing and behavior, heat treating, and processing of metals, ceramics, polymers, and composites. Degradation of materials and criteria for materials selection. Course requires completion of 4 credits of Area III Science.

**MSE 281. Physical Materials I. 4 Hours.**
Structure of metals, ceramics and polymers; crystal bonding; phase diagrams, diffusion, dislocations and grain boundaries. Applications to the iron-carbon system, including heat treatment. MSE 281L must be taken concurrently.
**Prerequisites:** (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and MSE 280 [Min Grade: D]

**MSE 281L. Physical Materials I Laboratory. 0 Hours.**
Laboratory component of MSE 281 and must be taken concurrently with MSE 281.

**MSE 350. Introduction to Materials. 3 Hours.**
Concepts and applications, crystal structure of materials, formation of microstructures, and selected structure-property relationships. Not available for credit toward engineering major. For non-engineering majors only.

**MSE 380. Thermodynamics of Materials. 3 Hours.**
First, second, and third laws of thermodynamics. Gibbs free energy, heat capacity, enthalpy, entropy, and relationships between thermodynamic functions. Free-energy versus composition relationships; behavior of ideal and non-ideal solutions; concept of thermodynamic activity of components in solution. Applications to materials systems.
**Prerequisites:** CH 117 [Min Grade: D] and CH 118 [Min Grade: D] and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and MSE 280 [Min Grade: D]

**MSE 381. Physical Materials II. 3 Hours.**
Microstructural changes in response to temperature and time; vacancies, annealing, diffusion, nucleation and growth kinetics. Equilibrium and non-equilibrium microstructures. Applications to precipitation hardening and solidification of metals.
**Prerequisites:** MSE 281 [Min Grade: D]

**MSE 382. Mechanical Behavior of Materials. 3 Hours.**
Microscopic deformation mechanisms in materials leading to macroscopic properties of fatigue; creep; ductile, transitional, and brittle fracture; friction; and wear. CE 220 (Mechanics of Solids) is recommended as a prerequisite for this course.
**Prerequisites:** MSE 281 [Min Grade: D]

**MSE 401. Materials Processing. 3 Hours.**
Processing of metals, glasses, ceramics, and composites. Powder processing, casting, welding, rapid solidification, and other advanced methods. Ethics and Civic Responsibility are significant components of this course.
**Prerequisites:** MSE 280 [Min Grade: D] and CE 220 [Min Grade: D]

**MSE 405. Frontiers of Automotive Materials. 3 Hours.**
Advanced lightweight automotive materials, manufacturing and modeling techniques. Technology advancements in cost-effective carbon, glass and related reinforcements; "green" and sustainable materials, crashworthiness and injury protection of occupants and pedestrians, metal castings, heavy truck, mass transit, fuel cell and hybrid vehicles. Students taking this class will receive a GATE certificate of training in automotive materials technologies upon successful completion.
**Prerequisites:** MSE 281 [Min Grade: D]

**MSE 408. Nanobiomaterials. 3 Hours.**
Basic tools of nanotechnology, building blocks of nanostructured materials. Behavior of materials with nanoscale structures and their technological applications, including automotive, medical, and electronic applications. Introduction to biomaterials and nanobiomaterials. Concepts in tissue engineering with special focus on nanoscaffolds and nanoparticles in drug delivery.
**Prerequisites:** MSE 280 [Min Grade: D]
MSE 409. Principles of Metal Casting. 3 Hours.
Production and evaluation of cast ferrous metals (gray iron, ductile iron, steel) and non-ferrous metals (brass, bronze, aluminum). Design of castings and molds. Laboratory on the gating, risering and molten metal treatment, analysis and handling techniques required to produce high quality castings. MSE 409L must be taken concurrently.
Prerequisites: MSE 280 [Min Grade: D]

MSE 409L. Principles of Metal Casting Laboratory. 0 Hours.
Laboratory component of MSE 409 and must be taken concurrently with MSE 409.

MSE 413. Composite Materials. 3 Hours.
Processing, structure, and properties of metal-, ceramic-, and polymer-matrix composite materials. Roles of interfacial bond strength, reinforcement type and orientation, and matrix selection in physical and mechanical properties of composite materials. MSE 382 (Mechanical Behavior of Materials) is recommended as a prerequisite for this course. Writing is a significant component of this course.
Prerequisites: MSE 281 [Min Grade: D]

MSE 425. Statistics and Quality. 3 Hours.
This course is arranged to reflect the sequential steps an engineer or scientist take to assess process capability and implement process improvement studies. There is a focus on connecting the theoretical equations to practical examples as well as interpreting and communicating of statistical results.
Prerequisites: MSE 281 [Min Grade: D]

MSE 430. Polymeric Materials. 3 Hours.
Processing methods, structure/engineering/property relationships, and applications of polymeric materials.
Prerequisites: MSE 281 [Min Grade: D] and CH 117 [Min Grade: D] and CH 118 [Min Grade: D]

MSE 430L. Polymeric Materials Laboratory. 0 Hours.
Laboratory component of MSE 430 and must be taken concurrently with MSE 430.

MSE 433. Nondestructive Evaluation of Materials. 3 Hours.
Principles, applications, and limitation of ultrasonic vibrations, acoustic emission, radiographic, magnetic particle, eddy current, and other nondestructive testing methods. Intelligent sensors and health monitoring of real structures.
Prerequisites: MSE 281 [Min Grade: D]

MSE 445. The Evolution of Engineering Materials. 3 Hours.
Past, present and future of engineering materials; how new materials and processing methods have impacted human society, from the Stone Age until today. Taught as a 3-week study abroad course in Germany, with visits to universities, industrial facilities, research labs, museums and selected cultural sites.
Prerequisites: MSE 280 [Min Grade: D]

MSE 462. Composites Manufacturing. 3 Hours.
Principles of manufacturing and processing of polymeric matrix composites. Production techniques including filament winding, pultrusion, and liquid infusion techniques combined with design, environmental and manufacturing issues of polymer matrix composites.
Prerequisites: MSE 281 [Min Grade: D]

MSE 464. Metals and Alloys. 4 Hours.
Microstructures, properties, heat treatment, and processing of ferrous and nonferrous materials.
Prerequisites: MSE 281 [Min Grade: D]

MSE 464L. Metals and Alloys Laboratory. 0 Hours.
Laboratory component of MSE 464 and must be taken concurrently with MSE 464.

MSE 465. Characterization of Materials. 4 Hours.
Theory and practice of materials characterization, with emphasis on optical metallography, quantitative metallography, scanning electron microscopy, crystallography, and x-ray diffraction. Specific applications in metals and ceramics considered. MSE 465L must be taken concurrently.
Prerequisites: MSE 281 [Min Grade: D]

MSE 465L. Characterization of Materials Laboratory. 0 Hours.
Laboratory component of MSE 465 and must be taken with MSE 465.

MSE 470. Ceramic Materials. 4 Hours.
Structure, processing, properties, and uses of ceramic compounds and glasses. Mechanical, thermal, and electrical behavior of ceramic materials in terms of microstructure and processing variables.
Prerequisites: MSE 281 [Min Grade: D] and CH 117 [Min Grade: D] and CH 118 [Min Grade: D]

MSE 470L. Ceramic Materials Laboratory. 0 Hours.
Laboratory component of MSE 470 and must be taken concurrently with MSE 470.

MSE 474. Metals and Alloys II. 3 Hours.
Production and physical metallurgy of ferrous and non-ferrous alloys including: steel alloys, inoculation and production of ductile, gray, compacted and malleable iron; advanced heat treatments of steel and iron; conventional and ultra-high strength aluminum alloys; wrought and cast copper alloys; wrought and cast magnesium alloys.
Prerequisites: MSE 281 [Min Grade: D] and MSE 464 [Min Grade: D]

MSE 489. Undergraduate Research in MSE. 0 Hours.
Undergraduate research experiences in materials science and/or engineering.
Prerequisites: (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C]) or EGR 200 [Min Grade: C] or HC 111 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C](Can be taken Concurrently)

MSE 490. Special Topics in Materials Engineering. 1-6 Hour.
Special Topics in Materials Engineering.

MSE 491. Individual Study in Materials Engineering. 1-6 Hour.
Individual Study in Materials Engineering.

MSE 496. MSE Honors Seminar. 1 Hour.
Research presentations by faculty, students, and invited guests on topics related to Materials Science and Engineering.

MSE 497. MSE Honors Research. 2-6 Hours.
Honor students develop materials engineering research skills by working closely with faculty and graduate students.
Prerequisites: EGR 301 [Min Grade: C](Can be taken Concurrently)

MSE 498. Capstone Design Project I. 3 Hours.
Capstone design project: interdisciplinary design teams, ethics, materials selection, design process, development of proposal, project planning and scheduling, project execution and resource scheduling, and communication of design. Writing is a significant component of this course.
Prerequisites: MSE 401 [Min Grade: D](Can be taken Concurrently) or ME 405 [Min Grade: D](Can be taken Concurrently)
MSE 499. Capstone Design Project II. 3 Hours.
Continuation of MSE 498 which must be taken in the previous term.
Interim and final design reviews with written and oral reports. Writing is a
significant component of this course.
Prerequisites: MSE 498 [Min Grade: D]