School of Engineering

Dean: J. Iwan Alexander  
Senior Associate Dean: Timothy M. Wick  
Associate Dean for Undergraduate Programs: Zoe B. Dwyer

The School of Engineering provides professional education in engineering through the Departments of Biomedical Engineering; Civil, Construction, and Environmental Engineering; Electrical and Computer Engineering; Materials Science and Engineering; and Mechanical Engineering. The School of Engineering offers programs of study leading to Bachelor of Science in Biomedical Engineering, Bachelor of Science in Civil Engineering, Bachelor of Science in Electrical Engineering, Bachelor of Science in Materials Engineering, and Bachelor of Science in Mechanical Engineering. All undergraduate programs are accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org.

Each undergraduate curriculum is comprised of four components: the UAB Core Curriculum as specified for engineering majors; basic mathematics and science courses; a series of engineering courses intended to provide a breadth of technical education; and concentrated study in a particular engineering discipline. The curricula are designed to prepare the graduate to practice the profession of engineering and effectively participate as a member of society. Additionally the School of Engineering participates in UABTeach (https://www.uab.edu/uabteach). For more information, see the UABTeach (https://www.uab.edu/uabteach) website at www.uab.edu/uabteach/

At the graduate level, the School of Engineering offers programs of study leading to the Master of Science in Biomedical Engineering, the Master of Science in Civil Engineering, the Master of Science in Electrical Engineering, the Master of Science in Materials Engineering, and the Master of Science in Mechanical Engineering. A Master of Engineering degree is offered with concentrations in Construction Engineering Management, Information Engineering and Management, and Advanced Safety Engineering and Management. The Doctor of Philosophy degree in Biomedical Engineering and the Doctor of Philosophy degree in Interdisciplinary Engineering are also offered. Joint Doctor of Philosophy degrees are offered in Materials/Metallurgical Engineering, Materials Science, and Civil Engineering. A shared Doctor of Philosophy degree in Computer Engineering is available.

In order to keep pace with accreditation standards as well as educational and technological developments, the School of Engineering reserves the right to make changes in its degree requirements. Changes may be applied to students already enrolled; but, in such cases, every effort will be made to give the student the benefit of the new educational program without imposing undue hardships.

Vision

To be nationally and internationally recognized as a top research-oriented School of Engineering: a first choice for a quality undergraduate and graduate education.

Mission

To create and apply knowledge for the benefit of society, and to prepare engineering graduates to be immediately productive and able to adapt and to lead in a rapidly changing environment.

Goals

- Provide an excellent educational experience for a community of highly capable students that reflect the diversity of our society
- Develop an education and research program that fosters the development of a community of scholars capable of defining and solving problems to benefit society
- Develop an internationally recognized research program focused in distinctive multi-disciplinary areas
- Develop extensive and mutually beneficial relationships that foster understanding, respect, and a sense of common responsibility
- Provide an environment where faculty and staff can achieve their full potential for the mutual benefit of the School and the individual

School of Engineering Office of Academic Programs

UAB School of Engineering • Hoehn Engineering Building • 1075 13th Street South Suite 101 • Birmingham, Alabama 35294-4440 • Telephone: (205) 934-8410 • Email: enginfo@uab.edu (info@uab.edu)

UAB Admissions Office

1701 11th Ave South• Birmingham, Alabama 35294-1150 • Telephone: (205) 934-8221 • Email: chooseuab@uab.edu (undergradadmit@uab.edu)

Pre-college Preparation

The recommended program of high school preparation for the study of engineering includes four units of English; four units of mathematics (including algebra, geometry, trigonometry, and calculus); four units of science (biology, chemistry, and physics are strongly recommended); and four units of social science (history, psychology, sociology, etc.). Mechanical drawing, keyboarding, and computer science are also excellent preparatory courses.

Admission to the School of Engineering

In addition to satisfying the general requirements for admission to UAB listed in the Undergraduate Catalog, incoming students must be eligible to enroll in Pre-Calculus Algebra (MA 105) or higher in the pre-calculus series to be admitted to the School of Engineering. Students who do not satisfy this requirement but are still interested in an engineering program should successfully complete the course(s) necessary to satisfy the requirement(s) as an Undeclared - Interest in Engineering student in the University Academic Success Center and then request a major change.

All freshmen students who meet the requirement for admission to the School of Engineering are admitted as Pre-Biomedical, Pre-Civil, Pre-Electrical, Pre-Materials, or Pre-Mechanical Engineering major based on their intended program. Undecided students are admitted as Pre-General Engineering students. Freshmen indicating an interest in Biomedical Engineering with an ACT score of 28 or higher (or SAT equivalent) and a high school GPA of at least 3.20 may be admitted directly to the Biomedical Engineering program. Students admitted to UAB conditionally or on academic probation are not eligible for admission to the School of Engineering and may be admitted to an engineering program only upon successful completion of the requirements for advancement listed below.

In addition to math placement into Pre-Calculus Algebra (MA 105) or higher, all transfer students or students seeking re-admission to UAB must have a cumulative GPA of 2.20 and, if applicable, an institutional
(UAB) GPA of 2.20 to be admitted to the School of Engineering. These students are admitted as Pre-Civil, Pre-Electrical, Pre-Materials, or Pre-Mechanical Engineering majors based on their intended program. Students seeking admission to Biomedical Engineering are admitted to Pre-Biomedical Engineering if they have a cumulative GPA of 3.20 and, if applicable, an institutional (UAB) GPA of 3.20. Transfer and returning students receive a Pre-Engineering designation for a minimum of one semester following admission to UAB and are then admitted to their chosen department upon completion of the minimum requirements listed below.

Students who are seeking admission to the School of Engineering and are currently enrolled in other UAB schools or divisions must have an institutional (UAB) GPA of 2.20 (3.20 for Pre-Biomedical) or greater and must be eligible to enroll in Pre-Calculus Algebra (MA 105) or higher in the pre-calculus series.

Requirements for Advancing from Pre-Engineering to Civil, Electrical, Materials or Mechanical Engineering

In order to advance from pre-engineering to one of the engineering majors listed above, students must meet the following minimum requirements:

- Sophomore standing
- Completion (C or better) of MA 125 Calculus I and MA 126 Calculus II
- Completion (C or better) of two required science courses with appropriate labs
- Completion of EGR 110 and EGR 111 (or EGR 200), ME 102 Engineering Graphics, and EGR 150 or BME 150 (or equivalent)
- An institutional (UAB) GPA of 2.20

Requirements for Advancing from Pre-Engineering to Biomedical Engineering

In order to advance from pre-engineering to Biomedical Engineering, students must meet all of the following minimum requirements:

- Sophomore standing
- Completion (C or better) of MA 125 Calculus I and MA 126 Calculus II
- Completion (C or better) of two required science courses with appropriate labs
- Completion of EGR 110 and EGR 111 (or EGR 200)
- Completion of ME 102 Engineering Graphics
- An institutional (UAB) GPA of 3.20 (and cumulative [UAB + transfer] GPA of 3.20 if applicable)

If a Pre-Biomedical or Pre-Engineering student is not eligible to advance into Biomedical Engineering after completing a maximum of 64 hours of course work, they may advance into another engineering major if the qualifications for that major (as listed above) are met.

Change of Major within the School of Engineering

Students changing majors within the School of Engineering should follow procedures outlined under Declaration of Major in this catalog. Students must meet the requirements listed previously.

Transfer Credit

In addition to guidelines for transfer credit outlined in the current UAB catalog, the following policies apply to students transferring into the School of Engineering:

1. The UAB School of Engineering may grant transfer credit for engineering, math and science courses taken at another institution only if a grade of C or higher was earned. Students admitted to the School of Engineering who have earned a grade of D in a course within a required sequence of courses may be required to repeat all or part of the sequence.

2. Engineering technology courses are not equivalent to engineering courses.

Transient Credit

In addition to guidelines for transient credit outlined in the current UAB catalog, engineering requires the following:

The prerequisites for any course that is part of a student's UAB engineering program must be satisfied prior to starting the course. This requirement must be met for courses taken at UAB and for courses the student wishes to take as transient and transfer the credit to UAB under the UAB Transient policy. Additionally, a student who has attempted but failed to successfully complete a UAB course offered by their specific engineering program must repeat that course at UAB for credit.

Dual Degree Program Participants

Dual degree program participants from cooperating four-year institutions must provide the following information to School of Engineering advisors in order to advance from pre-engineering to an engineering major:

- A letter from the cooperating institution stating that the student has successfully completed the general education requirements at that institution, and will be awarded a degree from the institution upon completion of UAB Engineering requirements.

Reasonable Progress

All students in the School of Engineering must continually make reasonable progress toward the completion of their academic programs. To assure that students are achieving reasonable academic progress towards graduation, the School of Engineering provides academic advice and planning each term through EGR 110 and EGR 111 and appointments with assigned engineering advisors. During advising, students receive a registration access code (RAC) which will allow them to register for courses the following semester. Pre-Engineering students in all disciplines are advised by engineering faculty in the School of Engineering’s Office of Academic Programs (OAP). Upon admission to Biomedical, Civil, Electrical, Materials or Mechanical Engineering, students are advised by engineering faculty within their major.

Reasonable progress is defined as follows:

1. All students must comply with appropriate prerequisite and concurrent requirements for all courses in which they enroll. Students will be administratively withdrawn from engineering courses for which they do not meet prerequisite or concurrent requirements.
2. All required courses offered by the student's specific engineering program failed at UAB must be repeated and successfully completed at UAB for the student to apply the credit to satisfy degree requirements.

3. The School of Engineering follows the University's Course Repeat and Forgiveness Policy as previously stated in this catalog.

4. Engineering students with the exception of students majoring in biomedical engineering must maintain a GPA of at least 2.00 in all UAB courses and all UAB engineering courses. Biomedical engineering majors must maintain an institutional (UAB) GPA of at least 3.00.

5. Engineering students must successfully complete two courses applicable to their engineering program within an academic year.

6. If a pre-engineering student is not eligible to advance to an engineering major within 64 hours, the student may be dismissed from the School of Engineering and may not seek readmission to the School of Engineering until another baccalaureate degree is earned.

**Academic Warning, Probation, and Suspension**

The School of Engineering follows the UAB Policy for Academic Warning, Probation, and Suspension with the following additions:

1. Students on Academic Warning or Probation are advised to register for no more than 14 semester credit hours per term.

2. While on Academic Warning or Probation, students may only register for 100- and 200-level engineering courses, or repeat courses for which they previously earned a grade of D or F.

3. Students suspended from the University will be removed from the School of Engineering and returned to the College of Arts and Sciences with a Liberal Arts designation if another major is not specified at the time of suspension. Students may not seek readmission to the School of Engineering unless, and until, the requirements for advancing from a pre-engineering designation to Civil, Electrical, Materials, Mechanical, or Biomedical Engineering are met.

4. First-term freshmen students in Biomedical Engineering who have an institutional (UAB) GPA below a 3.00 will be placed on academic probation in Biomedical Engineering. Biomedical students (excluding first-term freshmen) who have an institutional (UAB) GPA below a 3.00 will be placed on academic probation in Biomedical Engineering. Biomedical Engineering students on academic probation who do not attain an institutional (UAB) GPA of 3.00 in their next term attempted will be reclassified as Pre-General Engineering.

5. Engineering students must successfully complete two courses applicable to their engineering program within an academic year.

6. If a pre-engineering student is not eligible to advance to an engineering major within 64 hours, the student may be dismissed from the School of Engineering and may not seek readmission to the School of Engineering until another baccalaureate degree is earned.

**Graduation Requirements**

In addition to satisfying the general UAB graduation requirements (Baccalaureate Degrees), all engineering students must earn an engineering grade point average (GPA) of at least 2.00 in order to graduate. The engineering grade point average includes all engineering course work applicable to the degree attempted at UAB. Students who are on academic warning or probation cannot graduate from the School of Engineering.

Individual engineering programs may have additional graduation requirements which can be found in the program description.

**Office of Academic Programs**

**Director:** Dr. Zoe B. Dwyer

The freshman year program is similar among the engineering curricula at UAB. It is based upon substantial high school preparation in English, mathematics, and natural sciences. Students must enroll in appropriate English, chemistry, mathematics, or physics sequences according to placement. Incomplete preparation at the high school level is not unusual, and course work to strengthen the student's academic background is routinely offered by UAB. Advice on this subject may be obtained from the Office of Academic Programs.

**Suggested Freshman Year**

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 110</td>
<td>2</td>
</tr>
<tr>
<td>&amp; EGR 111</td>
<td></td>
</tr>
<tr>
<td>ME 102</td>
<td>2</td>
</tr>
<tr>
<td>EGR 150</td>
<td>3</td>
</tr>
<tr>
<td>CH 115</td>
<td>3</td>
</tr>
<tr>
<td>CH 116</td>
<td>1</td>
</tr>
<tr>
<td>CH 117</td>
<td>3</td>
</tr>
<tr>
<td>CH 118</td>
<td>1</td>
</tr>
<tr>
<td>EH 101</td>
<td>3</td>
</tr>
<tr>
<td>EH 102</td>
<td>3</td>
</tr>
<tr>
<td>MA 125</td>
<td>4</td>
</tr>
<tr>
<td>MA 126</td>
<td>4</td>
</tr>
<tr>
<td>PH 221</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PH 221L</td>
<td></td>
</tr>
</tbody>
</table>

**Total Hours:** 33

1. Transfer Students should substitute EGR 200 for EGR 110 and EGR 111
2. Except for Electrical Engineering
3. Except for Electrical Engineering and Mechanical Engineering

**Pre-Health Program Option**

A number of students choose a pre-health curriculum before pursuing a course of study in one of the health disciplines, such as medicine, dentistry, or optometry. As health professions become more technologically based, engineering provides an excellent undergraduate preparation for these fields. All courses necessary for passage of professional-school entrance examinations should be completed by the end of the sophomore year.

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The additional coursework for this option includes the following:
Core Curriculum as Specified for Engineering Majors

Students in the School of Engineering follow the University Core Curriculum, which includes EH 101 English Composition I and EH 102 English Composition II, with the following exceptions and additional specifications:

1. Engineering students are required to take 9 hours in Core Curriculum Area II: Humanities and Fine Arts to include a minimum of 3 semester hours in literature and 3 semester hours in the fine arts. The following courses are recommended as they best complement the technical coursework of engineering programs: CMST 101 Public Speaking, EH 217 World Literature I: Before 1660, EH 218 World Literature II: 1660-Present, PHL 115 Contemporary Moral Issues, PHL 116 Bioethics, and PHL 125 Introduction to Ethics.

2. Engineering students should take the following course to satisfy the Core Curriculum Area III Mathematics requirement: MA 125 Calculus I.

3. Engineering students should take the following courses to satisfy the Core Curriculum Area III Natural Science requirement: PH 221 General Physics I and PH 222 General Physics II.

4. Engineering students are required to take 9 hours in Core Curriculum Area IV: History, Social, and Behavioral Sciences to include a minimum of 3 semester hours in history. Please note: for Core Area IV, students cannot apply more than 6 hours of History. The following courses are recommended as they best complement the technical coursework of engineering programs: EC 210 Principles of Microeconomics, EC 211 Principles of Macroeconomics, ITS 101 Introduction to International Studies, PSY 101 Introduction to Psychology, SOC 100 Introduction to Sociology, and SOC 245 Contemporary Social Problems.

5. Engineering majors must complete a six-semester-hour sequence in either Area II or Area IV. To be considered a sequence, courses must have the same prefix and must be sequential if possible. Sequences in history, such as HY 101 Western Civilization I and HY 102 Western Civilization II or literature, such as EH 221 British and Irish Literature I: Before 1800 and EH 222 British and Irish Literature II: 1800-Present are common. Two courses in a foreign language such as ARA 101 and ARA 102; CHI 101 and CHI 102; FR 101 and FR 102; FR 201 and FR 202; GN 101 and GN 102; GN 201 and GN 202; JPA 101 and JPA 102; SPA 101 and SPA 102; and SPA 201 and SPA 202 also fulfill this requirement. Any two Area II courses in one of the following disciplines: ARH, PHL or THR; or any two Area IV courses in one of the following disciplines: ANTH, EC, PSC, PY, or SOC, can also fulfill this requirement.

University Requirements for the School of Engineering

In order to receive a degree in the School of Engineering at UAB, a student must have at least 128 semester hours of acceptable credit.

Students majoring in disciplines other than engineering may choose a minor in engineering to become familiar with topics such as biomedical engineering, environmental engineering, electrical systems, engineering materials, thermodynamic sciences, applied mechanics, or software engineering. Because technology greatly affects most aspects of society, the study of technology in conjunction with the pursuit of a non-engineering major can provide a worthwhile career-oriented educational experience.

Because enrollment in engineering courses is restricted, it is essential that students with declared minors in engineering receive an approved program of study. These students should visit the School of Engineering Office of Academic Programs to receive relevant information. Students planning to minor in engineering should exercise care in the selection of courses to meet the requirements of their major as well as concurrently satisfying prerequisite requirements for engineering courses. Students should be particularly aware of the mathematics and natural sciences prerequisites.

Students majoring in engineering may select a minor offered from outside their engineering discipline as listed below, with the exception of engineering science.

To satisfy the minor requirements, a minimum grade point average of 2.00 is required for all engineering coursework attempted for all programs except biomedical engineering which requires a minimum GPA of 3.00 in all engineering coursework. Transfer students wishing to earn a minor in engineering must take at least nine (9) semester hours at UAB and earn a minimum GPA of 2.00 in UAB engineering courses attempted with the exception of biomedical engineering. For the biomedical engineering minor, students must earn a minimum GPA of 3.00 in UAB engineering coursework attempted and must take at least nine (9) semester hours at UAB. Students who are not majoring in biomedical engineering but wish to enroll in 300- or 400-level BME courses must fulfill course prerequisites, have an institutional (UAB) GPA of at least 3.00, and be approved by the BME Undergraduate Program Director.

A non-engineering major who wishes to minor in engineering may choose one of the minor programs listed here.
Minor Requirements for Applied Mechanics

Offered through the Department of Civil Construction and Environmental Engineering

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Requirement</td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Engineering Courses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210 Statics</td>
<td>3</td>
</tr>
<tr>
<td>CE 220 Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>CE 360 Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 215 Dynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Civil Engineering Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Select three of the following courses:</td>
<td>9</td>
</tr>
<tr>
<td>CE 420 Advanced Mechanics</td>
<td></td>
</tr>
<tr>
<td>CE 460 Structural Mechanics</td>
<td></td>
</tr>
<tr>
<td>CE 461 Introduction to the Finite Element Method</td>
<td></td>
</tr>
<tr>
<td>CE 462 Advanced Structural Analysis</td>
<td></td>
</tr>
<tr>
<td>CE 464 Structural Dynamics</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 21

Minor Requirements for Biomedical Engineering

Offered through the Department of Biomedical Engineering

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Requirement</td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 3.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 3.00 in UAB engineering courses attempted.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Biomedical Engineering Courses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 210 Engineering in Biology</td>
<td>3</td>
</tr>
<tr>
<td>BME 401 Undergraduate Biomedical Engineering Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Introduction to Engineering Course(s)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 110 Introduction to Engineering I &amp; EGR 111 and Introduction to Engineering II* or EGR 200 Introduction to Engineering Design</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biomedical Engineering Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Select three of the following courses:</td>
<td>9</td>
</tr>
<tr>
<td>BME 310 Biomaterials</td>
<td></td>
</tr>
<tr>
<td>BME 312 Biocomputing</td>
<td></td>
</tr>
<tr>
<td>BME 313 Bioinstrumentation</td>
<td></td>
</tr>
<tr>
<td>BME 333 Biomechanics of Solids</td>
<td></td>
</tr>
<tr>
<td>BME 340 Biomaging</td>
<td></td>
</tr>
<tr>
<td>BME 350 Biological Transport Phenomena</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biomedical Engineering Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Select two of the following courses:</td>
<td>6</td>
</tr>
<tr>
<td>BME 408 Advanced Biological Transport Phenomena</td>
<td></td>
</tr>
<tr>
<td>BME 417 Engineering Analysis</td>
<td></td>
</tr>
<tr>
<td>BME 420 Implant-Tissue Interactions</td>
<td></td>
</tr>
<tr>
<td>BME 423 Living Systems Analysis</td>
<td></td>
</tr>
<tr>
<td>BME 435 Tissue Engineering</td>
<td></td>
</tr>
<tr>
<td>BME 443 Medical Image Processing</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 21

Minor Requirements for Civil Engineering

Offered through the Department of Civil Construction and Environmental Engineering

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Requirement</td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Civil Engineering Courses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210 Statics</td>
<td>3</td>
</tr>
<tr>
<td>CE 220 Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>CE 230 Plane Surveying</td>
<td>3</td>
</tr>
<tr>
<td>CE 236 Environmental Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Civil Engineering Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Select three of the following courses:</td>
<td>9</td>
</tr>
<tr>
<td>CE 332 Soil Engineering</td>
<td></td>
</tr>
<tr>
<td>CE 345 Transportation Engineering</td>
<td></td>
</tr>
<tr>
<td>CE 360 Structural Analysis</td>
<td></td>
</tr>
<tr>
<td>CE 395 Engineering Economics</td>
<td></td>
</tr>
<tr>
<td>CE 450 Structural Steel Design</td>
<td></td>
</tr>
<tr>
<td>CE 453 Design of Wood Structures</td>
<td></td>
</tr>
<tr>
<td>CE 455 Reinforced Concrete Design</td>
<td></td>
</tr>
<tr>
<td>CE 457 Concrete Technology</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 21

Minor Requirements for Electrical Engineering

Offered through the Department of Electrical and Computer Engineering

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Requirement</td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Electrical Engineering Courses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 210 Digital Logic</td>
<td>3</td>
</tr>
<tr>
<td>EE 233 Engineering Programming Methods</td>
<td>3</td>
</tr>
<tr>
<td>EE 300 Engineering Problem Solving II</td>
<td>3</td>
</tr>
<tr>
<td>EE 314 Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td>EE 316 Electrical Networks</td>
<td>4</td>
</tr>
<tr>
<td>EE 351 Electronics</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Engineering Course</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 150 Computer Methods in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours 23
Minor Requirements For Engineering Science

Requirements Hours

Grade Requirement
A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.

Required Engineering Courses
CE 210 Statics 3
EE 312 Electrical Systems 3
ME 241 Thermodynamics I 3
MSE 280 Engineering Materials 3

Required Introduction to Engineering Course(s) 2
EGR 110 Introduction to Engineering I & EGR 111 Introduction to Engineering II or EGR 200 Introduction to Engineering Design

Engineering Electives
Select two of the following courses: 6-7
EE 210 Digital Logic
ME 215 Dynamics
ME 321 Introduction to Fluid Mechanics
MSE 281 Physical Materials I & 281L Physical Materials I Laboratory

Total Hours 20-21

Minor Requirements for Engineering World Health

Requirements Hours

Choose 3 of the following Engineering courses 9
BME 310 Biomaterials
BME 312 Biocomputing
BME 313 Bioinstrumentation
CE 220 Mechanics of Solids
CE 236 Environmental Engineering
CE 337 Hydraulics
CE 430 Water Supply/Drainage Design
CE 433 Solid and Hazardous Wastes Management
CE 434 Air Quality Modeling and Monitoring
CE 480 Introduction to Water and Wastewater Treatment
EE 305 Fundamentals of Electrical Engineering
EE 490 Special Topics in (Area) (Medical Devices)
EE 490 Special Topics in (Area) (Big Data in Medicine)
ME 103 Drawing, Design and Measurement for Industrial Distribution
ME 251 Introduction to Thermal Sciences
ME 302 Overview of Mechanical Components
MSE 350 Introduction to Materials

Choose 3 of the following Public Health courses 9
GHS 429 Intensive Global Health Training - SIFAT
PUH 201 The Origins of Epidemics: How Public Health Defines Population and Nations
PUH 202 Introduction to Global Health
PUH 302 Epid: Beyond the Outbreak
PUH 220 Environmental Factors in Public Health

Minor Requirements For Environmental Engineering

Offered through the Department of Civil Construction and Environmental Engineering

Requirements Hours

Grade Requirement
A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.

Required Civil Engineering Courses
CE 236 Environmental Engineering 3
CE 337 Hydraulics 3
CE 430 Water Supply/Drainage Design 3
CE 480 Introduction to Water and Wastewater Treatment 3

Civil Engineering Electives
Select three of the following courses: 9
CE 344 Civil Engineering Analysis I
CE 433 Solid and Hazardous Wastes Management
CE 434 Air Quality Modeling and Monitoring
CE 437 Environmental Experimental Design and Field Sampling
CE 485 Engineering Hydrology

Total Hours 21

Minor Requirements For Materials Engineering

Offered through the Department of Materials Science and Engineering

Requirements Hours

Grade Requirement
A minimum GPA of 2.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.

Required Materials Engineering Courses
MSE 280 Engineering Materials 3
MSE 281 Physical Materials I & 281L Physical Materials I Laboratory 4
MSE 380 Thermodynamics of Materials 3
MSE 381 Physical Materials II 3
MSE 382 Mechanical Behavior of Materials 3
MSE 465 Characterization of Materials & 465L Characterization of Materials Laboratory 4

Materials Engineering Electives
Select one of the following courses: 3-4
MSE 413 Composite Materials
MSE 430 Polymeric Materials & 430L Polymeric Materials Laboratory
MSE 464 & 464L | Metals and Alloys and Metals and Alloys Laboratory
MSE 470 | Ceramic Materials

Total Hours | 23-24

### Minor Requirements for Mechanical Engineering - Thermal Systems

**Offered through the Department of Mechanical Engineering**

#### Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 241</td>
<td>Thermodynamics I</td>
</tr>
<tr>
<td>ME 242</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>ME 321</td>
<td>Introduction to Fluid Mechanics</td>
</tr>
<tr>
<td>ME 322</td>
<td>Introduction to Heat Transfer</td>
</tr>
</tbody>
</table>

#### Mechanical Engineering Electives

Select three courses from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 361 &amp; 361L</td>
<td>Thermo-Fluids Systems and Thermo-Fluids Systems Laboratory</td>
</tr>
<tr>
<td>ME 411</td>
<td>Intermediate Fluid Mechanics</td>
</tr>
<tr>
<td>ME 421</td>
<td>Introduction to Computational Fluid Dynamics Basics</td>
</tr>
<tr>
<td>ME 445</td>
<td>Combustion</td>
</tr>
<tr>
<td>ME 449</td>
<td>Power Generation</td>
</tr>
<tr>
<td>ME 455</td>
<td>Thermal-Fluid Systems Design</td>
</tr>
</tbody>
</table>

Total Hours | 21

### Minor Requirements for Mechanical Engineering - Mechanical Systems

**Offered through the Department of Mechanical Engineering**

#### Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210</td>
<td>Statics</td>
</tr>
<tr>
<td>CE 220</td>
<td>Mechanics of Solids</td>
</tr>
<tr>
<td>ME 215</td>
<td>Dynamics</td>
</tr>
<tr>
<td>ME 370</td>
<td>Kinematics and Dynamics of Machinery</td>
</tr>
<tr>
<td>ME 371</td>
<td>Machine Design</td>
</tr>
</tbody>
</table>

#### Engineering Electives

Select two of the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 464</td>
<td>Introduction to Finite Element Method</td>
</tr>
<tr>
<td>ME 475</td>
<td>Mechanical Vibrations</td>
</tr>
<tr>
<td>MSE 401</td>
<td>Materials Processing</td>
</tr>
</tbody>
</table>

Total Hours | 21

### Business Administration Minor for Non-Business Majors

Engineering students may choose to pursue a Minor in Business Administration. This minor combined with an undergraduate engineering degree and co-op/internship experience provides a powerful and highly sought-after combination in today’s competitive economy. Engineering students interested in exploring the Business Administration Minor should contact the academic advisor in the School of Engineering (205) 934-8410.

### Honors in Engineering

Honors Programs are offered by all undergraduate degree programs in the School of Engineering.

- Biomedical Engineering
- Civil Engineering
- Electrical Engineering
- Materials Engineering
- Mechanical Engineering

#### Purpose

The honors programs are intended to enrich educational opportunities for talented students in the School of Engineering.

#### Eligibility

Students who have earned a GPA of at least 3.25 (3.75 for BME); have completed MA 227 Calculus III or EGR 265 Math Tools for Engineering Problem Solving; and receive departmental endorsement are invited to participate in an engineering honors program. Invitations are extended by the Dean’s office during spring semester of each year.

Community college transfer students who have earned a GPA of at least 3.50 (3.75 for BME); have completed MA 227 Calculus III; and have been elected to Phi Theta Kappa are also eligible.
Requirements

Honors programs require nine credit hours of honors coursework.

- Students enroll in EGR 301 Honors Research I, a one-hour course, no later than junior year. Students participating in the Science and Technology Honors program are not required to take EGR 301.
- Students enroll in two one-hour seminars which can be taken at any time in their course of study.
- Students complete six hours of credit in departmental honors research.
- Individual programs may vary in the way credit is awarded. For information regarding departmental requirements, contact the departmental program director.

Benefits

Students who complete an engineering honors program will have earned nine credit hours in honors coursework. Honors research beyond the required six hours may be applied as graduate credit. Three credit hours of honors research may be applied as an undergraduate elective according to departmental policy. Students who complete an honors program in engineering with a minimum GPA of 3.0 will receive a bachelor’s degree "with Honors" in addition to any University honors designations.

Contact

For more information about Engineering Honors Programs, contact:

Dr. Timothy M. Wick • Senior Associate Dean and Professor of Biomedical Engineering • School of Engineering • Birmingham, AL 35294-4440 • Telephone (205) 934-8410

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 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] and 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] and (MA 227 [Min Grade: C] or MA 252 [Min Grade: C]) and BME 210 [Min Grade: C] and BY 409 [Min Grade: C] (Can be taken Concurrently) and ME 215 [Min Grade: C]

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

BME 408. Advanced Biological Transport Phenomena. 3 Hours.
Application of fluid mechanics in blood flow in the circulatory system; cardiovascular fluid mechanics, wall shear stress and the development of atherosclerosis, viscoelastic behavior of the arteries, non-Newtonian character of blood.
Prerequisites: BME 350 [Min Grade: C] and (CE 220 [Min Grade: C] or BME 333 [Min Grade: C])

BME 417. Engineering Analysis. 3 Hours.
Solutions to engineering problems involving ordinary and partial differential equations; Laplace transform, power series, Bessel functions, Legendre polynomials, Fourier series, Fourier integral and transform, Sturm-Liouville and separation of variables.
Prerequisites: (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) or EGR 265 [Min Grade: C]

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. 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 423L. Living Systems Analysis Laboratory. 0 Hours.  
Labs include blood flow data acquisition and analysis, implant biocorrosion testing, evaluation and analysis of cell proliferation, and apoptosis. The laboratory component of BME 423 must be taken concurrently.

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 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] or MA 252 [Min Grade: C]) and (BME 333 [Min Grade: C] or CE 220 [Min Grade: C])

BME 475. Quantitative Biomechanics of Injury & Rehabilitation. 3 Hours.  
Students will learn the material, mechanical, electrophysiological and energetic principles of human movement. Students will learn about the healthy nonimpaired system and compare to systems impaired by injury or disability for applications in rehabilitation.  
Prerequisites: ME 215 [Min Grade: C]

BME 489. Undergraduate Research in Biomedical Engineering. 0 Hours.  
Undergraduate research experiences in biomedical engineering.  
Prerequisites: EGR 200 [Min Grade: C] or (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C]) and MA 125 [Min Grade: C] and PH 221 [Min Grade: C](Can be taken Concurrently)

BME 490. Special Topics in Biomedical Engineering. 3 Hours.  
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]

BME 495. Honors Research II. 1-3 Hour.  
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 498L. Senior Design and Product Development Laboratory. 0 Hours.  
Lab component for BME 498 Senior Design Product Development. Laboratory activities include break-out sessions for team discussions (Problem definition and brainstorming of solutions), training and use of computer design software (Creo, CES Edupak, ABAQUS), and machine shop training for prototype development. Must be taken concurrently with BME 498.

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]

BME 499L. Capstone Design II Lab. 0 Hours.  
Exposure to engineering skills common to all senior design projects. Students working in teams solicit input from clients and instructions. The laboratory component of BME 499 and must be taken concurrently.
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 solid earth, the nature of the earth's crust and surficial processes.

CE 210. Statics. 3 Hours.
Prerequisites: EGR 200 [Min Grade: C] (Can be taken Concurrently) or EGR 110 [Min Grade: C] (Can be taken Concurrently) and EGR 111 [Min Grade: C] (Can be taken Concurrently) and MA 126 [Min Grade: C] and PH 221 [Min Grade: C]

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

CE 221. Mechanics of Solids Laboratory. 1 Hour.
Strain gage installation and applications. Standard tensile, torsion, bending, and column tests. 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, concrete, and masonry. Design of Portland cement concrete and asphalitic concrete mixes.
Prerequisites: CE 220 [Min Grade: D] (Can be taken Concurrently)

CE 230. 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 230L must be taken concurrently.
Prerequisites: MA 125 [Min Grade: C]

CE 230L. Plane Surveying Laboratory. 0 Hours.
To provide the student with an understanding of the principles of land measurement, the instruments and techniques used in surveying, theory of errors and mathematical precision in engineering analysis and design. 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 236. Environmental Engineering. 3 Hours.
Air/water pollution and solid waste. Quality of environment. Environmental health. Regulations and legal considerations. Must have a grade of C or better to complete this course. Ethics and Civic Responsibility are significant components of this course.
Prerequisites: MA 125 [Min Grade: C] (Can be taken Concurrently) and CH 117 [Min Grade: C]

CE 236L. Environmental Engineering Laboratory. 0 Hours.
Laboratory equipment and methods. Biological, chemical, and physical tests to determine characteristics of water and wastewater. Companion lab 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. 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 hydograph 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]

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. Quality control and reliability analyses. Emphasis on Quantitative Literacy. Quantitative Literacy is a significant component of this course.
Prerequisites: MA 126 [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] 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 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]

CE 410. FE Review for Civil Engineers. 1 Hour.
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.

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, spheres, and rotating disks. 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]

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. 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: C]

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: C]

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.
Design and detailing of timber structures. Properties and specifications for dimension and glulam timber. Design of beams, columns, beam-columns, connections (nail and bolts), roof diaphragms, and shear walls. Design of timber structures to meet the requirements of the National Design Specification Standards.
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: D]

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: C] and CE 455 [Min Grade: C](Can be taken Concurrently)

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: C]
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 100 [Min Grade: C] and MA 125 [Min Grade: C] and PH 221 [Min Grade: C](Can be taken Concurrently)

CE 490. Special Topics in (Area). 3 Hours.
Special Topics in (Area).

CE 491. Individual Study in (Area). 1-3 Hour.
Individual Study in (Area).

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 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.
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 125 [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 125 [Min Grade: C](Can be taken Concurrently) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C]) or EE 130 [Min Grade: C] or EE 130 [Min Grade: D])

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

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: MA 125 [Min Grade: C] and MA 126 [Min Grade: C] and (MA 227 [Min Grade: C] and MA 252 [Min Grade: D] or EGR 265 [Min Grade: D])

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] and MA 126 [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 126 [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: D] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D](Can be taken Concurrently) and EH 101 [Min Grade: C] and PH 222 [Min Grade: C] and EE 314 [Min Grade: C] and MA 125 [Min Grade: C](Can be taken Concurrently) and MA 126 [Min Grade: C]

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

EE 318. Methods of System Analysis. 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 (MA 227 [Min Grade: C] and MA 252 [Min Grade: D] or EGR 265 [Min Grade: D]) and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) 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 create their own 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: PH 222 [Min Grade: D] and EE 300 [Min Grade: D](Can be taken Concurrently) and (MA 227 [Min Grade: C] and MA 252 [Min Grade: D]) and EE 312 [Min Grade: D] and (MA 227 [Min Grade: C] or MA 252 [Min Grade: D] or EGR 265 [Min Grade: D]) and EE 314 [Min Grade: C] 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 (MA 227 [Min Grade: C] and MA 252 [Min Grade: D] or EGR 265 [Min Grade: D]) and PH 222 [Min Grade: D] and (EE 312 [Min Grade: C] or EE 314 [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 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and (MA 227 [Min Grade: C] and MA 252 [Min Grade: D] or EGR 265 [Min Grade: D]) and PH 222 [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: EGR 265 [Min Grade: C](Can be taken Concurrently) or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D] and EGR 265 [Min Grade: C]) and EE 300 [Min Grade: C] and EE 314 [Min Grade: C] and EE 316 [Min Grade: C] and EE 318 [Min Grade: C]

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 300 [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]

EE 421. Communication Systems. 3 Hours.
Prerequisites: EE 300 [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]

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 300 [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]

EE 426. Control Systems. 3 Hours.
Prerequisites: EE 300 [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]

EE 427. Industrial Control. 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: C] and (EGR 150 [Min Grade: C] or EE 130 [Min Grade: C] or ME 130 [Min Grade: C])

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 300 [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: C] and EE 351 [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: C]

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 EE 134 [Min Grade: C])

EE 434. Power Semiconductor Electronics. 3 Hours.
This course covers the fundamentals of power electronics, principles of static power conversions, power semiconductor switches, power converters - DC-DC, DC-AC, and rectifier: pulse width modulation and controller design, circuit design considerations, and applications of power electronics. The course project emphasizes computer-aided analysis and design of power electronic circuits.
Prerequisites: EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D]
EE 437. Microprocessor Applications. 3 Hours.
Applications of microprocessors in engineering problems such as data acquisition, control, and real-time input/output. Lecture and laboratory. 
**Prerequisites:** (EE 210 [Min Grade: C] or EE 300 [Min Grade: C] or EE 312 [Min Grade: C] or EE 314 [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 Java, 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. VHDL Digital Systems Design. 3 Hours.
Digital system design, verification, and simulation using VHDL. Lecture and laboratory.
**Prerequisites:** EE 337 [Min Grade: D] and EE 210 [Min Grade: C] and EE 337 [Min Grade: D] and EE 351 [Min Grade: D] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and EE 233 [Min Grade: D]

EE 453. 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] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 337 [Min Grade: D] and EE 351 [Min Grade: C]

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] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C]

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] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C]

EE 472. Power Systems II. 3 Hours.
**Prerequisites:** EE 471 [Min Grade: D] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and EE 361 [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 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and 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:** (EE 411 [Min Grade: C] or EGR 200 [Min Grade: C]) and EE 210 [Min Grade: C] and EE 314 [Min Grade: C] and EE 312 [Min Grade: C]

EE 489. Undergraduate Engineering Research. 0 Hours.
Undergraduate research experiences in electrical engineering.
**Prerequisites:** (EE 411 [Min Grade: C] or EGR 200 [Min Grade: C]) and EE 210 [Min Grade: C] and EE 314 [Min Grade: C]

EE 490. Special Topics in (Area). 3 Hours.
Topic assigned with course.

EE 491. Special Problems in (Area). 3 Hours.
Topic assigned with course.

EE 492. Honors Research I. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
**Prerequisites:** EGR 301 [Min Grade: P] (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: P]

EE 497. Team Design Project. 3 Hours.
Senior Design Team Project Course. Capstone design project: analysis, 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 485 [Min Grade: D] and EE 210 [Min Grade: C] and EE 323 [Min Grade: D] and EE 300 [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 337 [Min Grade: D] and EE 351 [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)

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 210 [Min Grade: C] and EE 233 [Min Grade: D] and EE 300 [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 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: E210 [Min Grade: C] and EE 233 [Min Grade: D] and EE 300 [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 337 [Min Grade: D] and EE 485 [Min Grade: D] and EE 351 [Min Grade: D] and 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 110. Introduction to Engineering I. 1 Hour.
Introduction to profession of engineering, engineering specialties; education requirements; team work and present and future societal demands on profession.

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)

EGR 111. Introduction to Engineering II. 1 Hour.
Ethics and safety; career opportunities in engineering, introduction to engineering design and technical communications; team work and present and future societal demands on profession.

Prerequisites: EGR 110 [Min Grade: C]

EGR 125R. Engineering Applications of Calculus I. 1 Hour.
An application based course designed to reinforce concepts from MA 125.

EGR 126R. Engineering Applications of Calculus II. 1 Hour.
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 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 125 [Min Grade: C] (Can be taken Concurrently)

EGR 197. Engineering Approaches to Problem Solving I. 1-3 Hour.
EGR 197 offers an introduction to a rationally developed method of solving practical problems. This is engineering. Starting with the ancient Greeks, who initiated reasoned speculation, and the Romans, who made practical use of it, the course develops an understanding of why we approach problems the way we do.

EGR 198. Engineering Approaches to Problem Solving II. 1-3 Hour.
Building on engineering principles, focus on the engineering process. Develop and practice good communication, collaboration and presentation skills. Explore interdisciplinary approaches through hands-on projects.

EGR 199. Engineering Approaches to Problem Solving III. 1-3 Hour.
EGR 199 builds on knowledge gained in EGR 197 and 198. While EGR 197 & 198 regarded the theories and practice of integrational engineering principles, this course focuses on innovation. The hows of creating new solutions to old problems will be explored.

EGR 200. Introduction to Engineering Design. 2 Hours.
Profession of engineering; ethics and safety, engineering specialties and career opportunities, educational requirements, introduction to engineering design, team work and technical communications, 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)

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]

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: D])

EGR 400. Special Topics in (Study Abroad). 9 Hours.
Independent studies in various subject and/or service areas outside the state of Alabama or the continental United States.

EGR 410. Engineering Service Learning in Education. 1-6 Hour.
Course provides students an opportunity to help students in K-12 to analyze and solve problems using engineering concepts and design process to engage and excite them about engineering, science, and technology.

EGR 420. Engineering in Service Learning through EiSAL. 6 Hours.
This course will allow engineering students the opportunity to communicate and live in other cultural environments, allowing them to share interdisciplinary engineering design and analysis in a real-world setting. It will also allow them the opportunity to work in multi-cultural groups to solve a common problem.

EGR 440. Social Responsibility in Global Health. 1 Hour.
This course provides students with an understanding of key social and economic concepts of global health that, together with an understanding of interprofessional collaboration and community partnerships, will enable them to participate in developing and implementing sustainable global health projects in collaboration with local and international community partners. The course is open to undergraduate and graduate students who are enrolled in two co-requisite courses that are requirements for students participating in the interprofessional global health service learning program at the University of Alabama at Birmingham.

EGR 441. Interprofessional Collaboration (IPC) and Community Partnerships in Global Health. 1 Hour.
This course provides students with an understanding of principles of interprofessional collaboration and community partnerships that, together with key social and economic concepts of global health, enables them to participate in developing and implementing sustainable global health projects in collaboration with local and international community partners.
EGR 442. EGR Service Learning in Interprofessional Global Health Service Learning I: Project Planning. 1 Hour.
This course provides students with an opportunity to apply principles of interprofessional collaboration, community partnerships, and global health in the development of a plan to address a global health problem in collaboration with a community partner. The course is open to undergraduate and graduate students who are enrolled in two corequisite courses that are requirements for students participating in the global health service learning program at the University of Alabama at Birmingham.

EGR 450. Engineering Service Learning: Teaching Experiences. 1 Hour.
This course provides engineering students the opportunity to assist engineering faculty and fellow students in a tutorial environment by serving as teaching assistants in engineering service courses.

EGR 490. Special Topics in (Area). 6 Hours.
Special Topics in engineering.

EGR 499. Industrial Distribution Senior Design Project. 4 Hours.
Capstone design project: interdisciplinary design teams, ethics, materials selection, the design process, development of a proposal, project planning and scheduling, project execution and resource scheduling. Successful completion and oral defense of a design project. Limited to students majoring in Industrial Distribution.

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]

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 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] and MA 126 [Min Grade: C] [Can be taken Concurrently]

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] 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.
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 370 [Min Grade: C]

ME 405. Manufacturing Processes. 3 Hours.
Processing of metals, glasses, ceramics, and composites. Power processing, casting, welding, rapid solidification, and other advanced methods.
**Prerequisites:** MSE 280 [Min Grade: C] and CE 220 [Min Grade: C] and MA 125 [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 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 448. Internal Combustion Engines. 3 Hours.
Fundamentals of reciprocating internal combustion engines: engine types, engine components, engine design and operating parameters, thermo-chemistry 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 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 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 476. Failure Analysis. 3 Hours.
Procedures for failure analysis, failure mechanisms, examples of service failures, and methods to prevent failures.
Prerequisites: ME 280 [Min Grade: C] and CE 220 [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 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]) and MA 125 [Min Grade: C] and PH 221 [Min Grade: C](Can be taken Concurrently)

ME 490. Special Topics in (Area). 1-4 Hour.
Special Topics in (Area).

ME 491. Individual Study in (Area). 1-4 Hour.
Individual Study in (Area).

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: P]

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 371 [Min Grade: C] and MSE 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 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] and MSE 280 [Min Grade: D]

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

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] 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 402. Frontiers of Materials. 3 Hours.
Recent advances in materials technology and application. Novel processing, structures, properties, and performance issues.
Prerequisites: MSE 281 [Min Grade: D]

School of Engineering
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. Nanomaterials. 3 Hours.
The emphasis of this course will be to introduce the basic tools of nanotechnology, building blocks of nanostructured materials, the behavior of materials with nanoscale structures and their technological applications, including automotive, medical, and electronic, etc.
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.

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 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.

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 465 [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.

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 concurrently.

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.

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 484. Electronic Magnetic and Thermal Prop of Materials. 3 Hours.
Fundamentals of electron band structure, mechanisms behind rectifying junctions, transistors, and other electronic devices. Magnetic and thermal properties of materials.
Prerequisites: MSE 280 [Min Grade: D] and PH 221 [Min Grade: C]

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]) and MA 125 [Min Grade: C] and PH 221 [Min Grade: C](Can be taken Concurrently)

MSE 490. Special Topics in (Area). 1-6 Hour.
Special Topics in (Area).

MSE 491. Individual Study in (Area). 1-6 Hour.
Individual Study in (Area).

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.
Honors students develop materials engineering research skills by working closely with faculty and graduate students.
Prerequisites: EGR 301 [Min Grade: P]

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]