School of Engineering

Dean: Jeffrey W. Holmes, MD, PhD
Associate Dean for Academic Affairs & Graduate Programs: Gregg M. Janowski, PhD
Associate Dean for Undergraduate Programs: Zoe B. Dwyer, PhD
Associate Dean for Research: Timothy M. Wick, PhD

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 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 are accredited by the Engineering Accreditation Commission (EAC) of ABET. The Bachelor of Science in Engineering degree in Engineering Design will seek accreditation from the Engineering Accreditation Commission of ABET as soon as it is eligible to do so.

Each undergraduate curriculum is comprised of four components: the UAB Core Curriculum as specified for engineering majors; mathematics and basic 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.

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 and Computer 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 Advanced Safety Engineering and Management; Construction Engineering Management; Information Engineering and Management; Structural Engineering; and Sustainable Smart Cities. A Master of Science in Engineering Management degree is offered with concentrations in Biomaterials and Tissue Engineering, Design and Commercialization, Environmental Engineering, Manufacturing Engineering, Power Systems Engineering, Software Engineering, and Vehicle and Robotics Engineering. 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 Civil Engineering, Materials/Metallurgical Engineering, and Materials Science. 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. 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.

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.).

Admission to the School of Engineering

First-Term Freshmen

In addition to satisfying the general requirements for admission to UAB listed in the Undergraduate Catalog, individuals must meet the following minimum requirements:

- For admission to the School of Engineering, an ACT Math sub score of 22 (or SAT equivalent) and high school GPA of 3.00. All freshmen students who meet these requirements are admitted as a Pre-Biomedical, Pre-Civil, Pre-Electrical, Pre-Engineering Design, Pre-Materials, or Pre-Mechanical Engineering major based on their intended program. Students who are undecided on an engineering major are admitted as Pre-Engineering students.
- For direct admission as a Biomedical Engineering major, an ACT composite score of 28 (or SAT equivalent) and high school GPA of 3.00. All freshmen students who meet these requirements are admitted to Biomedical Engineering.

Students who do not meet the above criteria are admitted as Undeclared – Interest in Engineering student in the Vulcan Materials University Academic Success Center. Placement into MA 105 Pre-Calculus Algebra or higher in the pre-calculus sequence will allow students to be admitted to the School of Engineering.

Transfer Students, Re-Admitted Students, Post-Baccalaureate Students, and Change of Major

To be admitted to the School of Engineering as Pre-Civil, Pre-Electrical, Pre-Engineering Design, Pre-Materials, or Pre-Mechanical Engineering, students must have a minimum cumulative GPA of 2.20 and, if applicable, a minimum institutional (UAB) GPA of 2.20 in addition to math placement in MA 105 Pre-Calculus Algebra or higher in the pre-
calculus sequence. Students who are undecided on an engineering major are admitted as Pre-Engineering students.

To be admitted to the School of Engineering as Pre-Biomedical Engineering, students must have a minimum cumulative GPA of 3.00 and, if applicable, a minimum institutional (UAB) GPA of 3.00 in addition to math placement in MA 105 Pre-Calculus Algebra or higher in the pre-calculus sequence. Students who meet the math requirement with GPAs between 2.20 and 2.99 will be admitted as Pre-Engineering.

Students are admitted to their chosen department upon completion of the minimum requirements listed below.

**Advancing to Civil, Electrical, Engineering Design, Materials, or Mechanical Engineering**

In order to advance to an engineering major listed above, 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 Introduction to Engineering I and EGR 111 Introduction to Engineering II (or EGR 200 Introduction to Engineering)
- ME 102 Engineering Graphics
- A minimum institutional (UAB) GPA of 2.20 (and a minimum cumulative [UAB + transfer] GPA of 2.20 if applicable)

**Advancing to Biomedical Engineering**

In order to advance 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 Introduction to Engineering I and EGR 111 Introduction to Engineering II (or EGR 200 Introduction to Engineering)
- ME 102 Engineering Graphics
- A minimum institutional (UAB) GPA of 3.00 (and a minimum cumulative [UAB + transfer] GPA of 3.00 if applicable)

**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 to an engineering major:

- A letter or email from the student acknowledging their participation in the Dual Degree Program and intent to complete an Engineering degree at UAB
- 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

**Core Curriculum as Specified for Engineering Majors**

Students in the School of Engineering follow the University Core Curriculum with the following exceptions and additional specifications:

- 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.
- Engineering students should take the following course to satisfy the Core Curriculum Area III Mathematics requirement: MA 125 Calculus I.
- 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.
- 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 School of Engineering and the Department of History offers , which also meets this requirement.
- 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 106 World History and Technology I and HY 107 World History and Technology 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 Introductory Arabic I and ARA 102 Introductory Arabic II or any other sequential language courses offered by UAB. 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.

**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.

**Mandatory Academic Advising**

To assure that students are progressing toward graduation, the School of Engineering faculty advisors provide academic advice and planning each term. During advising, students receive a registration access code (RAC) which will allow them to register for courses the following semester. Pre-Engineering students are advised by engineering faculty in the School of Engineering’s Dean’s Office. Upon admission to Biomedical, Civil, Electrical, Engineering Design, Materials, or Mechanical Engineering, students are advised by engineering faculty within their major.

**Pre-Health Program Option**

Any undergraduate program in engineering can be configured to satisfy pre-health requirements but requires additional coursework. Further information on pre-health program options can be obtained from:

Pre-Health Advising • Dr. Dale S. Feldman • School of Engineering, Pre-Health Program Coordinator • Hoehn Engineering Building • 1075 13th Street South • Room 361 • Birmingham, Alabama 35294-4440
Reasonable Progress

All students in the School of Engineering must continually make reasonable progress toward the completion of their academic programs. Reasonable progress is defined as follows:

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

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.

Transfer Credit

The School of Engineering follows the UAB policy for transfer credit with the following stipulations.

The School of Engineering may accept a course for engineering credit from a two-year community college if the following conditions are satisfied:

• The appropriate UAB program has reviewed the course syllabus and determined that it satisfies the key requirements of the equivalent UAB course in terms of content, rigor, and prerequisites;
• The course is equivalent to a freshman or sophomore-level engineering course at UAB. No junior or senior-level courses will be accepted;
• The two-year community college offers engineering courses in partnership with or under the supervision of an ABET-accredited four-year Engineering program.

The School of Engineering accepts transfer credit for EGR 200 Introduction to Engineering from Alabama Community Colleges that offer an equivalent course.

Please note that engineering technology courses are generally not accepted for engineering credit.

Prerequisite and Transient Requirements

All students must comply with prerequisite and corequisite requirements for all courses in which they enroll. Prerequisites are enforced for engineering courses and must be satisfied prior to starting the course. Students will be administratively withdrawn from engineering courses for which they do not meet prerequisite or corequisite requirements.

Prerequisite requirements must be met for required courses taken at UAB as well as all courses taken as transient with the intent to 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.

Transient Students taking UAB Engineering Courses

In addition to guidelines for transient credit outlined in the current UAB catalog, prerequisites are enforced for transient students wishing to register for Engineering courses at UAB.

Academic Warning, Probation, and Suspension

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

• Students in Biomedical Engineering should refer to the BME program overview in this catalog for program-specific requirements.
• Students on Academic Warning or Probation are advised to register for no more than four courses per term.
• Students may register for 100- or 200-level engineering courses or repeat courses for which they previously earned a grade of D or F. The School of Engineering follows the University’s Course Repeat and Forgiveness policies as previously stated in this catalog.
• Students suspended from the University will be removed from the School of Engineering and will be placed in Undeclared - Interest in Engineering in the Vulcan Materials University Academic Success Center.

Appeal for Reinstatement to the School of Engineering

A student suspended from the School of Engineering must meet the requirements necessary to advance to their intended major before petitioning for reinstatement. The petition should be addressed to the Dean of Engineering and should clearly state the circumstances resulting in the dismissal from the School and include steps taken to resolve the deficiency. The student's petition should be received in the Office of the Dean of Engineering no later than five business days prior to the beginning of the desired semester of re-entry.

Graduation Requirements

In addition to satisfying the University’s graduation requirements, all engineering students must earn a minimum of 128 semester hours in specified coursework and a minimum engineering grade point average (GPA) of 2.00 to graduate. The engineering grade point average includes all engineering coursework applicable to the degree attempted at UAB (after applying the University’s grade forgiveness policy, if applicable). BME students must also have an institutional GPA of 2.50 or higher and have earned a grade of C or better in all BME courses to graduate.

Minors

Students who declare minors in the School of Engineering must develop a program of study in consultation with an academic advisor within the Engineering Dean’s Office. Students 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 majoring in engineering may not select a minor offered by their engineering discipline. See minors below for specific restrictions. Engineering majors may not minor in 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. 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. 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.

**Minor in Applied Mechanics**

*Offered through the Department of Civil Construction and Environmental Engineering*

*Not available to Civil Engineering Undergraduate Students*

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Grade Requirement</strong></td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 2.00 is required for all engineering coursework.</td>
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</tr>
<tr>
<td>Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.</td>
<td></td>
</tr>
<tr>
<td><strong>Required Engineering Courses</strong></td>
<td></td>
</tr>
<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>
<tr>
<td><strong>Civil Engineering Electives</strong></td>
<td></td>
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<tr>
<td>Select three of the following courses:</td>
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<tr>
<td>CE 420 Advanced Mechanics</td>
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<tr>
<td>CE 460 Structural Mechanics</td>
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<tr>
<td>CE 461 Introduction to the Finite Element Method</td>
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<tr>
<td>CE 462 Advanced Structural Analysis</td>
<td></td>
</tr>
<tr>
<td>CE 464 Structural Dynamics</td>
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<td><strong>Total Hours</strong></td>
<td>21</td>
</tr>
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</table>

**Minor in Biomedical Engineering**

*Offered through the Department of Biomedical Engineering*

*Not available to Biomedical Engineering Undergraduate Students*

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Grade Requirement</strong></td>
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<tr>
<td>A minimum GPA of 3.00 is required for all engineering coursework.</td>
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<tr>
<td>Transfer students must earn a minimum GPA of 3.00 in UAB engineering courses attempted.</td>
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<tr>
<td><strong>Biomedical Engineering Courses</strong></td>
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<tr>
<td>BME 210 Engineering in Biology</td>
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<tr>
<td>BME 401 Undergraduate Biomedical Engineering Seminar</td>
<td>1</td>
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<tr>
<td><strong>Required Introduction to Engineering Course(s)</strong></td>
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</tr>
<tr>
<td>EGR 110 Introduction to Engineering I</td>
<td>2</td>
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<tr>
<td>&amp; EGR 111 and Introduction to Engineering II</td>
<td></td>
</tr>
<tr>
<td>or EGR 200 Introduction to Engineering</td>
<td></td>
</tr>
<tr>
<td><strong>Biomedical Engineering Electives</strong></td>
<td></td>
</tr>
<tr>
<td>Select three of the following courses:</td>
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<tr>
<td>BME 310 Biomatérielles</td>
<td></td>
</tr>
<tr>
<td>BME 312 Biocomputing</td>
<td></td>
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<tr>
<td>BME 313 Bioinstrumentation</td>
<td></td>
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<tr>
<td>BME 333 Biomechanics of Solids</td>
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<tr>
<td>BME 340 Bioimaging</td>
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<td><strong>Total Hours</strong></td>
<td>21</td>
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</tbody>
</table>

**Minor in Electrical Engineering**

*Offered through the Department of Electrical and Computer Engineering*

*Not available to Electrical Engineering Undergraduate Students*

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Grade Requirement</strong></td>
<td></td>
</tr>
<tr>
<td>A minimum GPA of 2.00 is required for all engineering coursework.</td>
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</tr>
<tr>
<td>Transfer students must earn a minimum GPA of 2.00 in UAB engineering courses attempted.</td>
<td></td>
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<tr>
<td><strong>Required Electrical Engineering Courses</strong></td>
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<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 361 Electronics</td>
<td>4</td>
</tr>
<tr>
<td><strong>Required Engineering Course</strong></td>
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</tr>
</tbody>
</table>
Minor in Engineering Science

Not Available to Engineering Undergraduate Students

**Requirements**

<table>
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<tr>
<th>Grade Requirement</th>
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<tbody>
<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>
</tr>
</tbody>
</table>

**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)**

- EGR 110 Introduction to Engineering I 3
- **EGR 111** and Introduction to Engineering II 3

**Engineering Electives**

Select two of the following courses:

- **EE 210** Digital Logic 3
- **ME 215** Dynamics 3
- **ME 321** Introduction to Fluid Mechanics 3
- **MSE 281** Physical Materials I 3
- **& 281L** and Physical Materials I Laboratory 4

**Total Hours**

23

Minor in Engineering World Health

**Requirements**

Choose 3 of the following Engineering courses:

- **BME 310** Biomaterials 3
- **BME 312** Biocomputing 3
- **BME 313** Bioinstrumentation 3
- **CE 220** Mechanics of Solids 3
- **CE 230** Plane Surveying 3
- **CE 236** Environmental Engineering 3
- **CE 337** Hydraulics 3
- **CE 430** Water Supply/Drainage Design 3
- **CE 433** Solid and Hazardous Wastes Management 3
- **CE 434** Air Quality Modeling and Monitoring 3
- **CE 485** Engineering Hydrology 3

**Total Hours**

20-21

Minor in Environmental Engineering

Offered through the Department of Civil Construction and Environmental Engineering

Not available to Civil Engineering Undergraduate Students

**Requirements**

<table>
<thead>
<tr>
<th>Grade Requirement</th>
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<tbody>
<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>
</tr>
</tbody>
</table>

**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:

- **CE 344** Civil Engineering Analysis I 3
- **CE 433** Solid and Hazardous Wastes Management 3
- **CE 434** Air Quality Modeling and Monitoring 3
- **CE 485** Engineering Hydrology 3

**Total Hours**

21

Minor in Materials Engineering

Offered through the Department of Materials Science and Engineering

Not available to Materials Engineering Undergraduate Students

**Requirements**

<table>
<thead>
<tr>
<th>Grade Requirement</th>
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</thead>
<tbody>
<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>
</tr>
</tbody>
</table>

**Required Materials Engineering Courses**

- **MSE 280** Engineering Materials 3
- **MSE 281** Physical Materials I 4
- **& 281L** and 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 4
- **& 465L** and Characterization of Materials Laboratory 4

**Materials Engineering Electives**

Select one of the following courses:

- **MSE 413** Composite Materials 3-4
### Minor in Software Engineering

**Offered through the Department of Electrical and Computer Engineering**

Not available to Electrical Engineering Undergraduate Students

<table>
<thead>
<tr>
<th>Requirements</th>
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<tr>
<td>Required Electrical Engineering Courses</td>
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</tr>
<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 333 Engineering Programming Using Objects</td>
<td>3</td>
</tr>
<tr>
<td>EE 337 Introduction to Microprocessors</td>
<td>4</td>
</tr>
<tr>
<td>EE 432 Introduction to Computer Networking</td>
<td>3</td>
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<tr>
<td>Required Engineering Course</td>
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<tr>
<td>EGR 150 Computer Methods in Engineering</td>
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<tr>
<td>Electrical Engineering Electives</td>
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<tr>
<td>Select one of the following courses:</td>
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<tr>
<td>EE 433 Engineering Software Solutions</td>
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<tr>
<td>EE 444 Real-Time Process &amp; Protocols</td>
<td></td>
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<tr>
<td>EE 447 Internet/Intranet Application Development</td>
<td></td>
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<tr>
<td>EE 452 Digital Systems Design</td>
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Total Hours 22

### Minor in Neuroengineering

**Offered through the Department of Biomedical Engineering**

<table>
<thead>
<tr>
<th>Requirements</th>
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<tbody>
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<td>Grade Requirement</td>
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<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>
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<tr>
<td>EGR 150 Computer Methods in Engineering</td>
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<td>BME 312 Biocomputing</td>
<td>3</td>
</tr>
<tr>
<td>NBL 355 Synapses, Neurons and Brains</td>
<td>3</td>
</tr>
<tr>
<td>NBL 356 Mechanisms of Sensation, Movement &amp; Cognition</td>
<td>3</td>
</tr>
<tr>
<td>BME 450 Computational Neuroscience</td>
<td>3</td>
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<td>Select one of the following:</td>
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<tr>
<td>NBL 425 Methods in Human Neuroimaging</td>
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<tr>
<td>NBL 454 Mind/Brain Course</td>
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</tbody>
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Total Hours 21

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**Minor in Mechanical Engineering - Thermal Systems**

**Offered through the Department of Mechanical Engineering**

Not available to Mechanical Engineering Undergraduate Students

<table>
<thead>
<tr>
<th>Requirements</th>
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<tbody>
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<tr>
<td>Required Engineering Courses</td>
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<tr>
<td>ME 241 Thermodynamics I</td>
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<tr>
<td>ME 242 Thermodynamics II</td>
<td>3</td>
</tr>
<tr>
<td>ME 321 Introduction to Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 322 Introduction to Heat Transfer</td>
<td>3</td>
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<tr>
<td>Mechanical Engineering Electives</td>
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</tr>
<tr>
<td>Select three courses from the following:</td>
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</tr>
<tr>
<td>ME 361 Thermo-Fluids Systems and Thermo-Fluids Systems Laboratory</td>
<td></td>
</tr>
<tr>
<td>ME 411 Intermediate Fluid Mechanics</td>
<td></td>
</tr>
<tr>
<td>ME 421 Introduction to Computational Fluid Dynamics Basics</td>
<td></td>
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<tr>
<td>ME 445 Combustion</td>
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<tr>
<td>ME 449 Power Generation</td>
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</tr>
<tr>
<td>ME 455 Thermal-Fluid Systems Design</td>
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</tbody>
</table>

Total Hours 21

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**Minor in Mechanical Engineering - Mechanical Systems**

**Offered through the Department of Mechanical Engineering**

Not available to Mechanical Engineering Undergraduate Students

<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>
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<tr>
<td>Required Engineering Courses</td>
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<tr>
<td>CE 210 Statics</td>
<td>3</td>
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<tr>
<td>CE 220 Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>ME 215 Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 370 Kinematics and Dynamics of Machinery</td>
<td>3</td>
</tr>
<tr>
<td>ME 371 Machine Design</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Electives</td>
<td></td>
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<tr>
<td>Select two of the following courses:</td>
<td>6</td>
</tr>
<tr>
<td>ME 464 Introduction to Finite Element Method</td>
<td></td>
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<tr>
<td>ME 475 Mechanical Vibrations</td>
<td></td>
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<tr>
<td>MSE 401 Materials Processing</td>
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</tbody>
</table>

Total Hours 21

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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 at (205) 934-8400.
Honors in Engineering

Purpose

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

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 cumulative GPA of 3.0 will receive a bachelor's degree "with Honors" in addition to any University honors designations.

Eligibility

In order to be eligible to participate in departmental honors programs, students must meet the following:

- Minimum institutional (UAB) GPA of 3.25 and minimum cumulative GPA of 3.00 (BME students must earn a minimum institutional (UAB) GPA and cumulative GPA of 3.75)
- Completion of MA 227 Calculus III or EGR 265 Math Tools for Engineering Problem Solving with a C or better
- Enrollment as a full-time UAB student for a minimum of one semester
- Departmental endorsement

Invitations are extended by the Dean's office.

Requirements

Honors programs require nine credit hours of honors coursework.

- Students enroll in EGR 301 Honors Research I, a one-hour course, during the fall term following acceptance into departmental honors. 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 listed below.

Contact

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

- Biomedical Engineering (Dr. Dale Feldman (dfeldman@uab.edu))
- Civil Engineering (Andy Sullivan, MSC (asullivan@uab.edu))
- Electrical Engineering (Dr. L (klinga@uab.edu) Leon Jololian (leon@uab.edu))
- Materials and Science Engineering (Dr. Manoj Mahapatra (mkmanoj@uab.edu))
- Mechanical Engineering (Dr. Pasquale Cinnella (pc1@uab.edu))

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 processes.
Prerequisites: BY 123 [Min Grade: C] and PH 222 [Min Grade: C](Can be taken Concurrently)

BME 221. Clinical Innovation I. 3 Hours.
The goals of this class are to develop an understanding of the concept of clinical innovation and develop skills in written and oral communication of innovation in the context of a business proposal/presentation.

BME 289. Undergraduate Research in Biomedical Engineering I. 1 Hour.
Undergraduate research experiences in biomedical engineering. Must have sophomore standing.
Prerequisites: EGR 200 [Min Grade: C] or EGR 111 [Min Grade: C] or HC 111 [Min Grade: C] or HC 120 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C](Can be taken Concurrently)

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

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

BME 312. Biocomputing. 3 Hours.
Introduction to computational techniques used in biomedical engineering.
Prerequisites: EGR 150 [Min Grade: C] and EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 292 [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 instrument control.
Prerequisites: EE 312 [Min Grade: C] and (MA 227 [Min Grade: C] and MA 292 [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] or (MA 227 [Min Grade: C] and MA 292 [Min Grade: C]) and ME 215 [Min Grade: C](Can be taken Concurrently)
BME 350. Biological Transport Phenomena. 3 Hours.
Basic mechanisms and mathematical analysis of transport processes with biological and biomedical applications. Analysis of flow, transport and reaction processes for biological fluids and biological molecules with applications towards development of artificial organs, drug delivery systems and tissue engineering products.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and BME 210 [Min Grade: C] and BY 409 [Min Grade: C](Can be taken Concurrently) and ME 215 [Min Grade: C](Can be taken Concurrently)

BME 370. Integrated Physiology. 3 Hours.
Integrated Physiology will introduce undergraduate students to mathematical models of major physiological systems. Basic anatomy will be reviewed in pre-recorded videos to be watched prior to coming to synchronous lectures. Lectures will include discussions, derivations of relevant equations, and development of models to demonstrate understanding of biological systems. In-class activities will be used as means to provide interactive content that will be assessed via Assignments and Exams. The course will culminate in a final project where teams of students select a pathological condition and model it in Matlab, including comparing to normal conditions and with currently-available clinical interventions. Open to junior and senior level Biomedical Engineering students.
Prerequisites: EGR 150 [Min Grade: C] and BME 210 [Min Grade: C]

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

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

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

BME 423. Living Systems Analysis and Biostatistics. 3 Hours.
Basic concepts and techniques of measurement processing and analysis of data from living systems. Statistics, analysis of variance and regression analysis. Emphasis is placed on data analysis and presentation of group projects.
Prerequisites: BME 312 [Min Grade: C]

BME 424. Current Topics in Stem Cell Engineering. 3 Hours.
This course is designed for students interested in the field of stem cells, regenerative medicine, and tissue engineering using stem cells and stem cell derived cells. The course will introduce the role of stem cells in tissue growth and development, the theory behind the design and in vitro construction of tissue and organ replacements, and the applications of biomedical engineering principles to the treatment of tissue-specific diseases. Students will have hands on experience on culturing and analyzing stem cells, stem cell differentiation, analysis of functional and physiological properties of differentiated cells, and fabricating basic engineered-tissues.
Prerequisites: BY 123 [Min Grade: C] and (BY 210 [Min Grade: C] or BY 212 [Min Grade: C]) or BY 115 [Min Grade: C]

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

BME 443. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.
Prerequisites: BME 312 [Min Grade: C](Can be taken Concurrently) and PH 222 [Min Grade: C]

BME 444. Machine Learning for Biomedical Engineering Applications. 3 Hours.
This course provides the introduction to the practical aspects of machine learning such that the students can apply some basic machine learning techniques in simple biomedical engineering problems. The course also provides the principle of machine learning ‘thinking process’ for the next machine learning – AI courses and more in-depth machine learning studies. By ‘thinking process’, at the beginning, it is better to view machine learning like human learning. Students who have experience with Data Mining may further understand the fundamental differences between Machine Learning and Data Mining, although these two fields share many concepts and techniques. Also, the student will learn fundamental theories in machine learning to be able to develop new machine learning techniques and research machine learning in biomedical engineering.
Prerequisites: EGR 150 [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 with focus on using simulations to examine responses in electrically excitable cell types.
Prerequisites: BME 312 [Min Grade: C]

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

BME 471. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansi strain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and (BME 333 [Min Grade: C] or CE 220 [Min Grade: C])
BME 472. Industrial Bioprocessing and Biomanufacturing. 3 Hours.
This course will introduce students to the growing industries related to biomedical, biopharmaceutical and biotechnology. It is targeted to offer the students marketable skills to work in a vital area of economic growth and also convey some of the challenges and opportunities awaiting.
Prerequisites: BME 310 [Min Grade: C](Can be taken Concurrently) or BY 330 [Min Grade: C](Can be taken Concurrently) or CH 460 [Min Grade: C](Can be taken Concurrently)

BME 489. Undergraduate Research in Biomedical Engineering III. 1-2 Hour.
Undergraduate research experiences in biomedical engineering. Must have senior standing.
Prerequisites: BME 210 [Min Grade: C]

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

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

BME 494. Honors Research I. 1-3 Hour.
Research experiences for undergraduates enrolled in the departmental honors program. The student should write a proposal and make a presentation based on the proposal.
Prerequisites: EGR 301 [Min Grade: C] or STH 201 [Min Grade: C]

BME 495. Honors Research II. 1-3 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 multidisciplinary 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] and BME 312 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 313 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 310 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 313 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 312 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 313 [Min Grade: C] and BME 333 [Min Grade: C]) or (BME 313 [Min Grade: C] and BME 350 [Min Grade: C]) or (BME 333 [Min Grade: C] and BME 350 [Min Grade: C])

BME 499. Capstone Design II. 3 Hours.
Capstone design project; a continuation of BME 498. Through experiential learning, student teams 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 BME 310 [Min Grade: C] and BME 312 [Min Grade: C] and BME 313 [Min Grade: C] and BME 333 [Min Grade: C](Can be taken Concurrently) and BME 350 [Min Grade: C](Can be taken Concurrently) and BME 423 [Min Grade: C](Can 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.
Fundamentals and advanced topics of geology including plate tectonics, mineral formation, sedimentary / igneous / metamorphic rocks, structural deformations, weathering and erosion, groundwater migration, and slope stability.

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

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

CE 221. Mechanics of Solids Laboratory. 1 Hour.
Standard tensile, torsion, bending, and column tests. Installation and applications of strain gages and rosettes. 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.
Testing properties of construction materials such as cement, aggregate, concrete, and asphalt. Design of Portland cement concrete mixes. Writing is a significant component of this course.
**Prerequisites:** CE 220 [Min Grade: D] (Can be taken Concurrently)

CE 230. Plane Surveying. 3 Hours.
Fundamental topics of surveying including 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 126 [Min Grade: C] or MA 225 [Min Grade: C]

CE 230L. Plane Surveying Laboratory. 0 Hours.
Principles of land measurement, the instruments and techniques used in surveying, theory of errors and mathematical precision in engineering analysis and design. 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.
Introduction to environmental engineering principles. Air and water pollution, solid waste, quality of environment, environment, regulations and legal considerations, and ethics and civic responsibility. Design of testing protocols.
**Prerequisites:** MA 125 [Min Grade: C] (Can be taken Concurrently) or MA 225 [Min Grade: C] (Can be taken Concurrently) and CH 117 [Min Grade: C]

CE 236L. Environmental Engineering Laboratory. 0 Hours.
Laboratory equipment and methods. Chemical and physical tests to determine characteristics of water and wastewater. Companion 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, and slope stability. CE 332L must be taken concurrently.
**Prerequisites:** CE 220 [Min Grade: D] and CE 220 [Min Grade: D]

CE 332L. Soil Engineering Laboratory. 0 Hours.
Soil classification, strength and shear tests, and 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. Other topics include river hydrograph routing, statistical hydrology, flow in open channels, culvert design, and applied hydraulic modeling. Must earn a grade of C or better to satisfy BSCE degree requirements.
**Prerequisites:** MA 126 [Min Grade: C] or MA 225 [Min Grade: C]

CE 344. Civil Engineering Analysis I. 3 Hours.
Inspection and treatment of data using exploratory data analysis. Descriptive statistics. Introduction to probability and commonly used distributions. Basic data analysis using regression analysis, hypothesis testing, and analysis of variance. Quantitative literacy is a significant component of this course.
**Prerequisites:** MA 126 [Min Grade: C] or MA 225 [Min Grade: C]

CE 345. Transportation Engineering. 3 Hours.
Principles of transportation engineering and urban transportation planning. Traffic flow characteristics, traffic control, capacity analysis of basic highway sections and intersections, geometric design, and travel demand forecasting.
**Prerequisites:** MA 125 [Min Grade: C] or MA 225 [Min Grade: C] and PH 221 [Min Grade: C]

CE 360. Structural Analysis. 3 Hours.
Reactions, shears, moments, and axial forces in determinate and indeterminate structures. Influence lines; moment area and energy methods of computing deflections; methods of truss and frame analysis. Computer applications.
**Prerequisites:** CE 220 [Min Grade: D]

CE 371. Engineering Communication. 2 Hours.
Introduces communication skills necessary for professional development. Topics include forms of technical writing and oral communication, report writing and organization, plan reading, professional practice, and ethics.
**Prerequisites:** EH 102 [Min Grade: C] and (EGR 111 [Min Grade: C] or EGR 200 [Min Grade: C])

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

CE 410. FE Review for Civil Engineers. 0 Hours.
Review concepts of the engineering core and civil engineering in preparation for the Fundamentals of Engineering (FE) exam.

CE 415. Building Information Modeling (BIM). 3 Hours.
Introduction to virtual design and construction using AutoCAD and Revit software. An emphasis is placed on the use of these tools and their practical applications to real world engineering and design projects. Students are provided with the software required to complete a multi-step project.
**Prerequisites:** ME 102 [Min Grade: C]

CE 420. Advanced Mechanics. 3 Hours.
**Prerequisites:** CE 220 [Min Grade: D]

CE 426. Foundation Engineering. 3 Hours.
Design of foundations including bearing capacity and settlement of spread footings, mats, single piles, and pile groups. Site investigation and evaluation of data from field and tests. Estimation of stresses in soil masses, lateral resistance of piles and pile groups. Design of retaining walls, sheet pile walls, and cofferdams.
**Prerequisites:** CE 332 [Min Grade: D] and CE 455 [Min Grade: D]

CE 430. Water Supply/Drainage Design. 3 Hours.
Water requirements; wastewater characteristics. Hydraulics and design of sewers; distribution and reuse of water. Development of water supplies; design considerations.
**Prerequisites:** CE 337 [Min Grade: C]
CE 431. Energy Resources. 3 Hours.
Overview of primary energy resources, including oil, natural gas, coal, nuclear, hydro, solar, geothermal, biomass, wind, and tidal. Resources are discussed in terms of supply, distribution, recovery and conversion, environmental impacts, economies, policy, and technology. Concepts and opportunities for energy conservation are examined, including electric power generation, transportation applications, and energy use in developing countries.
Prerequisites: CE 236 [Min Grade: C]

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

CE 434. Air Quality Modeling and Monitoring. 3 Hours.
Overview of atmospheric pollutant effects, reactions, and sources. Introduction to air dispersion modeling and ambient air quality 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 445. Engineering the Built Environment. 3 Hours.
This service learning course explores the effects the built environment has on urban function, connectivity, community health, and the well-being of its residents. Students work directly in local neighborhoods learning how to assess components of the built environment, including transportation, green spaces, lighting, and blight, and to estimate their impacts on community health and well-being. Students propose engineering solutions, develop cost estimates, assess potential benefits, and develop implementation plans. Registration restricted to Junior or Senior standing.

CE 446. Green Infrastructure and Transportation. 3 Hours.
Policy and technical issues related to sustainable transportation. Examines the concepts, viewpoints, and fundamentals essential for understanding sustainable transportation planning and the tools used to assess sustainability of transportation facilities and neighborhoods. Design options in support of green infrastructure and transportation, to assess sustainability of transportation facilities and neighborhoods. Understanding sustainable transportation planning and the tools used to assess sustainability of transportation facilities and neighborhoods.
Prerequisites: CE 236 [Min Grade: C]

CE 450. Structural Steel Design. 3 Hours.
Tension members, columns, beams, and beam columns. Simple connections. Load Resistance Factor Design (LRFD) approaches.
Prerequisites: CE 221 [Min Grade: C] and CE 360 [Min Grade: C]

CE 453. Design of Wood Structures. 3 Hours.
Properties of structural wood materials, both sawn lumber and engineered wood materials. Design of wood structures including beams, columns, connections, roof diaphragms, and shear walls. The requirements of the National Design Specification for Wood Structures will be addressed.
Prerequisites: CE 360 [Min Grade: C]

CE 454. Design of Masonry Structures. 3 Hours.
Design and detailing of masonry structures. Nomenclature, properties, and specifications for components. Design of assemblages, simple masonry structures, unreinforced and reinforced elements, and complex masonry structures.
Prerequisites: CE 360 [Min Grade: C]

CE 455. Reinforced Concrete Design. 3 Hours.
Behavior, strength, and design of reinforced concrete structural members (beams, columns, one-way slabs, and continuous beams) subjected to moment, shear, and axial forces according to the American Concrete Institute Building Code Requirements for Structural Concrete (ACI 318). Crack control and serviceability considerations. Introduction to the design of reinforced concrete structures.
Prerequisites: CE 222 [Min Grade: C] and 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 concordance and linear transformation for indeterminate prestressed structures.
Prerequisites: CE 455 [Min Grade: D]

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

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

CE 462. Advanced Structural Analysis. 3 Hours.
Analysis of indeterminate structures utilizing both classical and matrix methods. Use of computer structural analysis 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 465. CE Construction Documents. 3 Hours.
Introduction to Civil Engineering design and construction documents including drawings, specifications, contracts, and testing reports. Overview of civil infrastructure and project types, including the civil engineer’s role in the preparation, certification, and use of construction documents. Construction topics include measurement, quantity estimating, and engineering budgets.

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

Prerequisites: CE 360 (Min Grade: C)

CE 468. Bridge Engineering. 3 Hours.
Bridge loads, steel beam bridges, composite beam bridges, bridge bearings, reinforced and prestressed concrete slab and T-beam bridges, bridge evaluations and ratings, and upgrade methodologies; computer applications.

Prerequisites: CE 450 (Min Grade: D) and CE 455 (Min Grade: D) (Can be taken Concurrently)

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

Prerequisites: CE 344 (Min Grade: C)

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

Prerequisites: CE 344 (Min Grade: C)

CE 480. Introduction to Water and Wastewater Treatment. 3 Hours.
Examination of chemical/biological unit processes for water and wastewater treatment. Design of wastewater treatment facilities and unit processes. 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 200 [Min Grade: C] or HC 111 [Min Grade: C] or EGR 100 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C] (Can be taken Concurrently)

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

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

CE 497. Construction Engineering Management. 3 Hours.
Study of construction management services including project planning, scheduling, estimating, budgeting, contract administration, agreements, and ethics. Emphasis is 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 solve a complex engineering problem that incorporates the major aspects of civil engineering design including structural, geotechnical, environmental, transportation, and construction management components. The course also includes lectures 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) and CE 497 (Min Grade: D) (Can be taken Concurrently)

EE-Electrical Computer Egr Courses

EE 011. Coop/Internship in EE. 0 Hours.
The Co-op/Internship is a short-term engineering workplace learning experience in preparation for the student's intended career.

EE 210. Digital Logic. 3 Hours.
This course introduces the basic principles of how computers do computations using digital components. Topics include: the number systems, Boolean algebra, circuit minimization of multi-level logic, K-Maps, combinational and sequential logic circuit design, clocked latches, flip-flops, registers, and finite state machines. In class lab.

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.
This course covers fundamentals of computer programming including coding and design elements. Topics include: the software development method, logic and algorithm development, C language coding, debugging, documentation, file input and output, an introduction to data structures, development environments, and command line tools.

Prerequisites: EGR 150 (Min Grade: C)

EE 254. Applied Numerical Methods. 3 Hours.
This course covers applications of numerical mathematical techniques and theories laid out in prior courses. Topics include: Euler’s Method, numerical integration and differentiation methods, root finding methods, accuracy versus precision and its relationship to data storage and algorithm efficiency.

Prerequisites: EGR 265 (Min Grade: C) or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and EGR 150 (Min Grade: C)

EE 300. Engineering Problem Solving II. 3 Hours.
This course covers fundamental mathematical background on complex functions, linear algebra, and the theory of probability and statistics which are indispensable in many electrical and computer engineering sub-fields such as signal and image processing, circuit design, and control systems.

Prerequisites: EGR 265 (Min Grade: D) or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C])
EE 305. Fundamentals of Electrical Engineering. 3 Hours.
This course provides a 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.
This course introduces how electrical circuits work and how to analyze them. Topics include: introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, ideal transformers, and electrical safety. For non-EE majors.
**Prerequisites:** MA 126 [Min Grade: C] or MA 226 [Min Grade: C] and PH 221 [Min Grade: C]

EE 314. Electrical Circuits. 3 Hours.
This course covers electrical circuits and their analysis. Topics include: DC circuit analysis, AC steady-state analysis, first-order transient analysis, and electrical safety. For EE Majors.
**Prerequisites:** (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 314R. Electrical Circuits Recitation. 0 Hours.
A problem-solving course designed to reinforce concepts in EE 314.
**Prerequisites:** (MA 226 [Min Grade: C] or MA 126 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 316. Electrical Networks. 4 Hours.
This course expands the Electrical Circuits course with advanced circuits and teaches how to report the results of experiments (emphasis on quantitative literacy). Topics include: Analysis of circuits using classical differential/integral techniques; Laplace transforms; Two-port network parameters; Ideal operational amplifiers; Circuit solution using simulation.
**Prerequisites:** EE 314 [Min Grade: C] and EH 101 [Min Grade: C] and EGR 265 [Min Grade: D] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C])(Can be taken Concurrently) and EE 316L [Min Grade: C]

EE 316L. Electrical Networks Laboratory. 0 Hours.
Electrical Networks laboratory component.

EE 318. Signals and Systems. 3 Hours.
This course provides fundamental mathematical background for extraction of useful information from signals and for modeling dynamic systems in the frequency domain. Topics include: time-domain and frequency-domain methods for modeling and analyzing continuous-time and discrete-time signals and systems, Fourier, Laplace, and Z transform methods.
**Prerequisites:** EE 300 [Min Grade: D] and EE 316 [Min Grade: D]

EE 333. Engineering Programming Using Objects. 3 Hours.
This course covers object-oriented thinking and applies it to creating software for engineering applications. Topics include: object-oriented design and programming in an object-oriented language, graphical user interface framework, project management skills, written and oral communication, Team work, introduction to ethics and intellectual property issues.
**Prerequisites:** EE 233 [Min Grade: D]

EE 337. Introduction to Microprocessors. 4 Hours.
This course covers computer hardware, interfaces, and programming in assembly and C languages with applications of microcomputers to engineering problems, such as data acquisition and control. Topics include: CPU architecture, assembly language, Input/output interfacing.
**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 341. Electromagnetics. 3 Hours.
This course introduces mathematical techniques used to solve problems in antenna design, high-frequency circuit design, and communications. Topics include: Maxwell equations, dynamic and static problems, electromagnetic wave propagation.
**Prerequisites:** EE 300 [Min Grade: C](Can be taken Concurrently) and EE 316 [Min Grade: C]

EE 351. Electronics. 4 Hours.
This course covers fundamentals of solid-state electronics, PN junction diode and diode circuits, bipolar junction transistor (BJT) and field-effect transistor (FET) properties, biasing, frequency response, amplifier configurations, single and multistage amplifier circuits. Students will work on projects in areas such as Internet-of-Things (IoT), and sensor instrumentation.
**Prerequisites:** EE 210 [Min Grade: C] and EE 316 [Min Grade: C]

EE 351L. Electronics Laboratory. 0 Hours.
Electronics laboratory component.

EE 361. Machinery I. 4 Hours.
This course covers single and multi-phase electrical machines with an introduction to industrial applications. Topics include: Fundamentals and applications of polyphase circuits; magnetic circuits; transformers; polyphase synchronous and asynchronous machines.
**Prerequisites:** EE 316 [Min Grade: C]

EE 361L. Machinery I Laboratory. 0 Hours.
Machinery I laboratory component.

EE 412. Practical Computer Vision. 3 Hours.
This course covers fundamentals and applications of image analysis. Topics include: image preprocessing, detection, segmentation, classification and recognition, visual tracking, and deep learning.
**Prerequisites:** EE 318 [Min Grade: C]

EE 418. Wireless Communications. 3 Hours.
This course covers the principles and current applications of wireless technology. Topics include propagation models, modulation, multiple access, and channel and signal coding. Applications of wireless for cellular and Internet of Things (IoT) will also be covered.
**Prerequisites:** EE 316 [Min Grade: C]

EE 421. Communication Systems. 3 Hours.
This course covers the mathematics of modulation and demodulation of radio signals to transmit and receive information. It focuses on various forms of amplitude modulation (AM), phase and frequency modulation (FM). This course builds on the mathematics from signals and systems course to study how to represent and manipulate these signals in both time and frequency domain. It also studies the effects of sampling, and how these systems operate in the presence of noise.
**Prerequisites:** EE 318 [Min Grade: C]

EE 423. Digital Signal Processing. 3 Hours.
This course covers the theory and practice of using computers to process and analyze signals. The topics include Digital filter analysis and design; Fast Fourier Transform (FFT) algorithms; Applications of digital signal processing in engineering problems such as data acquisition and control.
**Prerequisites:** EE 318 [Min Grade: C]

EE 426. Control Systems. 3 Hours.
This course covers modeling and control of mechanisms or circuits to satisfy stability and performance criteria. Topics include: theory of linear feedback control systems using complex frequency techniques, block diagram manipulation, performance measures, stability, analysis and design using root locus, and Z-transform methods.
**Prerequisites:** EE 318 [Min Grade: C]
**EE 427. Controls and Automation. 3 Hours.**
This course covers power control devices and applications, relay logic and translation to other forms, programmable logic controllers (PLCs), proportional-integral-derivative (PID) and other methods for process control, modern laboratory instrumentation, and human-machine interface (HMI) software.

**Prerequisites:** EE 233 [Min Grade: C] and EE 318 [Min Grade: C] and EE 351 [Min Grade: C]

**EE 431. Analog Integrated Electronics. 4 Hours.**
This course covers advanced analysis and design using op-amps, differential amplifier, half-circuit analysis, error analysis and compensation. Applications include signal conditioning for instrumentation, instrumentation amplifiers, nonlinear and computational circuits, analog filter design, voltage regulator design, oscillators, and circuit configurations for A-to-D and D-to-A conversion methods. Laboratory exercises emphasize design techniques for projects in areas such as Internet-of-Things (IoT).

**Prerequisites:** EE 318 [Min Grade: C] and EE 351 [Min Grade: C]

**EE 432. Introduction to Computer Networking. 3 Hours.**
This course covers the fundamentals of modern computer networks including current applications such as Internet of Things (IoT). Topics include: hardware and software level network protocols, network architecture and topology including WANs and LANs, client-server relationships, distributed computing, data transfer, security, virtualization of hardware, multi-tier network configuration examples, and certifications will be addressed.

**Prerequisites:** EE 233 [Min Grade: C]

**EE 433. Engineering Software Solutions. 3 Hours.**
This course covers the fundamentals of software design, architecture, and implementation for future software engineers. Topics include: customer-focused requirements gathering, project planning, team tools, architectural patterns, environment and component selection, quality assurance, sustainability, versioning. Various development methodologies are discussed with a project demonstrating at least one release cycle.

**Prerequisites:** EE 333 [Min Grade: C]

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

**Prerequisites:** EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D]

**EE 437. Introduction to Embedded Systems. 3 Hours.**
This course provides an applied introduction to the design of embedded systems, including hardware and software aspects. Topics include: various embedded hardware platforms, interfacing industrial bus systems, sensors, actuators, low-power wireless communication, and application of Internet-of-Things (IoT).

**Prerequisites:** EE 314 [Min Grade: D] and EE 337 [Min Grade: D]

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

**Prerequisites:** EE 210 [Min Grade: C] and EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

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

**Prerequisites:** EE 233 [Min Grade: D] and EE 337 [Min Grade: D]

**EE 447. Internet/Intranet Application Development. 3 Hours.**
This course covers development of software models and applications using Internet/Intranet technologies. Topics include: web client-server relationships, multi-tier design models, scripting and validation, basic TCP/IP networking, separation of concerns, markup and data description languages. Projects will allow the opportunity for the use of a range of tools and development platforms.

**Prerequisites:** EE 233 [Min Grade: C]

**EE 448. Software Engineering Projects. 3 Hours.**
This course covers practical applications of software engineering including development of applications for Internet of Things (IoT). Topics include: requirements gathering, design matrices, environment selection, relevant architectural patterns, networking basics, databases, service endpoints, embedded systems selection and security. Projects with a software emphasis will be utilized to demonstrate principles of IoT applications.

**Prerequisites:** EE 333 [Min Grade: C]

**EE 452. Digital Systems Design. 3 Hours.**
This course covers the design of customized complex digital systems using Field Programmable Gate Array (FPGA) based platforms, using modern design tools for simulation, synthesis, and implementation. Topics include hardware design and development languages such as Verilog or VHDL.

**Prerequisites:** EE 337 [Min Grade: C] and EE 351 [Min Grade: C]

**EE 458. Medical Instrumentation. 3 Hours.**
This course covers the fundamental operating principles, applications, safety, and design of electronic instrumentation used in the measurement of physiological parameters.

**Prerequisites:** 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: C]

**EE 467. Brain Machine Interface. 3 Hours.**
This course explores the brain-machine interfaces, particularly the technologies that directly stimulate and/or record neural activity. This course is divided into three major components: 1) neuroscience and electrode interfaces, 2) brain recording and stimulating front-end circuits, and 3) circuit modeling, simulating, and optimization.

**Prerequisites:** EE 233 [Min Grade: C] and EE 351 [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]

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

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

EE 485. Engineering Operations. 3 Hours.
This course covers the principles and standards of engineering design from ideation to final design. Topics include: product development process, problem definition and need identification, embodiment and detail design, design for specific criterion, modeling and cost evaluation. Emphasis is placed on ethics and civil responsibilities in design including environmental, social, liable, sustainability and reliability through the lens of engineering design.
Prerequisites: (EGR 111 [Min Grade: C] or EGR 200 [Min Grade: C]) and EE 210 [Min Grade: D] and (EE 314 [Min Grade: D] or EE 312 [Min Grade: D])

EE 489. Undergraduate Engineering Research. 0 Hours.
Undergraduate research experiences in electrical and computer engineering under faculty guidance.
Prerequisites: EGR 111 [Min Grade: C] or EGR 200 [Min Grade: C]

EE 490. Special Topics in Electrical Engineering. 1-3 Hour.
This course covers contemporary topics in Electrical Engineering selected by faculty.

EE 491. Individual Study in Electrical Engineering. 1-6 Hour.
Faculty-guided self-study of special topic in electrical and computer engineering.

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

EE 493. Honors Research II. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 492 [Min Grade: C]

EE 498. Team Design Project I. 3 Hours.
This course is the first part of a two-semester team design project. The deliverables include: detailed design, documentation, and project plan for completion in EE 499. Design projects are chosen from analog/digital systems, machine learning, embedded systems, signal processing, Internet of Things (IoT), and others. Course taken during the student's final year of the program.
Prerequisites: EE 318 [Min Grade: D] and EE 337 [Min Grade: D] and EE 485 [Min Grade: D](Can be taken Concurrently) and EE 351 [Min Grade: D](Can be taken Concurrently)

EE 499. Team Design Project II. 3 Hours.
This course is the second part of a two-semester team design project focusing on project implementation. Teams are required to complete a written design report and a final oral and poster presentation. Course is taken during the student's final year of the program, in the term immediately after successfully completing EE 498.
Prerequisites: EE 498 [Min Grade: C]

EGR-Engineering Courses

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

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

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

EGR 111. Introduction to Engineering II. 1 Hour.
Introduction to engineering specialties; career opportunities in engineering; introduction to engineering design, technical communication, and team work; and present and future societal demands on profession. This is the second course in a two-course sequence for first-year students.
Prerequisites: EGR 110 [Min Grade: C]

EGR 117. Engineering Innovation I: Design Thinking. 3 Hours.
Learn to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact. This project based course gives students the ability to understand, contextualize, and analyze engineering designs and systems. By learning and applying design thinking, students will more effectively solve problems in any domain. Lectures focus on teaching a tested, iterative design process as well as techniques to sharpen creative analysis. Guest lectures from all disciplines illustrate different approaches to design thinking. This course develops students' skills to conceive, organize, lead, implement, and evaluate successful projects in any engineering discipline. Additionally, students learn how to give compelling in-person presentations.
Prerequisites: MA 106 [Min Grade: C](Can be taken Concurrently) and (EGR 110 [Min Grade: C] or EGR 200 [Min Grade: C](Can be taken Concurrently)
EGR 150. Computer Methods in Engineering. 3 Hours.
An introduction to engineering computation using MATLAB language and Excel. Basic programming skills using built-in functions is emphasized. Generation and manipulation of vectors and matrices, operations on vectors/matrices, plotting, iterations calculations. If/else and other logical constructs, and data input/output are covered. Engineering applications are used throughout the course.
Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C])

EGR 200. Introduction to Engineering. 2 Hours.
Introduction to the profession of engineering, ethics and safety, engineering specialties, career opportunities, and educational requirements; introduction to engineering design, team work, and technical communication; and present and future societal demands on profession.
Prerequisites: (MA 102 [Min Grade: C] or MA 105 [Min Grade: C] (Can be taken Concurrently) or MA 106 [Min Grade: C] (Can be taken Concurrently) or MA 107 [Min Grade: C] (Can be taken Concurrently) or MA 126 [Min Grade: C] (Can be taken Concurrently) or MA 225 [Min Grade: C] (Can be taken Concurrently)

EGR 217. EGR Design & Innovation II: EGR Design Prototyping. 3 Hours.
Students will learn to design and prototype physical system components and devices that meet design criteria of the intended user. Students will learn how and when to use paper and other low-fidelity prototyping techniques as well as more advanced techniques such as additive manufacturing, machining, and programming.
Prerequisites: EGR 117 [Min Grade: C] and ME 102 [Min Grade: C]

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

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

EGR 317. Engineering Innovation III: Project Lab. 3 Hours.
Student teams engineer devices based on client needs. The project team will collaborate with the client to establish an appropriate engineering design to meet user needs. Students are trained in product development, product design, engineering validation and will develop training and documentation market analysis, business plan and a go-to-market strategy as appropriate for the project.
Prerequisites: EGR 217 [Min Grade: C] and (EGR 265 [Min Grade: C] or MA 227 [Min Grade: C]) and (CE 210 [Min Grade: C] or EE 312 [Min Grade: C] or EE 314 [Min Grade: C] or EE 280 [Min Grade: C])

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

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

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

EGR 494. Undergraduate Honors Research in Engineering I. 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: EGR 301 [Min Grade: C] or STH 201 [Min Grade: C]

EGR 495. Undergraduate Honors Research in Engineering 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: EGR 494 [Min Grade: C]

EGR 498. Capstone Design I. 3 Hours.
Through experiential learning, students go through the early phases of engineering design innovation. Engineering students will work in multidisciplinary teams 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 to targeted audiences in both oral and written formats.
Prerequisites: EGR 317 [Min Grade: C] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C] and MSE 280 [Min Grade: C] and ME 215 [Min Grade: C] and CE 220 [Min Grade: C])

EGR 499. Capstone Design II. 3 Hours.
Capstone design project; a continuation of EGR 498. Through experiential learning, student teams 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: EGR 498 [Min Grade: C]

ME Mechanical Engineering Courses

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

ME 102. Engineering Graphics. 2 Hours.
Basic concepts in technical sketching, computer-aided drawing and design, projections, sections, and dimensioning.
Prerequisites: MA 105 [Min Grade: C] (Can be taken Concurrently) or MA 106 [Min Grade: C] (Can be taken Concurrently) or MA 107 [Min Grade: C] (Can be taken Concurrently) or MA 125 [Min Grade: C] (Can be taken Concurrently) or MA 225 [Min Grade: C]
ME 103. Drawing, Design and Measurement for Industrial Distribution. 3 Hours.
Technical sketching and reading of engineering drawings and analysis of systems involving human performance. For non-engineering majors. Not available for credit toward engineering major.

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

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

ME 241. Thermodynamics I. 3 Hours.
Thermodynamic definitions, properties of a pure substance, ideal, and real gases, work, and heat. Fundamental laws of thermodynamics, entropy, reversible cycles, and irreversibility.
Prerequisites: PH 221 [Min Grade: C] and (CH 115 [Min Grade: C] or CH 125 [Min Grade: C]) and (CH 116 [Min Grade: C] or CH 126 [Min Grade: C]) and MA 126 [Min Grade: C] (Can be taken Concurrently) or MA 226 [Min Grade: C] (Can be taken Concurrently)

ME 241R. Thermodynamics Recitation. 0 Hours.
An application-based course designed to reinforce concepts from ME 241.

ME 242. Thermodynamics II. 3 Hours.
Application of thermodynamic principles to engineering systems; vapor power cycles; gas turbine cycles; Otto and Diesel cycles; refrigeration cycles; mixtures of ideal gases; psychrometrics.
Prerequisites: ME 241 [Min Grade: C] and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

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

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

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

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

ME 360. Introduction to Mechatronic Systems Engineering. 3 Hours.
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 complets the course. Computer workshops support the learning process of main technical components.
Prerequisites: ME 102 [Min Grade: C] and ME 215 [Min Grade: C]

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

ME 411. Intermediate Fluid Mechanics. 3 Hours.
Applications of fluid dynamic principles to engineering flow problems such as turbo-machinery flow and one-dimensional compressible flow. Vorticity, potential flow, viscous flow, Navier-Stokes solutions, and boundary layers.
Prerequisites: ME 321 [Min Grade: C] and ME 364 [Min Grade: C]
ME 421. Introduction to Computational Fluid Dynamics Basics. 3 Hours.
Governing equations for fluid flows, classifications of flow regimes, and approaches to analyze fluid flow problems. Introduction to Computational Fluid Dynamics (CFD), mesh generation, boundary conditions, numerical solution of equations governing fluid flows, and visualization. Hands-on exercises using a commercial CFD solver.
Prerequisites: ME 321 [Min Grade: C]

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

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

ME 432. Introduction to Electric and Hybrid Vehicle Engineering. 3 Hours.
Introduction to fully electric and hybrid vehicle engineering. Mechatronic system and component design. Batteries and energy storage devices. Plug-in hybrid electric vehicles.
Prerequisites: ME 215 [Min Grade: C] and ME 360 [Min Grade: C] (Can be taken Concurrently)

ME 445. Combustion. 3 Hours.
Evaluation of the impact of fuel characteristics and operating conditions on the performance of coal-fired electric utility steam-raising plant and the prospects for continued reliance on coal as fuel for electric power generation. The phenomena emphasized are the behavior of turbulent jets; ignition, devolatilization and combustion of coal particles; radiative heat transfer and the effect of ash deposits on heat transfer; formation of air pollutants and their removal from combustion products; integrated gasification combined cycle; and capture and sequestration of carbon dioxide.
Prerequisites: ME 242 [Min Grade: C] and ME 322 [Min Grade: C]

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

ME 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 242 [Min Grade: C] and 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 242 [Min Grade: C] and ME 322 [Min Grade: C]

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

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

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

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

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

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

ME 478. Automated Manufacturing. 3 Hours.
Introduction to automated manufacturing technology. Components of automated systems (controllers, sensors and actuators) and automated manufacturing sub-systems (3D printer, CNC, robot and computer vision) will be studied in a lecture/lab environment with hands on activities.
Prerequisites: ME 102 [Min Grade: C] and EGR 150 [Min Grade: C]
ME 480. Instrumentation and Measurements. 3 Hours.
Thorough exploration of fundamental measurement concepts and techniques for data acquisition and validation. Explanation of important selection criteria for the identification and configuration of commercially available data acquisition devices. Students will get hands-on experience following best practices for data acquisition (high speed vs low speed) relevant to their field of study or career. Many types of sensors, their underlying technology, and measurement techniques will be discussed (i.e. accelerometers, load cells, Digital Image Correlation, etc.) to demonstrate best practices for sensor selection for a wide range of specialized applications. Registration is restricted to junior or higher standing.

ME 489. Undergraduate Research in Mechanical Engineering. 1-6 Hour.
Undergraduate research experiences in mechanical engineering.
**Prerequisites:** EGR 200 [Min Grade: C] or EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C] or HC 111 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C] (Can be taken Concurrently)

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

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

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

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

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

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

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

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

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

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

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

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

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

MSE 401. Materials Processing. 3 Hours.
Processing of metals, ceramics, polymers, and composites. Casting, forging, rolling, welding, powder processing, 3D printing, compression molding, and other advanced methods. Ethics and Civic Responsibility are significant components of this course.
**Prerequisites:** MSE 280 [Min Grade: D] and CE 220 [Min Grade: D]

MSE 405. Frontiers of Automotive Materials. 3 Hours.
Advanced lightweight automotive materials, manufacturing and modeling techniques. Technology advancements in cost-effective carbon, glass and related reinforcements; "green" and sustainable materials, crashworthiness and injury protection of occupants and pedestrians, metal castings, heavy truck, mass transit, fuel cell and hybrid vehicles.
**Prerequisites:** MSE 281 [Min Grade: D]
MSE 408. Nanobiomaterials. 3 Hours.
Basic tools of nanotechnology, building blocks of nanostructured materials. Behavior of materials with nanoscale structures and their technological applications, including automotive, medical, and electronic applications. Introduction to biomaterials and nanobiomaterials, concepts in tissue engineering with special focus on nanoscaffolds for tissue engineering, nanoparticles in drug delivery and safety and toxicity of nanomaterials.
Prerequisites: MSE 280 [Min Grade: D]

MSE 409. Principles of Metal Casting. 3 Hours.
Engineering theory and practice on the production of cast ferrous (gray iron, ductile iron, steel) and non-ferrous metals (brass, bronze, aluminum). Producer requirements/responsibilities such as part and mold design, material specifications, and testing requirements are discussed. Laboratory on common testing and production methods and analysis and handling techniques required to produce high quality castings.
Prerequisites: MSE 280 [Min Grade: D]

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

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

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

MSE 430. Polymeric Materials. 3 Hours.
Processing methods, structure/engineering/property relationships, and applications of polymeric materials.
Prerequisites: MSE 281 [Min Grade: D] and (CH 117 [Min Grade: D] or CH 127 [Min Grade: D]) and (CH 118 [Min Grade: D] or CH 128 [Min Grade: D])

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

MSE 433. Nondestructive Evaluation of Materials. 3 Hours.
This course reviews the principles, history, applications, and strengths/weaknesses of the five primary NDE techniques (RT, UT, EC, MP, and LP) with an emphasis on the fundamentals and techniques of each testing method. Importance of NDE on part performance and engineering design is also discussed.
Prerequisites: MSE 281 [Min Grade: D]

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

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

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

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

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

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

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

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

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

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

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

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

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

MSE 497. MSE Honors Research. 2-6 Hours.
Honors students develop materials engineering research skills by working closely with faculty and graduate students.
Prerequisites: EGR 301 [Min Grade: C](Can be taken Concurrently)
MSE 498. Capstone Design Project I. 3 Hours.
Capstone design project: interdisciplinary design teams, ethics, materials selection, design process, development of proposal, project planning and scheduling, project execution and resource scheduling, and communication of design. Writing is a significant component of this course.

Prerequisites: MSE 401 [Min Grade: D] (Can be taken Concurrently) and (MSE 413 [Min Grade: D] or MSE 430 [Min Grade: D] or MSE 465 [Min Grade: D] or MSE 470 [Min Grade: D])

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]