School of Engineering

Dean: J. Iwan Alexander
Senior Associate Dean: Timothy M. Wick
Associate Dean for Undergraduate Programs: Zoe B. Dwyer
Associate Dean for Professional Programs & Industry Relations: Dale Callahan

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

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

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 Materials/Metallurgical Engineering, Materials Science, and Civil Engineering. A shared Doctor of Philosophy degree in Computer Engineering is available.

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

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

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

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

School of Engineering Office of Academic Programs
UAB School of Engineering • Hoehn Engineering Building • 1075 13th Street South Suite 101 • Birmingham, Alabama 35294-4440 • Telephone: (205) 934-8400 • Email: enginfo@uab.edu (info@uab.edu)

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

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

Admission to the School of Engineering
First-Term Freshmen
In addition to satisfying the general requirements for admission to UAB listed in the Undergraduate Catalog, individuals must meet the following requirements:
- For admission as a Biomedical Engineering major, an ACT composite score \( \geq 28 \) (or SAT equivalent) and high school GPA \( \geq 3.20 \)
- For admission as a Pre-Engineering major, an ACT Math sub score \( \geq 22 \) (or SAT equivalent) and high school GPA \( \geq 3.0 \)

Pre-Engineering students who meet the requirement for admission to the School of Engineering and subsequently place in Pre-Calculus Algebra (MA 105) or higher will be designated as Undeclared Engineering majors. Students admitted to UAB conditionally or on academic probation are not eligible for admission to the School of 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.

Transfer Students, Re-Admitted Students, Change of Major

In addition to math placement into Pre-Calculus Algebra (MA 105) or higher, all other students (transfer, students seeking readmission to UAB, students entering the School of Engineering from another UAB program) must have a cumulative GPA $\geq 2.20$ and, if applicable, an institutional (UAB) GPA $\geq 2.20$ to be admitted to the School of Engineering. These students are admitted as Undeclared Engineering majors. Transfer and returning students may receive an Undeclared Engineering designation for a minimum of one semester following admission to UAB and are admitted to their chosen department upon completion of the minimum requirements listed below.

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

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

- Sophomore standing
- Completion (C or better) of MA 125 Calculus I and MA 126 Calculus II
- Completion (C or better) of two required science courses with appropriate labs
- Completion of EGR 110 Introduction to Engineering I and EGR 111 Introduction to Engineering II (or EGR 200 Introduction to Engineering), and ME 102 Engineering Graphics
- An institutional (UAB) GPA $\geq 2.20$ (and cumulative [UAB + transfer] GPA $\geq 2.20$ if applicable)

Requirements for Advancing from Pre-Engineering 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)
- Completion of ME 102 Engineering Graphics
- An institutional (UAB) GPA $\geq 3.20$ (and cumulative [UAB + transfer] GPA $\geq 3.20$ 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.

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 Office of Academic Programs (OAP). Upon admission to Biomedical, Civil, Electrical, 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 (https://www.uab.edu/cas/advising/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

Core Curriculum as Specified for Engineering Majors

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

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

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

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

4. Engineering students are required to take 9 hours in Core Curriculum Area IV: History, Social and Behavioral Sciences to include a minimum of 3 semester hours in history. Please note: for Core Area IV, students cannot apply more than 6 hours of History. The following courses are recommended as they best complement the technical coursework of engineering programs: EC 210 Principles of Microeconomics; EC 211 Principles of Macroeconomics; ITS 101
Introduction to International Studies; PY 101 Introduction to Psychology; SOC 100 Introduction to Sociology; and SOC 245 Contemporary Social Problems. The School of Engineering and the Department of History offers HY 106 World History and Technology I and HY 107 World History and Technology II, which also meets this requirement.

5. Engineering majors must complete a six-semester-hour sequence in either Area II or Area IV. To be considered a sequence, courses must have the same prefix and must be sequential if possible. Sequences in history, such as HY 101 Western Civilization I and HY 102 Western Civilization II or literature, such as EH 221 British and Irish Literature I: Before 1800 and EH 222 British and Irish Literature II: 1800-Present are common. Two courses in a foreign language such as ARA 101 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.

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:

1. Engineering students must successfully complete two courses applicable to their engineering program within an academic year.
2. All required courses offered by the student's specific engineering program failed at UAB must be repeated and successfully completed at UAB for the student to apply the credit to satisfy degree requirements.
3. If a Pre-Engineering student is not eligible to advance to an engineering major within 64 hours, the student may be dismissed from the School of Engineering and may not seek readmission to the School of Engineering until another baccalaureate degree is earned.

Transfer Credit

The School of Engineering follows the UAB Policy for transfer credit. Please note: Engineering technology courses are not equivalent to engineering courses.

Prerequisite and Transient Requirements

All students must comply with appropriate prerequisite and concurrent 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 concurrent 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 students wishing to register for Engineering courses who are transient 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:

1. Students in Biomedical Engineering should refer to the BME program overview in this catalog for program-specific requirements.
2. Students on Academic Warning or Probation are advised to register for no more than four courses per term.
3. Students may register for 100- or 200-level engineering courses or a 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 Policy as previously stated in this catalog.
4. Students suspended from the University will be removed from the School of Engineering and be placed in Undeclared - Interest in Engineering in the Vulcan Materials University Academic Success Center.
5. Students may not petition for readmission to the School of Engineering until the requirements for advancing to Civil, Electrical, Materials, Mechanical, or Biomedical Engineering are met.

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 Senior Associate Dean and should clearly state the circumstances resulting in their dismissal from the School and include steps taken to resolve the deficiency. The student's petition should be received in the Office of the Associate Dean of Engineering no later than five business days prior to the beginning of the desired semester of re-entry.

Graduation Requirements

All engineering students must earn a minimum of 128 semester hours and an engineering grade point average (GPA) of at least 2.00 in order to graduate. The engineering grade point average includes all engineering coursework applicable to the degree attempted at UAB. Students who are on academic warning or probation cannot graduate from the School of Engineering. BME students must also have an institutional GPA of 3.00 or higher and have earned a grade of C or better in all BME courses to graduate.

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

Minors

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

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

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

To satisfy the minor requirements, a minimum grade point average of 2.00 is required for all engineering coursework attempted for all programs. 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.

A non-engineering major who wishes to minor in engineering may choose one of the minor programs listed here.

**Minor in Applied Mechanics**

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

**Requirements**

**Grade Requirement**

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

**Required Engineering Courses**

- CE 210 Statics 3
- CE 220 Mechanics of Solids 3
- CE 360 Structural Analysis 3
- ME 215 Dynamics 3

**Civil Engineering Electives**

Select three of the following courses:

- CE 420 Advanced Mechanics
- CE 460 Structural Mechanics
- CE 461 Introduction to the Finite Element Method
- CE 462 Advanced Structural Analysis
- CE 464 Structural Dynamics

**Total Hours** 21

**Minor in Civil Engineering**

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

**Requirements**

**Grade Requirement**

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

**Required Civil Engineering Courses**

- CE 210 Statics 3
- CE 220 Mechanics of Solids 3
- CE 230 Plane Surveying 3
- CE 236 Environmental Engineering 3

**Civil Engineering Electives**

Select three of the following courses:

- CE 332 Soil Engineering
- CE 345 Transportation Engineering
- CE 360 Structural Analysis
- CE 395 Engineering Economics
- CE 450 Structural Steel Design
- CE 453 Design of Wood Structures

**Total Hours** 21

**Minor in Biomedical Engineering**

*Offered through the Department of Biomedical Engineering*

**Requirements**

**Grade Requirement**

A minimum GPA of 3.00 is required for all engineering coursework. Transfer students must earn a minimum GPA of 3.00 in UAB engineering courses attempted.

**Required Biomedical Engineering Courses**

- BME 210 Engineering in Biology 3
- BME 401 Undergraduate Biomedical Engineering Seminar 1

**Required Introduction to Engineering Course(s)**

- EGR 110 Introduction to Engineering I 2
- or EGR 200 Introduction to Engineering

**Biomedical Engineering Electives**

Select three of the following courses:

- BME 310 Biomaterials
- BME 312 Biocomputing
- BME 313 Bioinstrumentation
- BME 333 Biomechanics of Solids
- BME 340 Bioimaging
- BME 350 Biological Transport Phenomena

**Total Hours** 21
Minor in Electrical Engineering

*Offered through the Department of Electrical and Computer Engineering*

**Requirements**

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

**Required Electrical Engineering Courses**

<table>
<thead>
<tr>
<th>Course</th>
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<td>Electrical Circuits</td>
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</tr>
<tr>
<td>EE 316</td>
<td>Electrical Networks</td>
<td>4</td>
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<td>EE 351</td>
<td>Electronics</td>
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**Required Engineering Course**

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

**Total Hours:** 23

Minor in Engineering Science

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>EE 312</td>
<td>Electrical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 241</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>MSE 280</td>
<td>Engineering Materials</td>
<td>3</td>
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</tbody>
</table>

**Required Engineering Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>EE 312</td>
<td>Electrical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 241</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>MSE 280</td>
<td>Engineering Materials</td>
<td>3</td>
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</tbody>
</table>

**Required Introduction to Engineering Course(s)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 110</td>
<td>Introduction to Engineering</td>
<td>2</td>
</tr>
<tr>
<td>&amp; EGR 111</td>
<td>and Introduction to Engineering</td>
<td></td>
</tr>
<tr>
<td>or EGR 200</td>
<td>Introduction to Engineering</td>
<td></td>
</tr>
</tbody>
</table>

**Engineering Electives**

Select two of the following courses:

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

**Total Hours:** 20-21

Minor in Environmental Engineering

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

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 236</td>
<td>Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 337</td>
<td>Hydraulics</td>
<td>3</td>
</tr>
<tr>
<td>CE 340</td>
<td>Water Supply/Drainage Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 430</td>
<td>Water Supply/Drainage Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 480</td>
<td>Introduction to Water and Wastewater Design</td>
<td>3</td>
</tr>
</tbody>
</table>

**Civil Engineering Electives**

Select three of the following courses:

- CE 344  Civil Engineering Analysis I
- CE 433  Solid and Hazardous Wastes Management
- CE 434  Air Quality Modeling and Monitoring
- CE 437  Environmental Experimental Design and Field Sampling
- CE 485  Engineering Hydrology

**Total Hours:** 21

Minor in Engineering World Health

*Offered through the Department of Materials Science and Engineering*

**Requirements**

Choose 3 of the following Engineering courses

- BME 310  Biomaterials
- BME 312  Biocomputing
- BME 313  Bioinstrumentation
- CE 220  Mechanics of Solids
- CE 230  Plane Surveying
- CE 236  Environmental Engineering

**Total Hours:** 9

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

Required Materials Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE 280</td>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 281</td>
<td>Physical Materials I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 281L</td>
<td>Physical Materials I Laboratory</td>
<td></td>
</tr>
<tr>
<td>MSE 380</td>
<td>Thermodynamics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 381</td>
<td>Physical Materials II</td>
<td>3</td>
</tr>
<tr>
<td>MSE 382</td>
<td>Mechanical Behavior of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 465</td>
<td>Characterization of Materials</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 465L</td>
<td>Characterization of Materials Lab</td>
<td></td>
</tr>
</tbody>
</table>

Materials Engineering Electives

Select one of the following courses: 3-4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE 413</td>
<td>Composite Materials</td>
</tr>
<tr>
<td>MSE 430</td>
<td>Polymeric Materials</td>
</tr>
<tr>
<td>&amp; 430L</td>
<td>Polymeric Materials Laboratory</td>
</tr>
<tr>
<td>MSE 464</td>
<td>Metals and Alloys</td>
</tr>
<tr>
<td>&amp; 464L</td>
<td>Metals and Alloys Laboratory</td>
</tr>
<tr>
<td>MSE 470</td>
<td>Ceramic Materials</td>
</tr>
</tbody>
</table>

Total Hours 23-24

Minor in Mechanical Engineering - Thermal Systems

Offered through the Department of Mechanical Engineering

Required Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 241</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>ME 242</td>
<td>Thermodynamics II</td>
<td>3</td>
</tr>
<tr>
<td>ME 321</td>
<td>Introduction to Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 322</td>
<td>Introduction to Heat Transfer</td>
<td>3</td>
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</table>

Mechanical Engineering Electives

Select three courses from the following: 9

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

Total Hours 21

Minor in Mechanical Engineering - Mechanical Systems

Offered through the Department of Mechanical Engineering

Required Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 210</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>CE 220</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>ME 215</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 370</td>
<td>Kinematics and Dynamics of Machinery</td>
<td></td>
</tr>
<tr>
<td>ME 371</td>
<td>Machine Design</td>
<td>3</td>
</tr>
</tbody>
</table>

Engineering Electives

Select two of the following courses: 6

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

Total Hours 21

Minor in Software Engineering

Offered through the Department of Electrical and Computer Engineering

Required Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 210</td>
<td>Digital Logic</td>
<td>3</td>
</tr>
<tr>
<td>EE 233</td>
<td>Engineering Programming Methods</td>
<td>3</td>
</tr>
<tr>
<td>EE 333</td>
<td>Engineering Programming Using Objects</td>
<td></td>
</tr>
<tr>
<td>EE 337</td>
<td>Introduction to Microprocessors</td>
<td>4</td>
</tr>
<tr>
<td>EE 432</td>
<td>Introduction to Computer Networking</td>
<td></td>
</tr>
</tbody>
</table>

Required Engineering Course

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

Electrical Engineering Electives

Select one of the following courses: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>EE 433</td>
<td>Engineering Software Solutions</td>
</tr>
<tr>
<td>EE 444</td>
<td>Real-Time Process &amp; Protocols</td>
</tr>
<tr>
<td>EE 447</td>
<td>Internet/Intranet Application Development</td>
</tr>
<tr>
<td>EE 452</td>
<td>Digital Systems Design</td>
</tr>
</tbody>
</table>

Total Hours 22

Minor in Neuroengineering

Offered through the Department of Biomedical Engineering

Required Engineering Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EGR 150</td>
<td>Computer Methods in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BME 312</td>
<td>Biocomputing</td>
<td>3</td>
</tr>
<tr>
<td>NBL 355</td>
<td>Mechanisms of Synaptic Transmission</td>
<td></td>
</tr>
<tr>
<td>NBL 356</td>
<td>Mechanisms of Sensation, Movement &amp; Cognition</td>
<td></td>
</tr>
<tr>
<td>BME 450</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following: 3

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>NBL 425</td>
<td></td>
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<tr>
<td>NBL 454</td>
<td></td>
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</tbody>
</table>
Honors Programs are offered by all undergraduate degree programs. Students interested in exploring the Business Administration Minor should contact the academic advisor in the School of Engineering at (205) 934-8410.

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 3.0 (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 during spring semester of each year.

Requirements
Honors programs require nine credit hours of honors coursework.

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

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

BME-Biomedical Engineering Courses

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

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

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

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

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

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

BME 333. Biomechanics of Solids. 3 Hours.
Application of mechanics of solids principles to biomedical engineering problems: stress-strain of bone, viscoelasticity and constitutive equations of tissues, mechanics of the cell, introduction to molecular mechanics.
Prerequisites: EGR 265 [Min Grade: C](Can be taken Concurrently) or MA 227 [Min Grade: C](Can be taken Concurrently) and MA 252 [Min Grade: C](Can be taken Concurrently) and ME 215 [Min Grade: C](Can be taken Concurrently)

BME 340. Bioimaging. 3 Hours.
Overview of diagnostic imaging including major imaging modalities such as X-Ray/CT, Nuclear Imaging, Ultrasound, Magnetic Resonance and in vivo molecular imaging approaches. Physical principles of image formation, image interpretation and patient safety.
Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and BME 210 [Min Grade: C] and EE 312 [Min Grade: C](Can be taken Concurrently)
BME 350. Biological Transport Phenomena. 3 Hours.
Basic mechanisms and mathematical analysis of transport processes with biological and biomedical applications. Analysis of flow, transport and reaction processes for biological fluids and biological molecules with applications towards development of artificial organs, drug delivery systems and tissue engineering products.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and BME 210 [Min Grade: C](Can be taken Concurrently) and BY 409 [Min Grade: C](Can be taken Concurrently) and ME 215 [Min Grade: C](Can be taken Concurrently)

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

BME 408. Advanced Biological Transport Phenomena. 3 Hours.
Application of fluid mechanics in blood flow in the circulatory system; cardiovascular fluid mechanics, wall shear stress and the development of atherosclerosis, viscoelastic behavior of the arteries, non-Newtonian character of blood.

Prerequisites: BME 350 [Min Grade: C] and (CE 220 [Min Grade: C] or BME 333 [Min Grade: C])

BME 417. Engineering Analysis. 3 Hours.
Solutions to engineering problems involving ordinary and partial differential equations; Laplace transform, power series, Bessel functions, Legendre polynomials, Fourier series, Fourier integral and transform, Sturm-Liouville and separation of variables.

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

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

Prerequisites: BME 310 [Min Grade: C] or BME 311 [Min Grade: C]

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

Prerequisites: BME 312 [Min Grade: C]

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

Prerequisites: BY 123 [Min Grade: B] and BY 210 [Min Grade: B]

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

Prerequisites: BME 310 [Min Grade: C] or BME 311 [Min Grade: C]

BME 443. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] or MA 252 [Min Grade: C]) and PH 222 [Min Grade: C]

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

Prerequisites: BME 312 [Min Grade: C]

BME 454. Introduction to Pharmaceutical Engineering. 3 Hours.
This course is designed to introduce the science and biopharmaceutical principles of drug delivery to undergraduate students of Biomedical Engineering. Graduate students of BME, Pharmacology & Toxicology and Chemistry are also eligible to take it as an elective course.

Prerequisites: BME 310 [Min Grade: D] and CH 115 [Min Grade: D] and CH 116 [Min Grade: D]

BME 461. Bioelectric Phenomena. 3 Hours.
Quantitative methods in electrophysiology of neural, cardiac, and skeletal muscle systems.

Prerequisites: PH 222 [Min Grade: C] and BME 312 [Min Grade: C]

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

Prerequisites: BME 312 [Min Grade: C]

BME 471. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansi strain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C]) and (BME 333 [Min Grade: C] or CE 220 [Min Grade: C])

BME 472. Industrial Bioprocessing and Biomanufacturing. 3 Hours.
This course will introduce students to the growing industries related to biomedical, biopharmaceutical and biotechnology. It is targeted to offer an advanced overview of industrial bioprocessing and biomanufacturing with an emphasis on vision and audition, planning and decision-making, and also convey some of the challenges and opportunities awaiting.

Prerequisites: BME 310 [Min Grade: C] and CH 115 [Min Grade: D] and CH 116 [Min Grade: D] and BY 330 [Min Grade: C](Can be taken Concurrently) or CH 460 [Min Grade: C](Can be taken Concurrently)

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

Prerequisites: ME 215 [Min Grade: C]
BME 489. Undergraduate Research in Biomedical Engineering. 1-3 Hour.
Undergraduate research experiences in biomedical 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] 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)

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

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

BME 494. Honors Research I. 1-3 Hour.
Research experiences for undergraduates enrolled in the departmental honors program. The student should write a proposal and make a presentation based on the proposal.
Prerequisites: EGR 301 [Min Grade: C] 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 multi-disciplinary teams that include students from the School of Business to develop design concepts for both a client-based prototype and a commercializable version. Designs take into account client needs as well as legal, regulatory, and marketing requirements. Business ethics are also covered. Emphasis is placed on communication in both oral and written format to targeted audiences.
Prerequisites: BME 310 [Min Grade: C](Can be taken Concurrently) and BME 312 [Min Grade: C](Can be taken Concurrently) and BME 313 [Min Grade: C](Can be taken Concurrently) and BME 333 [Min Grade: C](Can be taken Concurrently)

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

CE-Civil Engineering Courses

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

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

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

CE 220. Mechanics of Solids. 3 Hours.
Variation of stress at a point. Equilibrium requirements and body force concepts. Variation of strain at a point. Strain gage installation and applications. Measurement of forces, displacements, strains, and other variables. Writing is a significant component of this course.
Prerequisites: CE 220 [Min Grade: D](Can be taken Concurrently)

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

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

CE 230. Plane Surveying. 3 Hours.
Care and use of surveying instruments, surveying methods, error theory, traversing, stadia, mapping techniques, circular and parabolic curves, areas, and volumes. CE 230L must be taken concurrently.
Prerequisites: MA 125 [Min Grade: C]

CE 230L. Plane Surveying Laboratory. 0 Hours.
To provide the student with an understanding of the principles of land measurement, the instruments and techniques used in surveying, theory of errors and mathematical precision in engineering analysis and design. To provide an introduction to route surveying, and the principles of horizontal and vertical curves. Companion to CE 230 and must be taken concurrently.

CE 236. Environmental Engineering. 3 Hours.
Air/water pollution and solid waste. Quality of environment. Environmental health. Regulations and legal considerations. Ethics and Civic Responsibility are significant components of this courses.
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 200 [Min Grade: D] and CE 220 [Min Grade: D]

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

CE 337. Hydraulics. 3 Hours.
Fundamentals of hydraulics including properties of water; hydrostatic
forces and pressures; flow, head losses, and related phenomena in
pipes; river hydrograph routing; statistical hydrology; flow in open
channels; culvert design; applied hydraulic modeling. Must have a grade
of C or better to complete the course.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

CE 344. Civil Engineering Analysis I. 3 Hours.
Inspection and treatment of data using exploratory data analysis.
Introduction to probability. Basic data analysis using comparisons and
regression, hypothesis testing, and analysis of variance. Quality control
and reliability analyses. Quantitative Literacy is a significant component
of this course.
Prerequisites: MA 126 [Min Grade: C] or MA 226 [Min Grade: C]

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

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

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

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

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

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

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

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

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

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

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

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

CE 441. Civil Engineering Honors Seminar. 1 Hour.
Seminar focusing on student research and guest presentations of various
topics of interest to civil and environmental engineering students.
CE 443. Pavement Design and Construction. 3 Hours.
Analysis of stresses and strains in pavement systems. Design and construction of flexible and rigid pavements, base courses, and subgrades. Effects of loading on pavement life.
Prerequisites: CE 345 [Min Grade: D]

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

CE 453. Design of Wood Structures. 3 Hours.
Design and detailing of timber structures. Properties and specifications for dimension and glulam timber. Design of beams, columns, beam-columns, connections (nail and bolts), roof diaphragms, and shear walls. Design of timber structures to meet the requirements of the National Design Specification Standards.
Prerequisites: CE 360 [Min Grade: C]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CE 498. Capstone Design Project Lab. 0 Hours.
Review of engineering, math, and science topics in preparation for the FE exam. The importance of professional licensure and professional development are also covered. Students must register for and take the FE exam in order to receive credit for this course. CE 499 must be taken concurrently.
CE 499. Capstone Design Project. 3 Hours.
Students work in teams to complete a capstone design project that incorporates the major aspects of civil engineering design including structural, geotechnical, environmental, transportation, and construction management components. The course also includes lecturing and assignments related to professionalism including engineering ethics, leadership, and management. Normally taken during last term before graduation. CE 498 is a companion lab and must be taken concurrently.

Prerequisites: CE 332 [Min Grade: D] and CE 337 [Min Grade: C] and CE 345 [Min Grade: D] and (CE 450 [Min Grade: D] or CE 455 [Min Grade: D]) and CE 430 [Min Grade: D](Can be taken Concurrently) or CE 480 [Min Grade: D](Can be taken Concurrently) and CE 497 [Min Grade: D](Can be taken Concurrently)

EE-Electrical Computer Egr Courses

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

EE 210. Digital Logic. 3 Hours.
Number systems and codes. Boolean algebra and combinational logic. Arithmetic and logic circuits. Memory elements. Synchronous sequential logic. Lecture and computer laboratory.

Prerequisites: MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 125 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C](Can be taken Concurrently)

EE 233. Engineering Programming Methods. 3 Hours.
Program design techniques, data structures, coding and documentation standards. File I/O. Product design and life cycles. Testing and software tools. Lecture and computer laboratory.

Prerequisites: (MA 106 [Min Grade: C] or MA 107 [Min Grade: C] or MA 125 [Min Grade: C](Can be taken Concurrently) or MA 225 [Min Grade: C](Can be taken Concurrently) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

EE 254. Applied Numerical Methods. 3 Hours.
Selected mathematical and computational topics appropriate to the numerical solution of engineering problems.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D]) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C] and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

EE 300. Engineering Problem Solving II. 3 Hours.
Selected mathematical and computational topics appropriate to the solution of engineering problems, including probability and statistics.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: D]) and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C] and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C])

EE 305. Fundamentals of Electrical Engineering. 3 Hours.
Survey of topics fundamental to field of electrical engineering. For non-engineering majors. Not available for credit toward engineering major.

Prerequisites: MA 109 [Min Grade: C]

EE 312. Electrical Systems. 3 Hours.
Introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, ideal transformers, and electrical safety. For non-EE majors.

Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 314. Electrical Circuits. 3 Hours.
Introduction to DC circuit analysis, AC steady-state analysis, first-order transient analysis, and electrical safety. For EE Majors.

Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 314R. Electrical Circuits Recitation. 0 Hours.
An application based course designed to reinforce concepts from EE 314.

Prerequisites: (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C]) and PH 221 [Min Grade: C]

EE 316. Electrical Networks. 4 Hours.
Analysis of circuits using classical differential/integral techniques, Laplace transforms, and two-port network parameters. Circuit solution using simulation. EE 316L must be taken concurrently. Quantitative Literacy is a significant component of this course.

Prerequisites: EGR 265 [Min Grade: C] or (MA 227 [Min Grade: C] and MA 252 [Min Grade: C](Can be taken Concurrently) and EH 101 [Min Grade: C] and PH 222 [Min Grade: C] and EE 314 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and (MA 126 [Min Grade: C] or MA 226 [Min Grade: C])

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

EE 318. Signals and Systems. 3 Hours.
Time-domain and frequency-domain methods for modeling and analyzing continuous and discrete-time signals and systems. Fourier, Laplace, and Z transform methods.

Prerequisites: EE 300 [Min Grade: D] and EE 316 [Min Grade: C]

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

Prerequisites: EE 233 [Min Grade: D]

EE 337. Introduction to Microprocessors. 4 Hours.
Application of microcomputers to engineering problems such as data acquisition and control. Topics include CPU architecture, assembly language, and input/output interfacing. EE 337L must be taken concurrently.

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

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

EE 341. Electromagnetics. 3 Hours.
Mathematical techniques used to solve electromagnetics problems. Fundamental concepts and applications for dynamic and static problems. Electromagnetic wave propagation and transmission. Transmission lines.

Prerequisites: EE 300 [Min Grade: D](Can be taken Concurrently) and EE 316 [Min Grade: C]

EE 351. Electronics. 4 Hours.
Solid-state electronics, bipolar junction and field-effect transistor (FET) properties, biasing, frequency response, single and multistage amplifier circuits. EE 351L must be taken concurrently.

Prerequisites: EE 210 [Min Grade: C] and EE 316 [Min Grade: C]
EE 351L. Electronics Laboratory. 0 Hours.
Electronics laboratory component. EE 351 must be taken concurrently.

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

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

EE 412. Practical Computer Vision. 3 Hours.
Fundamentals and applications of computer vision: image preprocessing, detection, segmentation, registration, classification and recognition, texture and color, visual tracking.
Prerequisites: EGR 150 [Min Grade: C] and EE 318 [Min Grade: D]

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

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

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

EE 427. Controls and Automation. 3 Hours.
Power control devices and applications. Relay logic and translation to other forms. Programmable logic controllers. Proportional-integral-derivative and other methods for process control. Modern laboratory instrumentation and man-machine interface software. Lecture and laboratory.
Prerequisites: EE 233 [Min Grade: D] and (EE 312 [Min Grade: C] or EE 314 [Min Grade: C]) and EE 316 [Min Grade: C] and EE 318 [Min Grade: D] and EE 351 [Min Grade: D] and (EGR 150 [Min Grade: C] or EE 130 [Min Grade: D] or ME 130 [Min Grade: C] or ME 134 [Min Grade: C])

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

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

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

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

EE 437. Introduction to Embedded Systems. 3 Hours.
Applications of microprocessors in engineering problems such as data acquisition, control, and real-time input/output. Lecture and laboratory.
Prerequisites: (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C] or EE 130 [Min Grade: C] or ME 130 [Min Grade: C] or EE 210 [Min Grade: C] or EE 233 [Min Grade: D] or EE 333 [Min Grade: D] or EE 337 [Min Grade: D])

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

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

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

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

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

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

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

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

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

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

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

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

EE 491. Individual Study in (Area). 3 Hours.
Topic assigned with course.

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

EE 493. Honors Research II. 4 Hours.
Departmental honors students work closely with faculty to develop research skills.
Prerequisites: EGR 301 [Min Grade: P]
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 227 [Min Grade: C] or EGR 265 [Min Grade: C]) (Can be taken Concurrently) or MA 125 [Min Grade: C] (Can be taken Concurrently) or MA 225 [Min Grade: C] (Can be taken Concurrently)

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

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

EGR 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 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 (Area). 0-6 Hours.
Special Topics in engineering.

ME-Mechanical Engineering Courses

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

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

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

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

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

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

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

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

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

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

ME 360. Introduction to Mechatronic Systems Engineering. 3 Hours.
Prerequisites: ME 215 [Min Grade: C] and ME 364 [Min Grade: C]
ME 361. Thermo-Fluids Systems. 3 Hours.
Pressure, temperature, fluid flow, and heat transfer instrumentation and their application to measurements of mass, heat, and momentum transport, flow characterization, heat engine and refrigeration cycles, and other thermal-fluids experiments. Experimental uncertainty analysis. Writing proficiency is required. ME 361L must be taken concurrently.
Prerequisites: ME 242 [Min Grade: C](Can be taken Concurrently) and ME 322 [Min Grade: C](Can be taken Concurrently)

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

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

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

ME 371. Machine Design. 3 Hours.
Body stress, deflection and fatigue strength of machine components. Failure theories, safety factors and reliability, surface damage. Application to the design of gears, shafts, bearings, welded joints, threaded fasteners, belts and chains, keys, pins, springs, as well as mechanical design and selection of other machine components. Software applications, design projects, and exposure to hardware and systems are used to reinforce concepts.
Prerequisites: CE 220 [Min Grade: C] and (BME 150 [Min Grade: C] or EGR 150 [Min Grade: C]) and ME 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 445. Combustion. 3 Hours.
Evaluation of the impact of fuel characteristics and operating conditions on the performance of coal-fired electric utility steam-raising plant and the prospects for continued reliance on coal as fuel for electric power generation. The phenomena emphasized are the behavior of turbulent jets; ignition, devolatilization and combustion of coal particles; radiative heat transfer and the effect of ash deposits on heat transfer; formation of air pollutants and their removal from combustion products; integrated gasification combined cycle; and capture and sequestration of carbon dioxide.
Prerequisites: ME 242 [Min Grade: C] and ME 322 [Min Grade: C]

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

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

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

ME 454. Heating, Ventilating and Air Conditioning. 3 Hours.
Fundamentals and practice associated with heating, ventilating, and air conditioning; study of heat and moisture flow in structures, energy consumption, and design of practical systems.
Prerequisites: ME 322 [Min Grade: C]
ME 455. Thermal-Fluid Systems Design. 3 Hours.
Comprehensive design problems requiring engineering decisions and
code/Standard compliance. Emphasis on energy system components:
piping networks, pumps, heat exchangers. Includes fluid transients and
system modeling.
Prerequisites: ME 322 [Min Grade: C]

ME 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.
Concepts and applications of finite element method. Development and
applications of basic elements used in engineering mechanics. Use of
finite element analysis software. Application of finite element concept to
several areas of mechanics.
Prerequisites: CE 220 [Min Grade: C]

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

ME 475. Mechanical Vibrations. 3 Hours.
Development of equations of motion for free and forced single-degree-of-
freedom (SDOF) systems. Multi-degree-of-freedom systems. Transient
response, support motion and vibration isolation for SDOFs. Vibration
absorbers, generalized mass and stiffness, orthogonality of normal
modes, and root solving and Gauss elimination procedures. Chelosky
decomposition and Jacobi diagonalization methods.
Prerequisites: MA 227 [Min Grade: C] and MA 252 [Min Grade: C] or
EGR 265 [Min Grade: C] and ME 215 [Min Grade: C]

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

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

ME 480. Instrumentation and Measurements. 3 Hours.
Through exploration of fundamental measurement concepts and
techniques for data acquisition and validation. Explanation of important
selection criteria for the identification and configuration of commercially
available data acquisition devices. Students will get hands-on experience
following best practices for data acquisition (high speed vs low speed)
relevant to their field of study or career. Many types of sensors, their
underlying technology, and measurement techniques will be discussed
(i.e. accelerometers, load cells, Digital Image Correlation, etc.) to
demonstrate best practices for sensor selection for a wide range of
specialized applications.

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

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

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

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

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

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

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

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

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

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

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

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

MSE 380. Thermodynamics of Materials. 3 Hours.
First, second, and third laws of thermodynamics. Gibbs free energy, heat capacity, enthalpy, entropy, and relationships between thermodynamic functions. Free-energy versus composition relationships; behavior of ideal and non-ideal solutions; concept of thermodynamic activity of components in solution. Applications to materials systems.
Prerequisites: CH 117 [Min Grade: D] and CH 118 [Min Grade: D] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and MSE 280 [Min Grade: D]

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

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

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

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

MSE 408. Nanobiomaterials. 3 Hours.
Basic tools of nanotechnology, building blocks of nanostructured materials. Behavior of materials with nanoscale structures and their technological applications, including automotive, medical, and electronic applications. Introduction to biomaterials and nanobiomaterials. Concepts in tissue engineering with special focus on nanoscaffolds and nanoparticles in drug delivery.
Prerequisites: MSE 280 [Min Grade: D]

MSE 409. Principles of Metal Casting. 3 Hours.
Production and evaluation of cast ferrous metals (gray iron, ductile iron, steel) and non-ferrous metals (brass, bronze, aluminum). Design of castings and molds. Laboratory on the gating, risering and molten metal treatment, analysis and handling techniques required to produce high quality castings. MSE 409L must be taken concurrently.
Prerequisites: MSE 280 [Min Grade: D]

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

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

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

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

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

MSE 445. The Evolution of Engineering Materials. 3 Hours.
Past, present and future of engineering materials; how new materials and processing methods have impacted human society, from the Stone Age until today. Taught as a 3-week study abroad course in Germany, with visits to universities, industrial facilities, research labs, museums and selected cultural sites.
Prerequisites: MSE 280 [Min Grade: D]
MSE 462. Composites Manufacturing. 3 Hours.
Principles of manufacturing and processing of polymeric matrix composites. Production techniques including filament winding, pultrusion, and liquid infusion techniques combined with design, environmental and manufacturing issues of polymer matrix composites.
Prerequisites: MSE 281 [Min Grade: D]

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

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

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

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

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

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

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

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

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

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

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

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