Engineering, Design, and Society

Program Description

The Department of Engineering, Design, and Society (EDS) engages in research, education, and outreach that inspires and empowers engineers and applied scientists to become innovative and impactful leaders. Our specialization is in socio-technical integration, design problem definition and solution, and interdisciplinary, real-world engineering design educational experiences. We seek to educate future leaders who will address the challenges of attaining a thriving, sustainable global society.

EDS is home to:

**Bachelor of Science in Design Engineering:** Design Engineering is an interdisciplinary engineering degree that focuses on the creation of innovative solutions to the challenging problems facing people, societies, and the world. Through a sequence of Integrated Design Studios that bridge first-year Cornerstone Design and senior-year Capstone Design, students become experts in design methods that deploy engineering principles to address human problems in real-world contexts. Design Engineering provides the flexibility for students to create specialized focus areas that suit their individual career and personal interests, and it ensures they gain practical engineering experience throughout their education at Mines.

**Humanitarian Engineering:** Mines' Humanitarian Engineering (HE) program is recognized internationally for its research, education, and outreach in socially responsible engineering. At the undergraduate level, HE includes two minors, Engineering for Community Development and Leadership in Social Responsibility, along with a range of electives courses open to all Mines students. At the graduate level, the interdisciplinary Humanitarian Engineering and Science program offers MS thesis and non-thesis degree options as well as a graduate certificate. HE enables Mines students to understand how engineering can contribute to co-creating just and sustainable solutions to the problems faced by communities globally.

**Cornerstone Design:** Cornerstone Design is a two-course sequence introducing Mines students to the engineering problem solving process. Cornerstone Design I (EDNS151), enrolled by all first-year Mines students, teaches open-ended problem solving, project management, professional communications, and teaming skills—all within a human-centered design framework. Cornerstone Design II (EDNS251 or a similar second-year course), enrolled by approximately half of Mines sophomore engineering students, applies and advances lessons from Cornerstone Design I by responding to real-world engineering challenges.

**Capstone Design:** Capstone Design entails a culminating two-semester senior design sequence for over half of Mines' engineering students, including those in the Design, Civil, Electrical, Environmental, and Mechanical Engineering programs. Capstone Design program provides unique client-sponsored, hands-on, interdisciplinary engineering project experiences for participating students.

Programs

Design Engineering

The Bachelor of Science in Design Engineering offers an interdisciplinary, creative, and flexible program of study that complements Mines' signature strengths in engineering and applied science. Design Engineering integrates:

1) The inspiration and engagement of studio-based design education focusing on technology innovation; open-ended problem solving, and social impact
2) The insights and analytic perspectives of a broad, liberal arts education, which helps students focus attention on the right problems and the best overall solutions
3) Mines' signature strength in engineering applications, built upon the fundamentals of mathematics, science, and engineering analysis

The Design Engineering curriculum revolves around hands-on, project-based design studios every semester, culminating in Capstone Design. We offer a unique educational experience through our Integrative Design Studios, which bridge the technical, social, and creative potentials of engineering problem solving. Additionally, Design Engineering allows students to specialize in a focus area of their choice, enabling students to apply their design expertise and pursue depth of study in an area of personal interest. Focus areas span emerging technologies, the application of technology to underserved communities, and the creation of new technology-driven startups. Design Engineering program details are provided under the Major tab above.

Humanitarian Engineering

Humanitarian Engineering (HE) serves students with a passion for contributing to social and environmental problem solving. HE connects these students to Mines faculty who lead in applying engineering techniques to pressing social, environmental, and community challenges. Integrating engineering with social sciences and design, the HE program spans minors, Design Engineering focus areas, and elective courses where students learn how to work with the communities they serve to create solutions that promote justice, responsibility, and sustainability. HE serves students from any discipline and with diverse career goals spanning NGOs, government agencies and research groups, startup businesses, and established companies. Seminar-style courses offered by the Engineering, Design, and Society Department and the Humanities, Arts, and Social Sciences Department, along with selected technical electives offered by other academic units across campus, provide students a balance of breadth and depth in areas related to Humanitarian Engineering. HE program details are provided under the Minor tab above.

**Engineering for Community Development**

The HE Minor in Engineering for Community Development (ECD) is an evolution of the country's very first minor in Humanitarian Engineering created at Mines in 2003. Designed specifically for engineers and applied scientists who desire to serve communities, the ECD minor prepares students to become leaders in community development through engineering.

Graduates with the ECD minor can work at the U.S. Peace Corps (see Mines Peace Corps Prep Program), community service NGOs, international organizations, or a range of companies hosting projects related to community development. The knowledge and skills learned through the ECD minor prepares graduates for any engineering job involving community engagement, cross-cultural work environments, or human-centered design.
The ECD minor is designed to support any degree program on campus.

Leadership in Social Responsibility

The HE Minor in Leadership in Social Responsibility (LSR) is the country’s first undergraduate minor in social responsibility designed specifically for engineers and applied scientists. The LSR minor prepares Mines students to become leaders in promoting shared social, environmental, and economic value for companies and their stakeholders.

Graduates of the LSR minor are sought by corporate employers that desire engineers who are prepared to factor public perception and community acceptance into the decisions they make and the technologies and processes they design. Graduates will also be prepared to take jobs that focus on corporate social responsibility, stakeholder engagement, and sustainability.

The LSR minor is designed to support any degree program on campus.

Humanitarian Engineering and Science (HES) Graduate Programs

The EDS Department also delivers the core curriculum of the interdepartmental Humanitarian Engineering and Science graduate programs. HES program details are in the Mines Catalog under Interdisciplinary Graduate Programs and are also summarized under the Humanitarian Engineering Masters tab above.

Cornerstone Design

Cornerstone Design immerses students in hands-on, open-ended problem-solving through iterative, project-based inquiry. Cornerstone Design combines engineering design, design thinking, and systems analysis to pursue open-ended problem scoping, definition, and articulation—all supported by direct stakeholder engagement and scholarly research. Students learn creative concept generation and selection techniques, solution validation and iteration, prototype development and testing, authoritative information gathering, and engineering analysis. Throughout these design experiences, students learn fundamental STEM analysis, a variety of design tools, and the professional communication skills necessary for academic and professional success.

In Cornerstone Design I (EDNS151), students work in teams on a semester-long design project, learning to communicate technical ideas and solutions visually, orally, in writing, and through prototype demonstrations. Cornerstone Design I introduces students to the human-centered design process. It includes exploration, ideation, solution concept development, and validation, while also ensuring solutions are viable, desirable, feasible, and sustainable.

Cornerstone Design II (EDNS251 and related courses) builds on the foundation of Cornerstone Design I by having student teams manage a client relationship and use commercial design software to model, predict, and analyze solution concepts. Students should check with their degree program to determine whether Cornerstone Design II is stipulated or permissible for satisfying program requirements.

Capstone Design

Capstone Design offers a one-of-a-kind, creative, multidisciplinary, team-based design experience for participating students in Design, Civil, Electrical, Environmental, and Mechanical Engineering. Capstone Design embraces the uniqueness of each disciplinary approach while enabling students to address real-world, interdisciplinary challenges. Capstone Design entails a two-semester, senior-year course sequence: Capstone Design I (EDNS491) and Capstone Design II (EDNS492).

Capstone Design addresses ABET accreditation guidelines for the engineering programs, particularly Criterion 3 Student Outcomes 2-5:

- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively with a range of audiences.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

The Capstone Design Showcase celebrates the engineering design achievements of participating students. This campus-wide celebration offers Capstone students an opportunity to present their real-world, client-driven design outcomes completed as part of their Capstone coursework.

Program Educational Objectives

The objectives of the Engineering, Design, & Society Bachelor of Science in Design Engineering program are to produce graduates who, within five years of graduation, will:

- Apply their creative interpretation of complex problems and propose novel solution concepts within unique social, technical, ethical and environmental constraints.
- Serve as innovators, bridging the gap between social, technical and creative design disciplinary teams, all while incorporating a high level of ethical standards, social consciousness and technical expertise.
- Seek to contribute to interdisciplinary endeavors and establish positions of leadership through service activities within their profession or community.
- Actively engage in lifelong learning, demonstrating continuous professional growth.

Student Learning Outcomes

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

**Bachelor of Science in Design Engineering**

The Bachelor of Science in Design Engineering is a flexible, interdisciplinary program of study combining:

1. The strength of a Mines' technical degree with fundamentals coursework in mathematics, science, and engineering
2. An integrated educational experience spanning engineering, design, innovation, social sciences, and the humanities and
3. A Focus Area allowing for a depth of study in an area of personal or career interest, such as innovation and emerging technologies, sustainability and socially responsible applications of engineering, or an individualized focus area at the intersection of technology and society.

These three components are brought together via:

4. A unique set of six Integrative Design Studios, culminating in the two-semester Capstone Design Studio.

The Integrative Design Studios teach students how to respond to authentic, open-ended problems by integrating diverse skills, perspectives, and disciplinary approaches. They also provide a broad set of design competencies that are applicable to solving problems in any domain. Students work on a wide variety of hands-on projects, individually and in teams, mastering the capacity to move creatively from ill-structured problems to concrete, innovative, human-centered solutions. Through this journey, students also develop a diverse project portfolio, illustrating their unique skills and individual identity as a design engineer.

In parallel with the experiential design approach of the integrative design studios, students have great flexibility in selecting engineering fundamentals and electives courses from a wide variety of engineering disciplines. This flexibility allows students to prepare for their chosen Focus Area or to chart their own engineering, innovation, or design pathways.

The program also includes a design applications experience (EDNS392) for students to develop a critical understanding of how engineers analyze their design work in the social and technical realms of open-ended problem solving. This opportunity provides motivations for students to explore career options early. It also helps them better understand how their individual design expertise can contribute to a variety of engineering problems, organizational needs, and multidisciplinary teams. Together, the key components of the program promote a “design early, design often, design real” approach to engineering education.

**Program Educational Outcomes**

Within several years of completing the degree, graduates with a Bachelor of Science in Design Engineering will be engaged in progressively more responsible positions as:

- **Innovators** who are comfortable taking risks and who are energized by the belief that engineers help make the world a better place by improving people’s lives through technologies designed with and for people and the planet.

- **Design Thinkers** who confidently approach engineering problems from a human and nature-centric perspective and identify multiple design solutions before converging on improvements and results that balance technical, economic, environmental, and societal goals.

**Impact Makers** who are much more than “just” engineers, with a broad perspective to responsibly envision, design, and implement new technologies that make a positive impact on people, organizations, the environment, and society.

**Student Outcomes**

Graduates of the program will have attained ABET Student Outcomes 1-7.

**Curriculum**

The Design Engineering degree program offers students a combination of courses that includes core mathematics, basic and advanced sciences, engineering fundamentals, and foundational studies in the social sciences and humanities throughout the freshman and sophomore years.

There is strong alignment of the initial course sequence between this degree program and other engineering degree programs at Mines, allowing smooth entry into the Bachelor of Science in Design Engineering degree program at any time during the first two years.

In the junior and senior years, students complete fundamental engineering courses across the breadth of traditional engineering disciplines and pursue advanced disciplinary studies through additional engineering electives, emphasizing engineering’s breadth as well as commonalities among different engineering disciplines. Integrated with their technical studies, students learn about the many human dimensions of defining and solving problems using perspectives and approaches from the social sciences, humanities, and design, including the creative, social, cultural, political (including policy), economic, and business components critical for understanding the big challenges facing society and the environment today.

A central component of this degree program is the extensive application of technical and non-technical skillsets in response to real-world problems throughout the Integrative Design Studios. This approach increases and solidifies students’ understanding of the content from their other courses. The Integrative Design Studio culminates in the Capstone Design Studio sequence, where students draw together the entirety of their educational experience to solve client-sponsored engineering problems in specific areas of student interest.

**Bachelor of Science in Design Engineering: Degree Requirements**

The curriculum comprises six groups of coursework and experiential learning for a total of 132 credits:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Fall</th>
<th>lec</th>
<th>lab</th>
<th>sem.hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM101</td>
<td>FRESHMAN SUCCESS</td>
<td></td>
<td>1.0</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>MATH111</td>
<td>CALCULUS FOR SCIENTISTS AND ENGINEERS I</td>
<td></td>
<td>4.0</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>CHGN121</td>
<td>PRINCIPLES OF CHEMISTRY I</td>
<td></td>
<td>4.0</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>EDNS200</td>
<td>INTRODUCTION TO DESIGN ENGINEERING</td>
<td></td>
<td>3.0</td>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>EDNS151</td>
<td>CORNERSTONE - DESIGN I</td>
<td></td>
<td>3.0</td>
<td></td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Total Credits**: 15.0
### Spring

**MATH112**  
**CALCULUS FOR SCIENTISTS AND ENGINEERS II**  
lec  lab  sem.hrs  4.0

**PHGN100**  
**PHYSICS I - MECHANICS**  
lec  lab  sem.hrs  4.0

**CSCI128**  
**COMPUTER SCIENCE FOR STEM**  
lec  lab  sem.hrs  3.0

**S&W**  
**SUCCESS AND WELLNESS**  
lec  lab  sem.hrs  1.0

**HASS100**  
**NATURE AND HUMAN VALUES**  
lec  lab  sem.hrs  3.0

---

**Sophomore**

**Fall**

**MATH213**  
**CALCULUS FOR SCIENTISTS AND ENGINEERS III**  
lec  lab  sem.hrs  4.0

**PHGN200**  
**PHYSICS II - ELECTROMAGNETISM AND OPTICS**  
lec  lab  sem.hrs  4.0

**MATH201**  
**INTRODUCTION TO STATISTICS, CBEN 110, CHGN 122, CHGN 125, CSCI 101, or GEGN 101**  
lec  lab  sem.hrs  3.0

**EDNS291**  
**DESIGN UNLEASHED**  
lec  lab  sem.hrs  3.0

**ELECTIVE**  
**CULTURE AND SOCIETY (CAS) Mid-Level Restricted Elective**  
lec  lab  sem.hrs  3.0

**CSM202**  
**INTRODUCTION TO STUDENT WELL-BEING AT MINES**  
lec  lab  sem.hrs  1.0

---

**Spring**

**MATH225**  
**DIFFERENTIAL EQUATIONS**  
lec  lab  sem.hrs  3.0

**CEEN241**  
**STATICS**  
lec  lab  sem.hrs  3.0

**MEGN261**  
**THERMODYNAMICS I, CHGN 209, or CBEN 210**  
lec  lab  sem.hrs  3.0

**EDNS292**  
**DESIGN FOR A GLOBALIZED WORLD**  
lec  lab  sem.hrs  3.0

**ENGR**  
**ENGINEERING ELECTIVE**  
lec  lab  sem.hrs  3.0

---

**Junior**

**Fall**

**EBGN321**  
**ENGINEERING ECONOMICS**  
For the 2023 Catalog EBGN321 replaced EBGN201 as a Core requirement. EBGN321 was added to the core, but has a prerequisite of 60 credit hours. Students whose programs that required EBGN201 the sophomore year may need to wait to take EBGN321 until their junior year. For complete details, please visit: https://www.mines.edu/registrar/core-curriculum/  
lec  lab  sem.hrs  3.0

**MEGN212**  
**INTRODUCTION TO SOLID MECHANICS, CEEN 311, or MTGN 202**  
lec  lab  sem.hrs  3.0

**EENG281**  
**INTRODUCTION TO ELECTRICAL CIRCUITS, ELECTRONICS AND POWER or 282**  
lec  lab  sem.hrs  3.0

**ENGR**  
**ENGINEERING ELECTIVE**  
lec  lab  sem.hrs  3.0

**EDNS391**  
**DESIGN & MODELING OF INTEGRATED SYSTEMS**  
lec  lab  sem.hrs  3.0

**FOCUS**  
**FOCUS AREA**  
lec  lab  sem.hrs  3.0

---

**Senior**

**Fall**

**EBGN321**  
**ENGINEERING ECONOMICS**  
lec  lab  sem.hrs  3.0

**EENG281**  
**INTRODUCTION TO ELECTRICAL CIRCUITS, ELECTRONICS AND POWER or 282**  
lec  lab  sem.hrs  3.0

**ENGR**  
**ENGINEERING ELECTIVE**  
lec  lab  sem.hrs  3.0

**EDNS391**  
**DESIGN & MODELING OF INTEGRATED SYSTEMS**  
lec  lab  sem.hrs  3.0

**FOCUS**  
**FOCUS AREA**  
lec  lab  sem.hrs  3.0

**FREE**  
**FREE ELECTIVE**  
lec  lab  sem.hrs  3.0

---

**Spring**

**ENGR**  
**ENGINEERING ELECTIVE**  
lec  lab  sem.hrs  3.0

**MEGN351**  
**FLUID MECHANICS, CBEN 307, or CEEN 310**  
lec  lab  sem.hrs  3.0

**ENGR**  
**ENGINEERING ELECTIVE**  
lec  lab  sem.hrs  3.0

**FOCUS**  
**FOCUS AREA**  
lec  lab  sem.hrs  3.0

**FREE**  
**FREE ELECTIVE**  
lec  lab  sem.hrs  3.0

---

**Total Semester Hrs: 132.0**

* A minimum of 10 credits of Core Distributed Science courses are required. Students must take PHGN200 (PHYSICS II – ELECTROMAGNETISM AND OPTICS) and two of the common distributed science courses: CBEN110, CHGN122 or CHGN125, CSCI101, GEGN101, and MATH201. One of CSCI101 (INTRODUCTION TO COMPUTER SCIENCE) or MATH201 (PROBABILITY AND STATISTICS FOR ENGINEERS) must be taken from this list, and both can be taken depending on student preference.

*#Students have limited flexibility as to when to take two of their Core Distributed Science courses starting in their freshman year into early junior year, and should be decided in consultation with student's advisor to accommodate prerequisite requirements.

**MEGN200 does not substitute for EDNS291 DESIGN Unleashed credit in any other degree program at this time. Additionally, the EDNS292...**
sequence does not count toward MEGN200 credit for students transferring out of the DE program into Mechanical Engineering at this time.

# ENGINEERING FUNDAMENTALS courses are: (1) one of the thermodynamics courses CHGN209 or CBEN210; (2) statics CEEN241; (3) one of the circuits courses EENG281 or EENG282; (4) one of the materials courses MTGN202, CEEN311, or MEGN212; and (5) one of the fluid mechanics courses CEEN310, or MEGN351. Prerequisites may apply.

## Culture and Society (CAS) Restricted Elective courses, a minimum of 9 credit hours of upper level coursework, as described in the Core Curriculum section of the catalog. Focus Areas may list recommended courses to use for these electives.

### ENGINEERING ELECTIVES are purposefully drawn from course offerings provided through other engineering programs. Details are provided in the following section. Some of the Focus Areas identify specific courses from the list of allowed engineering electives that must be taken to satisfy the requirements of the Focus Area. Those engineering elective courses are identified in the Focus Area description as being outside of the 18 credits allocated to Focus Area Coursework.

### Focus Area courses are a coherent set of required and suggested elective offerings around a particular topic. Details are given the Focus Area Requirements section below.

## Bachelor of Science in Design Engineering: Engineering Coursework Requirements:

A minimum of 30 credits of Design Engineering Coursework (designated as ENGR in the Bachelor of Science in Design Engineering Degree Requirements listing above) are required (typically ten courses). 15 credits (typically five courses) are prescribed ENGINEERING FUNDAMENTALS courses as noted in footnote # above. The additional 15 credits are ENGINEERING ELECTIVES. The requirement of 30 credits of Engineering Coursework may include engineering courses taken as a part of a student’s Focus Areas (Focus Areas may require specific engineering courses be taken — see footnote ### above). This Engineering Coursework requirement combined with specific engineering content in the six INTEGRATIVE DESIGN STUDIOs (allocating 11 credits of the 18 credits for the design studios) and the Capstone Senior Design sequence (EDNS491 and EDNS492) produces 47 credits of engineering course work for this degree program. Note that certain ENGINEERING FUNDAMENTALS may also be prescribed by a Focus Area in order to satisfy prerequisite requirements. Likewise, students are encouraged to select ENGINEERING ELECTIVES to reinforce and complement the courses in the student’s chosen Focus Area. ENGINEERING ELECTIVES must be chosen from the list below, select 400-level courses discussed with and approved by the student’s advisor. Finally, note that students must have at least 9 credits at or above the 300-level with a common theme or subject area within the group of courses that make up the required 30 credits of ENGINEERING FUNDAMENTALS and ENGINEERING ELECTIVES to ensure a reasonable level of disciplinary depth in a single field of engineering. Furthermore, students must have at least 9 credits at or above the 400-level of ENGINEERING ELECTIVES plus the 6 credits of capstone senior design course and project work (EDNS491 and EDNS492).

The complexity of integrating various department curriculum, the potential for missing prerequisites, and the need to follow an expected course sequence requires that students develop a 2nd, 3rd and 4th year plan with their advisor during the first semester of their sophomore year course of study, and to collaboratively work with their advisor and Program Director for curricular assessment and approval prior to registration for every semester. The course plan is expected to be a dynamic roadmap for a student’s particular degree curriculum.

The following engineering-content courses can be used to satisfy the 15-credit requirement for ENGINEERING ELECTIVES. Please be aware of course prerequisites, reviewed with the student’s advisor. The below list includes approved coursework, but is not exhaustive. Students can seek approval from faculty advisor for a course not listed below.

### Chemical Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBEN308</td>
<td>HEAT TRANSFER</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN310</td>
<td>INTRODUCTION TO BIOMEDICAL</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>CBEN312</td>
<td>UNIT OPERATIONS LABORATORY</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN313</td>
<td>UNIT OPERATIONS LABORATORY</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN314</td>
<td>CHEMICAL ENGINEERING HEAT AND</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>MASS TRANSFER</td>
<td></td>
</tr>
<tr>
<td>CBEN315</td>
<td>INTRODUCTION TO ELECTROCHEMICAL</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>CBEN357</td>
<td>CHEMICAL ENGINEERING THERMODYN</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>MATICS</td>
<td></td>
</tr>
<tr>
<td>CBEN358</td>
<td>CHEMICAL ENGINEERING THERMODYN</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>LABORATORY</td>
<td></td>
</tr>
<tr>
<td>CBEN360</td>
<td>BIOPROCESS ENGINEERING</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN365</td>
<td>INTRODUCTION TO CHEMICAL</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>ENGINEERING PRACTICE</td>
<td></td>
</tr>
<tr>
<td>CBEN372</td>
<td>INTRODUCTION TO BIOENERGY</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN375</td>
<td>CHEMICAL ENGINEERING</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>SEPARATIONS</td>
<td></td>
</tr>
<tr>
<td>CBEN401</td>
<td>PROCESS OPTIMIZATION</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN403</td>
<td>PROCESS DYNAMICS AND CONTROL</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN408</td>
<td>NATURAL GAS PROCESSING</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN409</td>
<td>PETROLEUM PROCESSES</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN415</td>
<td>POLYMER SCIENCE AND TECHNOLOGY</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN416</td>
<td>POLYMER ENGINEERING AND</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>CBEN418</td>
<td>KINETICS AND REACTION</td>
<td>3.0</td>
</tr>
<tr>
<td>RES ENGINEERING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBEN420</td>
<td>MATHEMATICAL METHODS IN CHEMICAL</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>ENGINEERING</td>
<td></td>
</tr>
<tr>
<td>CBEN422</td>
<td>CHEMICAL ENGINEERING FLOW</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>ASSURANCE</td>
<td></td>
</tr>
<tr>
<td>CBEN426</td>
<td>ADVANCED FUNCTIONAL POROUS</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>MATERIALS</td>
<td></td>
</tr>
<tr>
<td>CBEN430</td>
<td>TRANSPORT PHENOMENA</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN432</td>
<td>TRANSPORT PHENOMENA IN BIOLOGICAL</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>CBEN435</td>
<td>INTERDISCIPLINARY MICROELECTRONICS</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN440</td>
<td>MOLECULAR PERSPECTIVES IN CHEMICAL</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN454</td>
<td>APPLIED BIOINFORMATICS</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN460</td>
<td>BIOCHEMICAL PROCESS ENGINEERING</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN461</td>
<td>BIOCHEMICAL PROCESS ENGINEERING</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>LABORATORY</td>
<td></td>
</tr>
<tr>
<td>CBEN469</td>
<td>FUEL CELL SCIENCE AND</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>CBEN470</td>
<td>INTRODUCTION TO MICROFLUIDICS</td>
<td>3.0</td>
</tr>
<tr>
<td>CBEN472</td>
<td>INTRODUCTION TO ENERGY</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>TECHNOLOGIES</td>
<td></td>
</tr>
<tr>
<td>CBEN480</td>
<td>NATURAL GAS HYDRATES</td>
<td>3.0</td>
</tr>
</tbody>
</table>

### Civil & Environmental Engineering
CEEN301  FUNDAMENTALS OF ENVIRONMENTAL ENGINEERING: WATER  3.0
CEEN302  FUNDAMENTALS OF ENVIRONMENTAL ENGINEERING: AIR AND WASTE MANAGEMENT  3.0
CEEN303  ENVIRONMENTAL ENGINEERING LABORATORY  3.0
CEEN312  SOIL MECHANICS  3.0
CEEN312L  SOIL MECHANICS LABORATORY  1.0
CEEN314  STRUCTURAL ANALYSIS  3.0
CEEN315  CIVIL AND ENVIRONMENTAL ENGINEERING TOOLS  1.0
CEEN330  ENGINEERING FIELD SESSION, ENVIRONMENTAL  3.0
CEEN331  ENGINEERING FIELD SESSION, CIVIL  3.0
CEEN350  CIVIL AND CONSTRUCTION ENGINEERING MATERIALS  3.0
CEEN360  INTRODUCTION TO CONSTRUCTION ENGINEERING  3.0
CEEN381  HYDROLOGY AND WATER RESOURCES ENGINEERING  3.0
CEEN401  LIFE CYCLE ASSESSMENT  3.0
CEEN405  NUMERICAL METHODS FOR ENGINEERS  3.0
CEEN406  FINITE ELEMENT METHODS FOR ENGINEERS  3.0
CEEN410  ADVANCED SOIL MECHANICS  3.0
CEEN411  UNSATURATED SOIL MECHANICS  3.0
CEEN415  FOUNDATION ENGINEERING  3.0
CEEN419  RISK ASSESSMENT IN GEOTECHNICAL ENGINEERING  3.0
CEEN421  HIGHWAY AND TRAFFIC ENGINEERING  3.0
CEEN423  SURVEYING FOR ENGINEERS AND INFRASTRUCTURE DESIGN PRACTICES  3.0
CEEN425  CEMENTITIOUS MATERIALS FOR CONSTRUCTION  3.0
CEEN426  DURABILITY OF CONCRETE  3.0
CEEN430  ADVANCED STRUCTURAL ANALYSIS  3.0
CEEN433  MATRIX STRUCTURAL ANALYSIS  3.0
CEEN449  INTRODUCTION TO THE SEISMIC DESIGN OF STRUCTURES  3.0
CEEN442  DESIGN OF WOOD STRUCTURES  3.0
CEEN443  DESIGN OF STEEL STRUCTURES  3.0
CEEN445  DESIGN OF REINFORCED CONCRETE STRUCTURES  3.0
CEEN448  STRUCTURAL LOADS  3.0
CEEN460  MOLECULAR MICROBIAL ECOLOGY AND THE ENVIRONMENT  3.0
CEEN461  FUNDAMENTALS OF ECOLOGY  3.0
CEEN470  WATER AND WASTEWATER TREATMENT PROCESSES  3.0
CEEN472  ONSITE WATER RECLAMATION AND REUSE  3.0
CEEN473  HYDRAULIC PROBLEMS  3.0
CEEN475  HAZARDOUS SITE REMEDIATION ENGINEERING  3.0
CEEN478  WATER TREATMENT DESIGN AND ANALYSIS  3.0
CEEN479  AIR POLLUTION  3.0
CEEN480  CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT  3.0
CEEN482  HYDROLOGY AND WATER RESOURCES LABORATORY  3.0
CEEN493  SUSTAINABLE ENGINEERING DESIGN LABORATORY  3.0

Computer Science
CSCI303  INTRODUCTION TO DATA SCIENCE  3.0
CSCI306  SOFTWARE ENGINEERING  3.0
CSCI341  COMPUTER ORGANIZATION  3.0
CSCI370  ADVANCED SOFTWARE ENGINEERING  5.0
CSCI400  PRINCIPLES OF PROGRAMMING LANGUAGES  3.0
CSCI403  DATA BASE MANAGEMENT  3.0
CSCI404  ARTIFICIAL INTELLIGENCE  3.0
CSCI410  ELEMENTS OF COMPUTING SYSTEMS  3.0
CSCI422  USER INTERFACES  3.0
CSCI423  COMPUTER SIMULATION  3.0
CSCI425  COMPILER DESIGN  3.0
CSCI436  HUMAN-ROBOT INTERACTION  3.0
CSCI437  INTRODUCTION TO COMPUTER VISION  3.0
CSCI440  PARALLEL COMPUTING FOR SCIENTISTS AND ENGINEERS  3.0
CSCI442  OPERATING SYSTEMS  3.0
CSCI443  ADVANCED PROGRAMMING CONCEPTS USING JAVA  3.0
CSCI448  MOBILE APPLICATION DEVELOPMENT  3.0
CSCI455  GAME THEORY AND NETWORKS  3.0
CSCI470  INTRODUCTION TO MACHINE LEARNING  3.0
CSCI471  COMPUTER NETWORKS I  3.0
CSCI473  ROBOT PROGRAMMING AND PERCEPTION  3.0
CSCI475  INFORMATION SECURITY AND PRIVACY  3.0
CSCI477  ELEMENTS OF GAMES AND GAME DEVELOPMENT  3.0
CSCI478  INTRODUCTION TO BIOINFORMATICS  3.0

Electrical Engineering & Electronics
EENG307  INTRODUCTION TO FEEDBACK CONTROL SYSTEMS  3.0
EENG310  INFORMATION SYSTEMS SCIENCE I  3.0
EENG311  INFORMATION SYSTEMS SCIENCE II  3.0
EENG350  SYSTEMS EXPLORATION AND ENGINEERING DESIGN LAB  3.0
EENG383  EMBEDDED SYSTEMS  4.0
EENG385  ELECTRONIC DEVICES AND CIRCUITS  4.0
EENG386  FUNDAMENTALS OF ENGINEERING ELECTROMAGNETICS  3.0
EENG389  FUNDAMENTALS OF ELECTRIC MACHINERY  4.0
EENG390  ENERGY, ELECTRICITY, RENEWABLE ENERGY, AND ELECTRIC POWER GRID  3.0
EENG411  DIGITAL SIGNAL PROCESSING  3.0
EENG413  ANALOG AND DIGITAL COMMUNICATION SYSTEMS  4.0
EENG415  DATA SCIENCE FOR ELECTRICAL ENGINEERING  3.0
EENG417  MODERN CONTROL DESIGN  3.0
EENG423  INTRODUCTION TO VLSI DESIGN  3.0
to the directed Focus Area coursework, certain HASS and engineering electives may be suggested as supporting the Focus Area. Students should work closely with their advisor to select their electives in a way that complements their Focus Area studies.

In addition to coursework specific to their Focus Area, students must also complete a 6-credit, two-semester capstone senior design project. This project is the culmination of the student’s studies and brings together content learned through the three previous years of Integrative Design Studios, science, mathematics, engineering coursework, and Focus Area coursework.

A limited number of Focus Areas are currently defined. New Focus Areas will be added periodically, depending on student and faculty interest, as described in a separate Design Engineering Program Management document.

Current Focus Areas:

- **Energy Studies** (global energy development, sustainable energy, energy policy)
- **Robotics and Automation**
- **Water Security** (water quality, storage and management, efficient utilization, policy, law)
- **Music, Audio Engineering, and Recording Arts**
- **Corporate Sustainability**
- **Community Development**
- **STEM Teaching**
- **Individualized** (customized course of study)

Focus Area Requirements:

**Focus Area – Energy Studies:**

Students must take the following courses:

- ENGY200 INTRODUCTION TO ENERGY 3.0
- ENGY340 NUCLEAR ENERGY 3.0
- ENGY350 GEOTHERMAL ENERGY 3.0
- PHGN419 PRINCIPLES OF SOLAR ENERGY SYSTEMS 3.0
- PEGN450 ENERGY ENGINEERING * 3.0

* PEGN450 is also listed in the ENGINEERING ELECTIVE list of courses. Students may not count PEGN450 as an ENGINEERING ELECTIVE credit.

Students must also select one of the following courses:

- EBN330 ENERGY ECONOMICS 3.0
- HASS486 SCIENCE AND TECHNOLOGY POLICY ** 3.0
- HASS490 ENERGY AND SOCIETY ** 3.0

** HASS486 and HASS490, if used for Focus Area credits, may not also count toward the 9 credits of required Culture and Society (CAS) Restricted Electives.

** Focus Area – Robotics and Automation:**

NOTE: To satisfy pre-reqs - For their ENGINEERING ELECTIVES courses in students must select CSCI261 (Programming), CSCI262 (Data Structures), EENG284 (Digital).
Students must take the following courses:

MEGN315  DYNAMICS * 3.0
EENG307  INTRODUCTION TO FEEDBACK CONTROL SYSTEMS * 3.0
EENG383  EMBEDDED SYSTEMS * 4.0
MEGN441  INTRODUCTION TO ROBOTICS 3.0

* MEGN315, EENG307, and EENG383 are also listed in the ENGINEERING ELECTIVE list of courses. Students may not count these three courses as ENGINEERING ELECTIVE credits.

Students must also select two of the following courses:

CSCI404  ARTIFICIAL INTELLIGENCE 3.0
CSCI432  ROBOT ETHICS 3.0
CSCI436  HUMAN-ROBOT INTERACTION 3.0
CSCI437  INTRODUCTION TO COMPUTER VISION 3.0
CSCI470  INTRODUCTION TO MACHINE LEARNING 3.0
MEGN481  MACHINE DESIGN 3.0

Focus Area – Water Security:

NOTE: To satisfy pre-reqs - For their ENGINEERING FUNDAMENTALS courses in students must select CHGN209 (Thermo), CEEN310 (Fluids) and CEEN311 (Materials).

Students must take the following courses:

CEEN301  FUNDAMENTALS OF ENVIRONMENTAL ENGINEERING: WATER * 3.0
CEEN381  HYDROLOGY AND WATER RESOURCES ENGINEERING * 3.0
CHGN403  INTRODUCTION TO ENVIRONMENTAL CHEMISTRY 3.0
CEEN470  WATER AND WASTEWATER TREATMENT PROCESSES 3.0
CEEN480  CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT 3.0

* CEEN301 and CEEN381 are also listed in the ENGINEERING ELECTIVE list of courses. Students may not also count these courses as ENGINEERING ELECTIVE courses.

Students must also select one of the following courses:

EBGN310  ENVIRONMENTAL AND RESOURCE ECONOMICS 3.0
HASS488  GLOBAL WATER POLITICS AND POLICY ** 3.0

** HASS488, if used for Focus Area credits, may not also count toward the 9 credits of Culture and Society (CAS) Restricted Electives.

Focus Area – Music, Audio Engineering, and Recording Arts:

NOTE: To satisfy pre-reqs - For their ENGINEERING ELECTIVES courses in students must select EENG307 (Feedback Control) and MEGN315 (Dynamics).

Students must take the following courses**:

HASS324  AUDIO/ACOUSTICAL ENGINEERING AND SCIENCE ** 3.0
HASS326  MUSIC THEORY ** 3.0
HASS327  MUSIC TECHNOLOGY ** 3.0
HASS429  REAL WORLD RECORDING/RESEARCH ** 3.0
EENG385  ELECTRONIC DEVICES AND CIRCUITS 4.0
MEGN416  ENGINEERING VIBRATION 3.0

** HASS324, HASS326, HASS327, and HASS429 may not also count toward the required 9 credits of Culture and Society (CAS) Restricted Electives.

It is also suggested that students participate in Performance Enhancement (3 credits total taken as Free Elective):

LIMU  ENSEMBLE
LIMU189  INDIVIDUAL INSTRUMENTAL OR VOCAL MUSIC INSTRUCTION 1.0

Focus Area – Community Development:

NOTE: To satisfy pre-reqs - For their ENGINEERING ELECTIVES courses in students must select CEEN301 (Fund. of EnvE: Water).

Students must take the following courses:

EDNS315  ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY 3.0
EDNS477  ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT * 3.0
EDNS478  ENGINEERING AND SOCIAL JUSTICE * 3.0
EDNS479  COMMUNITY-BASED RESEARCH * 3.0

* EDNS477, EDNS478, and EDNS479 may not also count toward the 9 credits of Culture and Society (CAS) Restricted Electives.

Students must also select TWO of the following courses:

ANY 400+ HNRS COURSE
CEEN401  LIFE CYCLE ASSESSMENT 3.0
CEEN472  ONSITE WATER RECLAMATION AND REUSE 3.0
CEEN475  HAZARDOUS SITE REMEDIATION ENGINEERING 3.0
CEEN479  AIR POLLUTION 3.0
CEEN493  SUSTAINABLE ENGINEERING DESIGN 3.0
CEEN556  MINING AND THE ENVIRONMENT 3.0
EBGN340  ENERGY AND ENVIRONMENTAL POLICY 3.0
EDNS401  PROJECTS FOR PEOPLE 3.0
HASS419  ENVIRONMENTAL COMMUNICATION 3.0
HASS425  INTERCULTURAL COMMUNICATION ** 3.0
HASS427  RISK COMMUNICATION 3.0
HASS468  ENVIRONMENTAL JUSTICE 3.0
HASS490  ENERGY AND SOCIETY 3.0
MGN470  SAFETY AND HEALTH MANAGEMENT IN THE MINING INDUSTRY 3.0
PEGN430  ENVIRONMENTAL LAW AND SUSTAINABILITY 3.0
**HASS425 if used for Focus Area credits, may not also count toward the 9 credits of Culture and Society (CAS) Restricted Electives.

Focus Area – Corporate Sustainability:

NOTE: To satisfy pre-reqs - For their ENGINEERING ELECTIVES courses in students must select CEEN301 (Fund. of EnvE: Water).

Students must take the following courses:

- **EDNS315** ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY 3.0
- **EDNS430** CORPORATE SOCIAL RESPONSIBILITY **3.0
- **EDNS478** ENGINEERING AND SOCIAL JUSTICE 3.0
- **EDNS479** COMMUNITY-BASED RESEARCH **3.0

**EDNS430 and EDNS479 may not also count toward the 9 credits of Culture and Society (CAS) Restricted Electives.

Students must also select TWO of the following courses:

- ANY 400+ HNRS COURSE
- **CEEN401** LIFE CYCLE ASSESSMENT 3.0
- **CEEN472** ONSITE WATER RECLAMATION AND REUSE 3.0
- **CEEN475** HAZARDOUS SITE REMEDIATION ENGINEERING 3.0
- **CEEN479** AIR POLLUTION 3.0
- **CEEN493** SUSTAINABLE ENGINEERING DESIGN 3.0
- **CEEN556** MINING AND THE ENVIRONMENT 3.0
- **EBGN340** ENERGY AND ENVIRONMENTAL POLICY 3.0
- **EDNS401** PROJECTS FOR PEOPLE 3.0
- **HASS419** ENVIRONMENTAL COMMUNICATION 3.0
- **HASS425** INTERCULTURAL COMMUNICATION 3.0
- **HASS427** RISK COMMUNICATION 3.0
- **HASS468** ENVIRONMENTAL JUSTICE 3.0
- **HASS490** ENERGY AND SOCIETY 3.0
- **MGN470** SAFETY AND HEALTH MANAGEMENT IN THE MINING INDUSTRY 3.0
- **PEGN430** ENVIRONMENTAL LAW AND SUSTAINABILITY 3.0

Focus Area - STEM Teaching:

Students must take the following courses:

- **SCED262** K-12 FIELD EXPERIENCE AND BUILDING STUDENT RELATIONSHIPS 3.0
- **SCED333** EDUCATIONAL PSYCHOLOGY AND ASSESSMENT * 3.0
- **SCED363** DYNAMIC TEACHING: MOTIVATION, CLASSROOM MANAGEMENT, AND DIFFERENTIATION OF INSTRUCTION * 3.0
- **SCED464** CAPSTONE CURRICULUM DESIGN I 3.0

* SCED333 and SCED363 may not double-count for both the Focus Area and the Culture and Society (CAS) Restricted Electives

Students must also select one of the following courses:

- **MAED405** MATHEMATICAL PRACTICES AND THE SOCIAL CONTEXT OF MATHEMATICS 3.0
- **SCED415** SCIENTIFIC PRACTICES VS ENGINEERING DESIGN AND THE NATURE OF SCIENCE 3.0

Students must also select one of the following courses:

- **MAED425** PRE-ALGEBRA AND ALGEBRA TEACHING TECHNIQUES 3.0
- **SCED445** PHYSICS AND CHEMISTRY TEACHING TECHNIQUES 3.0

Focus Area – Individualized Focus Areas:

An Individualized Focus Area (IFA) is a customized course of study along with an associated senior design capstone experience that is agreed upon by the student, advisor, and Design Engineering Program Director. Typically, an IFA is defined for a student whose interests and passions are not represented by the existing predefined Focus Areas. The advisor and Design Engineering Program Director are responsible for ensuring an IFA meets the same standards as any of the predefined Focus Areas in the Design Engineering program, as described below in the Program Management section, including having at least three faculty mentors. The transcripts of students who follow an IFA will be denoted as “Individualized Focus Area” without further reference to the focus topic.

Major GPA

The Undergraduate Council considered the policy concerning required major GPAs and which courses are included in each degree’s GPA. While the GPA policy has not been officially updated, in order to provide transparency, council members agreed that publishing the courses included in each degree’s GPA is beneficial to students.

The following list details the courses that are included in the GPA for this degree:

- EDNS100 through EDNS599

The Mines guidelines for Minor/ASI can be found in the Undergraduate Information section of the Mines Catalog.

Minor in Engineering for Community Development

Program requirements (18 credits)

**Introductory Courses (9 credits required):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS315</td>
<td>ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY</td>
<td>3.0</td>
</tr>
<tr>
<td>EDNS478</td>
<td>ENGINEERING AND SOCIAL JUSTICE</td>
<td>3.0</td>
</tr>
<tr>
<td>EDNS479</td>
<td>COMMUNITY-BASED RESEARCH</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**CAS Elective (3 credits from this list):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HASS419</td>
<td>ENVIRONMENTAL COMMUNICATION</td>
<td>3.0</td>
</tr>
<tr>
<td>HASS425</td>
<td>INTERCULTURAL COMMUNICATION</td>
<td>3.0</td>
</tr>
<tr>
<td>HASS427</td>
<td>RISK COMMUNICATION</td>
<td>3.0</td>
</tr>
<tr>
<td>HASS468</td>
<td>ENVIRONMENTAL JUSTICE</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Minor in Leadership in Social Responsibility

The Minor in Leadership in Social Responsibility will prepare CSM students to become leaders in identifying and promoting the role that engineers can play in advancing social responsibility inside corporations. Graduates will be able to articulate the strategic value of social responsibility for business, particularly in achieving and maintaining the social license to operate, and the role engineering itself can play in advancing a firm’s social responsibility program, including community engagement.

For CSM students to “solve the world’s challenges related to the earth, energy, and the environment,” they must also be able to navigate the increasingly complex social, political, and economic contexts that shape those challenges. Achieving the social license to operate, for example, is recognized as necessary for developing mineral resources in the U.S. and abroad. Stewardship of the earth, development of materials, overcoming the earth’s energy challenges, and fostering environmentally sound and sustainable solutions – the bedrock of the Mines vision articulated in the Strategic Plan – requires engineers and applied scientists who are able to work in local and global contexts that are shaped by the sometimes conflicting demands of stakeholders, governments, communities and corporations. Reasoning through and managing these competing demands is at the core of social responsibility.

Minor in Leadership in Social Responsibility (18 credits required)

<table>
<thead>
<tr>
<th>Introductory Courses (9 credits required):</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS315</td>
</tr>
<tr>
<td>EDNS478</td>
</tr>
<tr>
<td>EDNS479</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LSR Required Course (3 credits required):</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS430</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAS Elective (3 credits from this list):</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY 400+ HNRS COURSE</td>
</tr>
<tr>
<td>HASS419</td>
</tr>
<tr>
<td>HASS425</td>
</tr>
<tr>
<td>HASS427</td>
</tr>
</tbody>
</table>

Area of Special Interest in Humanitarian Engineering (12 credits)

<table>
<thead>
<tr>
<th>Intro Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS315</td>
</tr>
</tbody>
</table>

Select one of the following: 3.0

| EDNS301 | HUMAN-CENTERED PROBLEM DEFINITION |
| EDNS401 | PROJECTS FOR PEOPLE |
| EDNS430 | CORPORATE SOCIAL RESPONSIBILITY |

Select two of the following: 6.0

| EDNS477 | ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT |
| EDNS478 | ENGINEERING AND SOCIAL JUSTICE |
| EDNS479 | COMMUNITY-BASED RESEARCH |
| EDNS480 | ANTHROPOLOGY OF DEVELOPMENT |
| HASS425 | INTERCULTURAL COMMUNICATION |
| CEEN493 | SUSTAINABLE ENGINEERING DESIGN |
Courses

EDNS151. CORNERSTONE - DESIGN I. 3.0 Semester Hrs.
Equivalent with EPIC151.
(I, II, S) Design I teaches students how to solve open-ended problems in a hands-on manner using critical thinking and workplace skills. Students work in multidisciplinary teams to learn through doing, with emphasis on defining and diagnosing the problem through a holistic lens of technology, people and culture. Students follow a user-centered design methodology throughout the process, seeking to understand a problem from multiple perspectives before attempting to solve it. Students learn and apply specific skills throughout the semester, including: communication (written, oral, graphical), project management, concept visualization, critical thinking, effective teamwork, as well as building and iterating solutions.

Course Learning Outcomes

- 1. Identify, breakdown, and define open-ended problems.
- 2. Research the context and background of problems and solutions, including user needs and technical requirements, through scholarly and authoritative sources, and stakeholder input.
- 3. Design solutions through a cycle of testing, refining, iterating, and feedback.
- 4. Equitably contribute to team efforts from start to end on a collaborative project, and participate in learning activities and coaching activities in the team.
- 5. Apply common workplace practices, tools and software in a semester-long team project, including project planning tools, team management tools, tools to generate solution alternatives, decision analysis methods, risk analysis methods, and value proposition analysis/baseline comparison.
- 6. Present technical ideas and solutions graphically, orally, written, and through prototype demonstrations
- 7. Visually depict ideas to teammates, supervisors, and stakeholders through the use of field sketching for the purposes of communication as well as idea development and development through iteration.
- 8. Model and communicate formalized design ideas through the use of standardized engineering graphics conventions as applied to engineering sketching and computer-aided design/solid modeling software

EDNS155. CORNERSTONE DESIGN I: GRAPHICS. 1.0 Semester Hr.
Equivalent with EPIC155.
(I, II, S) Design I: Graphics teaches students conceptualization and visualization skills, and how to represent ideas graphically, both by hand and using computer aided design (CAD).

Course Learning Outcomes

- 8) Use engineering graphics conventions as applied to technical sketching and computer-aided design/solid modeling software to communicate formalized design ideas.

EDNS156. AUTOCAD BASICS. 1.0 Semester Hr.
(I, II) This course explores the two- and three-dimensional viewing and construction capabilities of AutoCAD. Students will learn to use AutoCAD for modeling (2D line drawing, 3D construction, Rendering, Part Assembly) and will develop techniques to improve speed and accuracy. The AutoCAD certification exam will not be offered as part of this course; however, the professor will provide instructions on accessing certification options, which generally have their own fees associated with them. 3 hours lab; 1 semester hour.

Course Learning Outcomes

- 1- Identify the components of the AutoCAD user interface and basic CAD terminology.
- 2- Apply basic concepts to develop construction (drawing) techniques.
- 3- Manipulate drawings through editing and plotting techniques.
- 4- Apply geometric construction and produce 2D Orthographic Projections.
- 5 - Interpret dimensions and demonstrate dimensioning concepts and techniques.
- 6 - Reuse existing content and become familiar with the use of Blocks.
- 7- Explore the three-dimensional viewing and construction capabilities of AutoCAD.
- 8 - Create and edit 3D Models from 2D profiles. Extract 2D views from a 3D model for detail drafting.

EDNS157. SOLIDWORKS BASICS (FOR CERTIFICATION). 1.0 Semester Hr.
(I, II) Students will become familiar and confident with Solidworks CAD program and be able to use most of the basic functions well, including Parts, Assemblies, and Drawing Layouts. The Associate-level certification exam will be offered at the end of the course, and while there are no guarantees for students becoming certified, students will have gained the necessary skills to try. 3 hours lab; 1 semester hour.

Course Learning Outcomes

- 1- Identify the components of the Solidworks user interface and basic CAD terminology and approaches.
- 2- Apply basic solid modeling concepts and use the basic part modeling functionality of Solidworks software.
- 3 - Develop defined and valid advanced 2D sketch profiles in Solidworks for use in 3D operations and features.
- 4- Apply basic technical drawing concepts to interpret technical drawings for part modeling.
- 5 - Demonstrate dimensioning concepts and techniques by interpreting and creating properly annotated technical drawings.
- 6 - Identify and apply the techniques of 3D models such as revolve, sweep, and loft features.
- 7- Identify geometric relations and functions of an assembly design to virtually assemble a set of parts into an assembly.
- 8 - Extract two-dimensional views from a three-dimensional model and assembly for detail drafting.
EDNS191. INTRODUCTION TO INTEGRATIVE DESIGN. 3.0 Semester Hrs.
Students are introduced to human-centered design methodologies relative to open-ended problem solving using socially relevant challenges. Students in this first design studio course utilize a range of resources to explore ethical implications and test the logic of arguments for/against proposed design solutions. Hands-on activities and graphical visualization are utilized to approach the design process in a collaborative team environment. Students begin compiling a personal design portfolio that carries through their undergraduate studies for the Bachelor of Science in Design Engineering degree.

EDNS192. DESIGN AND HUMAN VALUES. 4.0 Semester Hrs.
Students explore and participate in design activities as an individual or on smaller teams. Projects include the design of experiential activities or community projects. Students evaluate the history of science and engineering and its impact on social and political systems as a foundation for creating smarter designs. Prototyping skills are utilized to explore design functionality and potential alternatives. The course emphasizes technical writing along with the development of other communication formats. Prerequisite: EDNS191 or EDNS151.

EDNS198. SPECIAL TOPICS. 1-6 Semester Hr.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EDNS199. INDEPENDENT STUDY. 1-6 Semester Hr.
(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: Independent Study form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EDNS200. INTRODUCTION TO DESIGN ENGINEERING. 3.0 Semester Hrs.
(I, II) Students are introduced to the unique ways designers frame complex open-ended problems, engage with end users, and develop solutions to meet the needs of diverse stakeholders. Students are introduced to designers’ creative communication strategies, including basic techniques for written, oral, graphic, and tangible product communication. Students will engage in individual and team-based projects, honing their design identity as well as their unique contributions to collaborative challenges. With extensive opportunity for design feedback and iteration, students learn to produce and analyze design artifacts for varied audiences and contexts. 5 studio hours; 3 semester hours. Prerequisite: none Co-requisite: none.

Course Learning Outcomes

• 1. Recognize and apply the ways in which communication functions: how, for whom, via what means, toward what ends, and for what purpose.
• 2. Reflect on positionality and its influence on interpretation, design, and communication of information.
• 3. Execute effective design through evaluation of stakeholder needs, use of oral, written, or graphical communication, completion of hands-on demonstrations or prototyping.
• 4. Understand the best methods for addressing challenges associated with user-centered design, communicating technical content to a non-technical audience, and verification of effective design artifacts.

EDNS205. PROGRAMMING CONCEPTS AND ENGINEERING ANALYSIS. 3.0 Semester Hrs.
(I, II) This course provides an introduction to techniques of scientific computation that are utilized for engineering analysis, with the software package MATLAB as the primary computational platform. The course focuses on methods data analysis and programming, along with numerical solutions to algebraic and differential equations. Engineering applications are used as examples throughout the course. 3 hours lecture; 3 semester hours.
EDNS251. CORNERSTONE DESIGN II. 3.0 Semester Hrs.
Equivalent with EPIC251.
(I, II, S) Design II builds on the design process introduced in Design I, which focuses on open-ended problem solving in which students integrate teamwork and communications with the use of design techniques, business tools, and computer software to solve engineering problems. Student project teams now work with real-world clients while infusing introductory business skills including Agile project management tools, time-value of money and financial project justifications to address client needs. Computer applications emphasize data analytics. Teams build team dynamics and ensure satisfaction of client needs through team meetings and sprint reviews. The course emphasizes oral, visual, and written technical communications techniques introduced in Design I. 2 hours lecture, 3 hours lab; 3 semester hours. Prerequisite: EDNS151, EDNS155, HNRS115, or HNRS120.

Course Learning Outcomes

1. Identify, breakdown, and define open-ended problems.
2. Research the context and background of problems and solutions, including user needs and technical requirements, through scholarly and authoritative sources, and stakeholder input.
3. Design solutions through a cycle of testing, refining, iterating, and feedback.
4. Equitably contribute to team efforts from start to end on a collaborative project, and participate in learning activities and coaching activities in the team.
5. Apply common workplace practices, tools and software in a semester-long team project, including project planning tools, team management tools, tools to generate solution alternatives, decision analysis methods, risk analysis methods, and value proposition analysis/baseline comparison.
6. Present technical ideas and solutions graphically, orally, written, and through prototype demonstrations.
7. Manage a client relationship, including communicating, soliciting and incorporating input, and delivering a solution that meets client requirements and constraints.
8. Use commercial software to create user interfaces or to collect data for accurate analyses as well as to make reasonable decisions and/or predictive models.

EDNS291. DESIGN UNLEASHED. 3.0 Semester Hrs.
(I) Students explore design as an approach to the world through a series of creative, hands-on projects. Projects are defined through designer goals and evaluated through iterative solution posing. This course investigates how design engineers frame open-ended problems and communicate design solutions. Multiple design challenges encourage the utilization of a variety of tools to further develop and iterate on design solutions and product verification. 5 studio hours; 3 semester hours. Prerequisite: EDNS192 or HNRS115 or HASS100, EDNS151. Co-requisite: EDNS200.

EDNS292. DESIGN FOR A GLOBALIZED WORLD. 3.0 Semester Hrs.
(II) This experiential design course focuses on how designers respond to increasing global interdependencies and diverse global cultures. Through a variety of design activities, students engage in systems thinking, strategic social planning, and sustainability analysis while applying skills toward reconciling competing perspectives, goals, and needs. The course also explores students’ place in the world and their responsibilities as design engineers, global thinkers, and interdisciplinary problem solvers. Prerequisite: EDNS200, EDNS291.

EDNS298. SPECIAL TOPICS. 1-6 Semester Hr.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EDNS299. INDEPENDENT STUDY. 1-6 Semester Hr.
(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Variable credit; 1 to 6 credit hours. Repeatable for credit. Prerequisite: Independent Study form must be completed and submitted to the Registrar.

EDNS301. HUMAN-CENTERED PROBLEM DEFINITION. 3.0 Semester Hrs.
(I, II) This class will equip students with the knowledge, skills and attitudes needed to identify, define, and begin solving real problems for real people, within the socio-technical ambiguity that surrounds all engineering problems. The course will focus on problems faced in everyday life, by people from different backgrounds and in different circumstances, so that students will be able to rise to the occasion presented by future workplace challenges. By the end of this course, students will be able to recognize design problems around them, determine whether they are worth solving, and employ a suite of tools to create multiple solutions. The follow up course -- "Design for People" -- will enable students to take the best solutions to the prototype phase. 3 hours lecture; 3 semester hours.

EDNS315. ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY. 3.0 Semester Hrs.
(I, II) (WI) This course explores how engineers think about and practice environmental and social responsibility, and critically analyzes codes of ethics before moving to a deeper focus on macroethical topics with direct relevance to engineering practice, environmental sustainability, social and environmental justice, social entrepreneurship, corporate social responsibility, and engagement with the public. These macroethical issues are examined through a variety of historical and contemporary case studies and a broad range of technologies. Prerequisite: HASS100, and EDNS151 or EDNS192. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

1. Identify and connect key moments in the history of engineering professions related to environmental and social responsibilities with current engineering challenges, particularly from the 20th century through current day, and how the idea of "responsibility" in the engineering profession has changed throughout this history
2. Define key terms that relate the engineering professions’ environmental and social responsibilities
3. Identify stakeholders in engineering projects, and analyze their roles, perspectives, and implications in environmental and social responsibility from various sectors and disciplines
4. Critique pervasive engineering mindsets and their relationship to engineers’ responsibilities; where these attitudes and approaches are first established and subsequently reinforced through educational and professional practice
5. Create and develop persuasive arguments for practical steps to promote environmental and social responsibility in engineering projects, using professional tools for risk analysis, life cycle assessment, and cost/benefit while recognizing the limitations of any numerical simplification

Course Learning Outcomes
EDNS391. DESIGN & MODELING OF INTEGRATED SYSTEMS. 3.0 Semester Hrs.
(I) Complex problems in areas of healthcare, transportation, energy distribution, communication require an integrative solution spanning technical, social, and environmental perspectives. In this course, students develop an appreciation of systems thinking as a holistic approach to complex problem solving. Students will engage with systems thinking in a way that recognizes the 'whole' of the problem through analyzing interrelationships, attributes, and effects. Students apply systems thinking perspectives to a socio-technical problem, describe the problem through modeling techniques, design a holistic solution, and improve upon the solution through justification and systems thinking approaches. Prerequisite: EDNS292.

EDNS392. DESIGN ENGINEERING APPLICATIONS. 3.0 Semester Hrs.
(II) Being a successful design engineer requires an interdisciplinary outlook, the ability to apply practical and conceptual design tools, and sound analytic judgment. This course culminates the integrative design studio sequence, which explores design techniques; problem-definition-and-solution in complex social, cultural, and political contexts; and the professional design ecosystems in which engineers work. The course offers an advanced opportunity to pair design theory with hands-on design projects, while also being attentive to a systems-approach for engineering design. The course emphasizes professional preparedness by refining students' skills in needs assessment, integrated modes of feasibility analysis, and contextualizing proposed solutions. The course allows students to refine their design engineering competencies and identities while simultaneously clarifying their career goals and preparing for a more meaningful Capstone Design experience. 5 studio hours; 3 semester hours. Prerequisite: EDNS391.

Course Learning Outcomes

1. Apply design process elements - including stakeholder engagement, iteration, hands-on skills, relevant background research, and engineering analysis within multiple contexts
2. Apply systems, logical, and critical thinking skills. This includes interpreting, analyzing, synthesizing, and using multiple perspectives and alternatives in your work, and identification of relevant "code of ethics" in action; creating strong arguments to support your decisions; and making judgments.
3. Examine design variables and impact on global, social, environmental, or economic contexts

EDNS398. SPECIAL TOPICS. 1-6 Semester Hr.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EDNS399. INDEPENDENT STUDY. 1-6 Semester Hr.
(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EDNS401. PROJECTS FOR PEOPLE. 3.0 Semester Hrs.
(I, II) Work with innovative organizations dedicated to community development to solve major engineering challenges. This course is open to juniors and seniors interested in engaging a challenging design problem and learning more about Human Centered Design (HCD). The course will be aimed at developing engineering solutions to real problems affecting real people in areas central to their lives. 3 hours lecture; 3 semester hours.

EDNS430. CORPORATE SOCIAL RESPONSIBILITY. 3.0 Semester Hrs.
Equivalent with LAIS430,
Businesses are largely responsible for creating the wealth upon which the well-being of society depends. As they create that wealth, their actions impact society, which is composed of a wide variety of stakeholders. In turn, society shapes the rules and expectations by which businesses must navigate their internal and external environments. This interaction between corporations and society (in its broadest sense) is the concern of Corporate Social Responsibility (CSR). This course explores the dimensions of that interaction from a multi-stakeholder perspective using case studies, guest speakers and field work. Prerequisite: HASS100. Corequisite: HASS200. 3 hours lecture; 3 semester hours.

EDNS477. ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT. 3.0 Semester Hrs.
(I, II) This course is an introduction to the relationship between engineering and sustainable community development (SCD) from historical, political, ideological, ethical, cultural, and practical perspectives. Students will study and analyze different dimensions of community and sustainable development and the role that engineering might play in them. Also students will critically explore strengths and limitations of dominant methods in engineering problem solving, design, and research for working in SCD. Students will learn to research, describe, analyze and evaluate case studies in SCD and develop criteria for their evaluation. Prerequisite: HASS100. Corequisite: HASS200. 3 hours seminar; 3 semester hours.

Course Learning Outcomes

1. Varies by semester

EDNS478. ENGINEERING AND SOCIAL JUSTICE. 3.0 Semester Hrs.
Equivalent with LAIS478,
(II) This course offers students the opportunity to explore the relationships between engineering and social justice. The course begins with students' exploration of their own social locations, alliances and resistances to social justice through critical engagement of interdisciplinary readings that challenge engineering mindsets. Then the course helps students to understand what constitutes social justice in different areas of social life and the role that engineers and engineering might play in these. Finally, the course gives students an understanding of why and how engineering has been aligned and/or divergent from social justice issues and causes. Prerequisite: HASS100. Corequisite: HASS200. 3 hours lecture; 3 semester hours.
EDNS479. COMMUNITY-BASED RESEARCH. 3.0 Semester Hrs.
Engineers and applied scientists face challenges that are profoundly socio-technical in nature, and communities are increasingly calling for greater participation in the decisions that affect them. Understanding the diverse perspectives of communities and being able to establish positive working relationships with their members is therefore crucial to the socially responsible practice of engineering and applied science. This course provides students with the conceptual and methodological tools to conduct community-based research. Students will learn ethnographic field methods and participatory research strategies, and critically assess the strengths and limitations of these through a final original research project. Prerequisite: HASS100 or graduate student standing. Co-requisite: EDNS400 or graduate student standing.

EDNS480. ANTHROPOLOGY OF DEVELOPMENT. 3.0 Semester Hrs.
Equivalent with LAIS480, Engineers and applied scientists face challenges that are profoundly socio-technical in nature, ranging from controversies surrounding new technologies of energy extraction that affect communities to the mercurial “social license to operate” in locations where technical systems impact people. Understanding the perspectives of communities and being able to establish positive working relationships with their members is therefore crucial to the socially responsible practice of engineering and applied science. This course provides students with the conceptual and methodological tools to engage communities in respectful and productive ways. Students will learn ethnographic field methods and participatory research strategies, and critically assess the strengths and limitations of these through a final original research project. Prerequisite: HASS200. Co-requisite: EDNS477 or HASS325.

EDNS491. CAPSTONE DESIGN I. 3.0 Semester Hrs.
Equivalent with EGGN491, (I, II) (WI) This course is the first of a two-semester capstone course sequence giving the student experience in the engineering design process. Realistic open-ended design problems are addressed for real world clients at the conceptual, engineering analysis, and the synthesis stages and include economic and ethical considerations necessary to arrive at a final design. Students are assigned to interdisciplinary teams and exposed to processes in the areas of design methodology, project management, communications, and work place issues. Strong emphasis is placed on this being a process course versus a project course. This is a writing-across-the-curriculum course where students’ written and oral communication skills are strengthened. The design projects are chosen to develop student creativity, use of design methodology and application of prior course work paralleled by individual study and research. 2 hours lecture; 3 hours lab; 3 semester hours. Prerequisite: For BSME students, completion of MEGN301; for BSCE students, completion of Engineering Field Session, Civil, CEEN 331; for BSENV completion of Engineering Field Session, Environmental, CEEN 330; and for all other students completion of Field Session appropriate to the student’s specialty and consent of instructor. Co-requisite: For BSME students, MEGN481; for BSCE students, any one of CEEN443, CEEN445, CEEN442, or CEEN415; for BSEE students, EENG 350 and EENG 389 plus any one of EENG 391, EENG 392, EENG 393, or EENG 394; for BSE students, EDNS392.

Course Learning Outcomes

•

EDNS492. CAPSTONE DESIGN II. 3.0 Semester Hrs.
(I, II) (WI) This course is the second of a two-semester sequence to give the student experience in the engineering design process. Design integrity and performance are to be demonstrated by building a prototype or model, or producing a complete drawing and specification package, and performing pre-planned experimental tests, wherever feasible, to verify design compliance with client requirements. 1 hour lecture; 6 hours lab; 3 semester hours. Prerequisite: EDNS491.

EDNS498. SPECIAL TOPICS. 6.0 Semester Hrs.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EDNS499. INDEPENDENT STUDY. 1-6 Semester Hr.
(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: Independent Study form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

Department Heads
Dean Nieusma, Department Head
Chelsea Salinas, Assistant Department Head; Director of Design Engineering Program

Professors
Kevin Moore, Executive Director of Humanitarian Engineering
Juan Lucena, Humanitarian Engineering Director of Undergraduate Programs and Outreach
Jessica Smith

Assistant professors
Elizabeth Reddy, Assistant Director of Humanitarian Engineering and Science Interdisciplinary Graduate Program
Marie Stettler Kleine

Teaching Professors
Yosef Allam, Director of Cornerstone Design Program
Alina Handorean

Teaching Associate Professors
Jack Bringardner
Mirna Mattijk
Mark Orrs
Sid Saleh, Director of McNeil Center for Entrepreneurship & Innovation
Kate Youmans, Presidential Faculty Fellow for Diversity, Inclusion & Access

Teaching Assistant Professors
Cynthia Athanasiou
Duncan Davis-Hall
Michael Sheppard
Aubrey Wigner

Professor of Practice
Donna Bodeau
Garrett Erickson
Antonie Vandenberge

Staff
Becky Buschke, Program Assistant
Leah Fitzgerald, Stakeholder Relations Manager
Kirsten Kelly, Capstone Administrative Assistant
Julia Roos, Associate Director of Humanitarian Engineering
Kimberly Walker, Department Manager