Engineering, Design, and Society

Program Description

The Division 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 problem definition, solution, and design, and we seek to educate future leaders who will address the challenges of attaining a sustainable global society.

EDS is home to:

**Cornerstone Design@Mines**: Cornerstone encompasses Introduction to Design (EDNS151), which is taken by all freshman, and Practice of Design (EDNS251 or a similar second-year course), which is taken by approximately half of the sophomore engineering students at Mines.

**Capstone Design@Mines**: Capstone entails a two-semester senior design sequence for most engineering students at Mines, including Civil Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, and the general Engineering degree programs. The capstone program provides a unique client-sponsored, project-based, hands-on, interdisciplinary engineering experience for Mines students.

**Humanitarian Engineering**: HE is recognized internationally for its research, education, and outreach in socially responsible engineering. 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. HE enables Mines students to understand how engineering can contribute to co-creating just and sustainable solutions to the problems faced by communities globally.

**Bachelor of Science in Engineering**: The BSE is an interdisciplinary engineering degree that focuses on creative design solutions throughout students’ four-year curriculum. Through a sequence of Integrated Design Studios that bridge first-year Cornerstone Design and senior-year Capstone Design, students become experts in the application of engineering principles to social problems in real-world contexts. The BSE gives students the opportunity to build specialized focus areas, customize their course selection to suite career and personal interests, and gain practical engineering experience throughout their educational experience at Mines.

Programs

**Cornerstone Design@Mines**

Offers courses that teach students how to solve complex, open-ended problems using critical thinking and professional workplace skills. Students work in multidisciplinary teams to learn through doing, with an emphasis on defining and re-defining problems through a holistic lens of technology, people, and environment. Students apply a user-centered design methodology throughout the semester, seeking to understand a problem from multiple perspectives before attempting to solve it. Instruction in these subjects is hands-on and experimental, with the instructor serving as both teacher and mentor.

Introduction to Design (EDNS151) is a 3-credit-hour course, where students work in teams on a semester-long project. Students in Introduction to Design learn to communicate technical ideas and solutions graphically, orally, in writing, and through prototype demonstrations. Introduction to Design introduces students to the human-centered design process, which teaches students to explore, ideate, and implement solution concepts, while also assessing their design work to ensure it is viable, desirable, feasible, and sustainable.

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

**Capstone Design@Mines**

Is comprised by a two-semester, senior-year course sequence: Senior Design I (EDNS491) and Senior Design II (EDNS492). The Capstone sequence offers a one-of-a-kind, creative, multidisciplinary design experience emerging from combined efforts in civil, electrical, mechanical, environmental, and general engineering. It is increasingly recognized within the engineering community that many of the grand challenges facing society today will only be met by multidisciplinary approaches. Capstone Design@Mines embraces the uniqueness of each disciplinary approach while enabling students to address real-world, interdisciplinary challenges.

Capstone Design@Mines addresses ABET accreditation guidelines for the engineering design component of engineering program curricula:

- use of open-ended problems,
- formulation of design problem statements and specifications,
- consideration of multiple alternative solutions for a given challenge, plus
- assessment of the desirability, feasibility, and viability of proposed solutions

The **Capstone Design Showcase** celebrates the engineering educational achievements of participating students. This twice-yearly event offers students an opportunity to present the real-world, client-driven project work that they have completed over the course of their senior year.

**Humanitarian Engineering (HE)**

Connects students with a passion for solving the world’s most pressing challenges with Mines faculty who lead the field of HE and community and corporate partners committed to sustainable solutions. Integrating engineering, social sciences, and design, the HE program offers minors, focus areas, and elective courses that teach students how to work with the communities they seek to serve by co-creating solutions that promote justice, responsibility, and sustainability. HE serves students from a wide range of disciplinary backgrounds and who have diverse career goals. It employs hands-on projects that employ engineering and applied science to promote sustainable community development, whether through NGOs, start-up businesses, or established companies. Seminar-style courses offered by the Engineering, Design, and Society Division and the Humanities, Arts, and Social Sciences Division, 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. Students may also wish to investigate one of the two minors in Humanitarian Engineering or a related BSE Focus Area in Community Development or Corporate Sustainability. Program details and course listings are available under the Minor tab.

ENGINEERING FOR COMMUNITY DEVELOPMENT

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

Graduates with the ECD minor can work in the US 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 fit with any degree program on campus. Please contact Professor Juan Lucena (jlucena@mines.edu) to sign up for the minor or for advice on course selection.

LEADERSHIP IN SOCIAL RESPONSIBILITY

The 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 fit with any degree program on campus. Please contact Professor Jessica Smith (jmsmith@mines.edu) to sign up for the minor or for advice on course selection.

Bachelor of Science in Engineering

The Bachelor of Science in Engineering (BSE) is a new degree program at Mines. It offers a rigorous, flexible, creative, interdisciplinary program of study that integrates:

1. the strength of Mines’ traditions in engineering, built upon the fundamentals of mathematics, science, and engineering;
2. the insights and analytic perspectives of disciplines in the humanities, arts, and social sciences;
3. the inspiration and hands-on skills of studio-based design education, which focuses on creativity and technology innovation.

The BSE curriculum revolves around hands-on, project-based studios every semester, with a unique set of Integrative Design Studios that culminate in Capstone Design. In addition to honing expertise in integrated design that bridges engineering and the social dimensions of innovation, the BSE allows students to specialize in a Focus Area of their choice. The Focus Area allows students to pursue depth of study in an area of personal interest, including emerging technologies, application of technology to underserved user groups, or even creating a new technology-driven business startup. BSE program details and course offerings are included under the Major tab.

Bachelor of Science in Engineering

The Bachelor of Science in Engineering (BSE) curriculum is a rigorous, flexible, interdisciplinary program of study that integrates

1. The strength of a Mines’ technical degree with coursework in the fundamentals of mathematics, science, and engineering with
2. Challenging and integrated education in design, innovation, humanities, and social sciences, and
3. A Focus Area that allows students to pursue depth of study in an area of personal interest, emerging technologies, and/or career interests as part of the core engineering degree.

These three components are tied together via

4. A set of unique education experiences built into six Integrative Design Studios, culminating in the Capstone Senior Design Studio.

The Integrative Design Studios provide opportunities for students to apply their studies to multi-year, hands-on projects (project/problem/place-based learning, PBL). Students of all levels work together on projects and have roles based on their academic ranking and coursework experience. This format allows them to gain real-world project experience, while obtaining a strong grounding in innovation and design from a human-centered perspective in specific social and environmental contexts. As a key component of the BSE, the design studios promote a “design early – design often – design real” approach to engineering education.

In parallel to the hands-on application of engineering practice through the design studio sequence, flexibility for students to choose their engineering fundamentals and electives courses from multi-disciplinary options leading into their chosen pre-defined Focus Areas or creation of an Individualized Focus Area allow students to explore personal interests and passions through a depth of study.

The Integrative Design Studios and student choice in which engineering courses to take for the degree, offer the potential for a meaningful co-op and practicum study in their chosen Focus Area.

Program Educational Outcomes

Within several years of completing the degree, graduates with a Bachelor of Science in 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
Impact Makers who are much more than “just” engineers, with a broad and responsible perspective to envision, design, and build 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 (a)-(k).

Curriculum
The curriculum comprises six groups of coursework and experiential learning; a total of 133.5 credits:

Group 1 .......................... 35.0 credit hours
The Core Curriculum
Mathematics and the Basic Sciences (23.5 credits)
Physical Activity (2.0 credits)
Freshman Orientation and Success (0.5 credits)
Free Electives (9.0 credits)

Group 2 .......................... 15.0 credit hours
Humanities and Social Science Requirement
Communication (3.0 credits)
Economics (3.0 credits)
HASS Mid-Level Electives (6.0 credits)
HASS 400-level Elective (3.0 credits)

Group 3 .......................... 10.5 credit hours
Distributed Science Requirement
PHGN200 (Physics II) (4.5 credits)
One of CSCI101 or MATH201 (3.0 credits)
One of CBEN110, CHGN122 or CHGN125, CSCI101, GEGN101, and MATH201 (3.0-4.0 credits)

Group 4 .......................... 30.0 credit hours
Engineering Coursework Requirements
Engineering Fundamentals (Statics, Circuits, Fluid Mechanics, Thermodynamics, Materials – 15.0 credits)
Engineering Electives (15.0 credits)

Group 5 .......................... 19.0 credit hours
Integrative Design Studios
Freshman Design Studio (7.0 credits)
Sophomore Design Studio (6.0 credits)
Junior Design Studio (3.0 credits)
Junior Field Session (3.0 credits)

Group 6 .......................... 24.0 credit hours
Focus Area and Capstone Design
Focus Area Coursework (18.0 credits)
Capstone Senior Design Studio (6.0 credits)

The BSE 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 and curriculum in this degree program with other engineering degree programs, allowing students to readily enter the Bachelor of Science in Engineering degree program at any time during their first two years at Mines.

In the junior and senior years, students complete fundamental engineering courses across the breadth of traditional engineering disciplines and pursue topical studies through additional engineering electives, emphasizing the breadth and commonality of what may be thought of as multi-disciplinary engineering. In parallel to the technical studies, students integrate studies emphasizing social, cultural, political (including policy), economics and business, and other humanities and social science areas that are recognized as critical components in preparing students to contribute to the definition and solution of pressing problems facing society and the environment. The curriculum includes three elective HASS course and a minimum of five engineering electives depending on choice of Focus Area. Focus Areas may suggest that these electives be chosen from complementary sets of courses.

A key component of this degree program is extensive and ongoing hands-on application of engineering and non-engineering studies using real-world problems to solidify and increase students’ understanding and application of content from prior courses. To this end, students engage in Integrative Design Studio courses throughout the first three years of their studies, with a culminating experience in the Capstone Senior Design Studio courses that build upon the preceding Integrative Design Studio project work as well as on the student’s engineering and Focus Area coursework.

Bachelor of Science in Engineering: Degree Requirements

Freshman
Fall .......................... lec lab sem.hrs
CSM101  FRESHMAN SUCCESS SEMINAR 0.5
MATH111  CALCULUS FOR SCIENTISTS 4.0
AND ENGINEERS I
CHGN121  PRINCIPLES OF CHEMISTRY I 4.0
EDNS200  COMMUNICATION 3.0
EDNS191  INTEGRATIVE DESIGN STUDIO IA* 4.0
PAGN  PHYSICAL ACTIVITY COURSE 0.5
Elective

Spring .......................... lec lab sem.hrs
MATH112  CALCULUS FOR SCIENTISTS 4.0
AND ENGINEERS II
PHGN100  PHYSICS I - MECHANICS 4.5
CSCI101  INTRODUCTION TO COMPUTER 3.0
SCIENCE or MATH 201**
EDNS192  INTEGRATIVE DESIGN STUDIO IB 3.0
PAGN  PHYSICAL ACTIVITY COURSE 0.5
Elective

Sophomore
Fall .......................... lec lab sem.hrs
MATH213  CALCULUS FOR SCIENTISTS 4.0
AND ENGINEERS III
PHGN200  PHYSICS II- ELECTROMAGNETISM AND 4.5
OPTICS**
<table>
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<th>Credits</th>
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<tr>
<td>MATH201</td>
<td>PROBABILITY AND STATISTICS FOR ENGINEERS, CBEN 110, CHGN 122, CHGN 125, CSCI 101, or GEGN 101</td>
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<td>EDNS291</td>
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<td>HASS/EBGN</td>
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**Spring**

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<td>CHGN209</td>
<td>INTRODUCTION TO CHEMICAL THERMODYNAMICS, CBEN 210, or MEGN 361</td>
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<td>CEEN241</td>
<td>STATICS</td>
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<tr>
<td>MTGN202</td>
<td>ENGINEERED MATERIALS, CEEN 311, or MEGN 312</td>
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<td>EBGN201</td>
<td>PRINCIPLES OF ECONOMICS</td>
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<tr>
<td>EENG281</td>
<td>INTRODUCTION TO ELECTRICAL CIRCUITS, ELECTRONICS AND POWER or 282</td>
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<td>ENGR</td>
<td>ENGINEERING ELECTIVE</td>
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<td>EDNS391</td>
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**Spring**

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<td>PEGN251</td>
<td>FLUID MECHANICS, CBEN 307, CEEN 310, GEGN 351, or MEGN 351</td>
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**Senior Fall**

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<tr>
<td>EDNS491</td>
<td>SENIOR DESIGN I</td>
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<tr>
<td>HASS/EBGN</td>
<td>HASS Mid-Level Restricted Elective</td>
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**Total Semester Hrs:** 133.5

* The INTEGRATIVE DESIGN STUDIO IA and INTEGRATIVE DESIGN STUDIO IB course sequence satisfies parallel humanities and social sciences plus EDNS151 requirements needed for other engineering degrees at Mines. Students may satisfy these requirements by separately taking HASS100 and EDNS151.

** A minimum of 10.5 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. Note that PHGN200 is 4.5 credit hours, the math and computer science courses are each 3.0 credit hours, and the remaining courses are each 4.0 credit hours.

**# 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.

*** The EDNS291 INTEGRATIVE DESIGN STUDIO IIA and EDNS292 INTEGRATIVE DESIGN STUDIO IIB course sequence substitutes for HASS200 GLOBAL STUDIES and any one of the EDNS2XX DESIGN II courses or MEGN200 for this degree only. MEGN200 does not substitute for EDNS2XX DESIGN II credit in any other degree program at this time. Additionally, the INTEGRATIVE DESIGN STUDIO II sequence does not count toward MEGN200 credit for students transferring out of the BSE program into Mechanical Engineering at this time.

# ENGINEERING FUNDAMENTALS courses are: (1) one of the thermodynamics courses CHGN209, CBEN210, or MEGN361; (2) statics CEEN241; (3) one of the circuits courses EENG281 or EENG282; (4) one of the materials courses MTGN202, CEEN311, or MEGN312; and (5) one of the fluid mechanics courses PEGN251, CBEN207,CEEN310, GEGN351, or MEGN351. Prerequisites may apply.

## HASS Restricted Elective courses, a minimum of 9 credit hours of upper level HASS/EBGN coursework, as described in the Humanities, Arts, and Social Sciences section of the Bulletin. 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 credit hours 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 Engineering: Engineering Coursework Requirements:**

A minimum of 30 credit hours of Engineering Coursework (designated as ENGR in the Bachelor of Science in Engineering Degree Requirements listing above) are required (typically ten courses). 15 credit hours (typically five courses) are prescribed ENGINEERING FUNDAMENTALS courses as noted in footnote # above. The additional 15 credit hours 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 credit hours of the 18 credit hours for the design studios) and the Capstone Senior Design sequence (EDNS491 and EDNS492) produces 47 credit hours 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, or select 400-level courses discussed with and approved by the student’s advisor. Finally, note that students must have at least 9 credit hours at or above the 300-level with a common theme or subject area within the group of courses that make up the required 30 credit hours of Engineering Coursework to ensure a reasonable level of disciplinary depth in a single field of engineering. Furthermore, students must have at least 9 credit hours at or above the 400-level plus the 6 credit hours 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 are used to satisfy the 15-credit hour requirement for ENGINEERING ELECTIVES. Please be aware of course prerequisites, reviewed with the student’s advisor.

**Chemical Engineering**

- CBEN201 MATERIAL AND ENERGY BALANCES 3.0
- CBEN308 HEAT TRANSFER 3.0
- CBEN357 CHEMICAL ENGINEERING THERMODYNAMICS 3.0
- CBEN375 CHEMICAL ENGINEERING SEPARATIONS 3.0

**Civil & Environmental Engineering**

- CEEN301 FUNDAMENTALS OF ENVIRONMENTAL ENGINEERING: WATER 3.0
- CEEN312 SOIL MECHANICS 3.0
- CEEN312L SOIL MECHANICS LABORATORY 1.0
- CEEN314 STRUCTURAL THEORY 3.0
- CEEN360 INTRODUCTION TO CONSTRUCTION ENGINEERING 3.0
- CEEN381 HYDROLOGY AND WATER RESOURCES ENGINEERING 3.0

**Electrical Engineering & Electronics**

- PHGN215 ANALOG ELECTRONICS 4.0
- EENG284 DIGITAL LOGIC 4.0
- EENG307 INTRODUCTION TO FEEDBACK CONTROL SYSTEMS 3.0
- PHGN317 SEMICONDUCTOR CIRCUITS - DIGITAL 3.0
- EENG383 MICROCOMPUTER ARCHITECTURE AND INTERFACING 4.0
- EENG385 ELECTRONIC DEVICES AND CIRCUITS 4.0
- EENG386 FUNDAMENTALS OF ENGINEERING ELECTROMAGNETICS 3.0

**Geological Engineering**

- GEGN203 ENGINEERING TERRAIN ANALYSIS 2.0
- GEGN204 GEOLOGIC PRINCIPLES AND PROCESSES 2.0
- GEGN206 EARTH MATERIALS 3.0
- GEGN307 PETROLOGY 3.0
- GEGN342 ENGINEERING GEOMORPHOLOGY 3.0

**Geology**

- GEOL308 INTRODUCTORY APPLIED STRUCTURAL GEOLOGY 3.0
- GEOL310 EARTH MATERIALS 3.0
- GEOL311 MINING GEOLOGY 3.0
- GEOL315 SEDIMENTOLOGY AND STRATIGRAPHY 3.0
- GEOL321 MINERALOGY AND MINERAL CHARACTERIZATION 3.0

**Mechanical Engineering**

- MEGN315 DYNAMICS 3.0
- MEGN416 ENGINEERING VIBRATION 3.0
- MEGN424 COMPUTER AIDED ENGINEERING 3.0
- MEGN451 FLUID MECHANICS II 3.0
- MEGN461 THERMODYNAMICS II 3.0
- MEGN471 HEAT TRANSFER 3.0

**Mining**

- MNGN210 INTRODUCTORY MINING 3.0
- MNGN316 COAL MINING METHODS 3.0
- MNGN317 DYNAMICS FOR MINING ENGINEERS 1.0
- MNGN321 INTRODUCTION TO ROCK MECHANICS 3.0

**Metallurgical and Materials Engineering**

- MTGN311 STRUCTURE OF MATERIALS 3.0
- MTGN311L STRUCTURE OF MATERIALS LABORATORY 1.0
- MTGN334 CHEMICAL PROCESSING OF MATERIALS 3.0
- MTGN348 MICROSTRUCTURAL DEVELOPMENT 3.0
- MTGN351 METALLURGICAL AND MATERIALS THERMODYNAMICS 3.0
MTGN352  METALLURGICAL AND MATERIALS KINETICS  3.0
MTGN381  INTRODUCTION TO PHASE EQUILIBRIA IN MATERIALS SYSTEMS  2.0

Petroleum Engineering
PEGN305  COMPUTATIONAL METHODS IN PETROLEUM ENGINEERING  2.0
PEGN308  RESERVOIR ROCK PROPERTIES  3.0
PEGN312  PROPERTIES OF PETROLEUM ENGINEERING FLUIDS  3.0

Bachelor of Science in Engineering: Focus Areas

Focus Areas are a compilation of prescribed and suggested courses and topical projects that have been reviewed by a broad spectrum of faculty from multiple programs/departments and of varied professional background who assess the collection of content to encompass technical, innovation, design, social/cultural, and environmental pillars needed by students who plan to pursue a career in that focus area.

All Focus Areas require a minimum of 18 credit hours of course work which may include prescribed or recommended engineering courses. In addition 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 hour, 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 BSE 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
- 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:

EBGN330  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 credit hours of required HASS Restricted Electives.

Focus Area – Robotics and Automation:

Students must take the following courses:

MEGN315  DYNAMICS *  3.0
EENG307  INTRODUCTION TO FEEDBACK CONTROL SYSTEMS *  3.0
EENG383  MICROCOMPUTER ARCHITECTURE AND INTERFACING *  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
CSCI473  HUMAN-CENTERED ROBOTICS  3.0
MEGN481  MACHINE DESIGN  3.0
CSCI507  INTRODUCTION TO COMPUTER VISION  3.0

Focus Area – Water Security:

(Note - this Focus Area requires 20 credits of topical coursework.) For their ENGINEERING FUNDAMENTALS courses in fluids and materials students must select GEGN351 and CEEN311.

Students must take the following courses:

GEGN203  ENGINEERING TERRAIN ANALYSIS *  2.0
CEEN301  FUNDAMENTALS OF ENVIRONMENTAL ENGINEERING: WATER *  3.0
CEEN381  HYDROLOGY AND WATER RESOURCES ENGINEERING *  3.0
CHGN403  INTRODUCTION TO ENVIRONMENTAL CHEMISTRY  3.0

* GEGN203, CEEN301, and CEEN381 are also listed in the ENGINEERING ELECTIVE list of courses. Students may not also count these three courses as ENGINEERING ELECTIVE courses.

Students must also select one of the following courses (both are recommended):

CEEN470  WATER AND WASTEWATER TREATMENT PROCESSES  3.0
Students must also select two of the following courses:

- EDGN310  ENVIRONMENTAL AND RESOURCE ECONOMICS  3.0
- HASS486  SCIENCE AND TECHNOLOGY POLICY  **  3.0
- HASS488  GLOBAL WATER POLITICS AND POLICY  **  3.0

** HASS486 and HASS488, if used for Focus Area credits, may not also count toward the 9 credit hours of HASS Restricted Electives.

Focus Area – Corporate Sustainability:

Students must take the following courses:

- EDNS472  SITE REMEDIATION ENGINEERING  3.0
- EDNS475  SITE REMEDIATION ENGINEERING  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 BSE 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 BSE Program Director are responsible for ensuring an IFA meets the same standards as any of the predefined Focus Areas in the BSE 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

During the 2016-2017 Academic Year, 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:

- EPIC100 through EPIC599
- EDNS100 through EDNS599

General CSM Minor/ASI requirements can be found here (catalog.mines.edu/undergraduate/undergraduateinformation/minorasi).

Minor in Engineering for Community Development

Program requirements (18 credit hours)
Introductory Course (3 credits required):

EDNS315  ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY 3.0

Area 1 - Engineers and Development (6 credits from this list):

EDNS377  ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT 3.0
EDNS475  ENGINEERING CULTURES IN THE DEVELOPING WORLD 3.0
EDNS478  ENGINEERING AND SOCIAL JUSTICE 3.0
EDNS479  ENGINEERS ENGAGING COMMUNITIES 3.0
EDNS480  ANTHROPOLOGY OF DEVELOPMENT 3.0

Area 2 - Community-Centered Design (6 credits from this list):

EDNS301  HUMAN-CENTERED PROBLEM DEFINITION 3.0
EDNS401  PROJECTS FOR PEOPLE 3.0
Or an EDNS2XX course with project directly related to community development

Capstone Design (3 credits from this list):

EDNS492  SENIOR DESIGN II ((for students in majors in the College of Engineering and Computational Sciences, CECS, and with an identified HE component to the project) or
CEEN477  SUSTAINABLE ENGINEERING DESIGN ((for students in majors outside of CECS)) 3.0

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 US 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)

Three required courses (9 credits):

EDNS315  ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY 3.0
EDNS430  CORPORATE SOCIAL RESPONSIBILITY 3.0
EDNS479  ENGINEERS ENGAGING COMMUNITIES 3.0

One cross-cultural competency course (3 credits):

EDNS475  ENGINEERING CULTURES IN THE DEVELOPING WORLD 3.0
HASS325  CULTURAL ANTHROPOLOGY 3.0
HASS425  INTERCULTURAL COMMUNICATION 3.0
EDNS480  ANTHROPOLOGY OF DEVELOPMENT 3.0

Two electives, at least one of which must be an engineering course (related to Leadership and/or Corporate Social Responsibility topics, approved by program director) (6 credits):

1. Approved Petroleum Engineering course, such as
   PEGN350  SUSTAINABLE ENERGY SYSTEMS 3.0
   PEGN430  ENVIRONMENTAL LAW AND SUSTAINABILITY 3.0
   PEGN481  PETROLEUM SEMINAR 2.0

2. Approved Mining Engineering course, such as
   MNGN308  MINE SAFETY 1.0
   MNGN427  MINE VALUATION 2.0
   MNGN470  SAFETY AND HEALTH MANAGEMENT IN THE MINING INDUSTRY 3.0
   MNGN510  FUNDAMENTALS OF MINING AND MINERAL RESOURCE DEVELOPMENT 3.0

3. Approved Environmental Engineering course, such as
   CEEN472  ONSITE WATER RECLAMATION AND REUSE 3.0
   CEEN475  SITE REMEDIATION ENGINEERING 3.0
   CEEN477  SUSTAINABLE ENGINEERING DESIGN 3.0

4. Approved Economics & Business course, such as
   EBGN340  ENERGY AND ENVIRONMENTAL POLICY 3.0
   EBGN443  PUBLIC ECONOMICS 3.0
   EBGN567  BUSINESS LAW AND ETHICS 3.0

5. Approved HASS courses are to be determined. Additional courses can be approved by the Program Director.

Director
Dean Nieusma – Director, Engineering, Design, & Society Division

Professor
Juan Lucena – Director, Humanitarian Engineering Program

Associate Professor
Jessica Smith – Co-Director, Humanitarian Engineering Program

Teaching Associate Professors
Yosef Allam
Robin Bullock
Stephanie Claussen
Alina Handorean
Leslie Light – Director, Cornerstone Design@Mines Program
Mirna Mattjik
Necessary skills to try. 3 hours lab; 1 semester hour.

Guarantees for students becoming certified, students will have gained the exam will be offered at the end of the course, and while there are no Parts, Assemblies, and Drawing Layouts. The Associate-level certification program and be able to use most of the basic functions well, including (I, II) Students will become familiar and confident with Solidworks CAD

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.

EDNS191. INTEGRATIVE DESIGN STUDIO IA. 4.0 Semester Hrs.
Equivalent with EGGN191,
(I) (WI) Introduces students 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 Engineering degree. 3 hours lecture; 3 hours lab; 4 semester hours.

EDNS192. INTEGRATIVE DESIGN STUDIO IB. 3.0 Semester Hrs.
Equivalent with EGGN192,
(II) (WI) Students explore and participate in design activities as a member of a multi-year, multi-discipline client project, or work on an individual or smaller team project such as the design of experiential activities or community projects. Students are challenged to 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 continues an emphasis on technical writing along with developing other communication formats. Prerequisite: EDNS191. 2 hours lecture; 3 hours lab; 3 semester hours.

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. COMMUNICATION. 3.0 Semester Hrs.
Equivalent with EGGN200,
(I, II) (WI) This course introduces future engineers to why communication matters in engineering and involves collaborative effort to convey technical details in socially embedded and socially transformative contexts. The course approach provides exposure to how engineers communicate a range and depth of sociotechnical content to varied audiences, in writing, orally, visually, electronically, and via contextual listening, and shows students ways in which communication functions via diverse genres, to multiple audiences, and for different purposes. With structured opportunity for feedback and revision, students both study and produce communication artifacts that aim to meet or exceed criteria for what constitutes legitimate evidence and context within and beyond diverse engineering fields. 3 hours lecture; 3 semester hours.

EDNS205. PROGRAMMING CONCEPTS AND ENGINEERING ANALYSIS. 3.0 Semester Hrs.
Equivalent with EGGN205,
(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. 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 computer software as tools to solve engineering problems. Computer applications emphasize information acquisition and processing based on knowing what new information is necessary to solve a problem and where to find the information efficiently. Teams analyze team dynamics through weekly team meetings and progress reports. The course emphasizes oral presentations and builds on written communications techniques introduced in Design I. 2 hours lecture, 3 hours lab; 3 semester hours. Prerequisite: EDNS151, EDNS155, EDNS192, or HNRS115.

EDNS261. DESIGN II: GIS. 3.0 Semester Hrs.
Equivalent with EPIC261,
(I.II,S) The Design II: GIS builds on the design process learned in Design I, which focuses on open-ended problem solving where students integrate teamwork and communication with the use of computer software as tools to solve engineering problems. Design II: GIS incorporates instruction and hands-on exercises in ArcGIS, a geographic information system software package, to enable students to capture, manage, analyze and display spatial data in maps and charts, to solve problems that depend on spatial analysis and orientation GIS for their design solutions. 2 hours lecture, 3 hours lab; 3 semester hours. Prerequisite: EDNS151, EDNS155, EDNS192, or HNRS115.

EDNS262. DESIGN II: AUTOCAD. 3.0 Semester Hrs.
Equivalent with EPIC262,
(I) Design II: AutoCAD builds on the design process from Design I, which focuses on open-ended problem solving where students integrate teamwork and communication with the use of computer software as tools to solve engineering problems. Design II: AutoCAD incorporates instruction in 3-D AutoCAD computer-aided drawing of elemental designs (structure and mechanical) and geo-spatial designs and analyses to solve problems and publish outcomes. Students are introduced to digital terrain modeling and geo-referencing concepts using AutoCAD Civil3D and raster satellite imagery. Students studying Civil Engineering, Environmental Engineering, and Mining Engineering might consider registering for this course. 2 hours lecture, 3 hours lab; 3 semester hours. Prerequisite: EDNS151, EDNS155, EDNS192, or HNRS115.

EDNS263. DESIGN II: MATERIALS. 3.0 Semester Hrs.
Equivalent with EPIC271,
(II) Design EPICS II builds on the design process introduced in Design EPICS I, which focuses on open-ended problem solving where students integrate teamwork and communication with the use of computer software as tools to solve materials engineering problems. The EPICS 271 MME curriculum matches the standard EPICS 251deliverables but with a focus on Metallurgical and Materials Engineering (MME) based projects. Previous projects have utilized areas such as mechanical testing, bio-materials, semiconductors, ceramics, and non destructive examination to address industrial, environmental, research and geopolitical open-ended problems. Prerequisite: EDNS151, EDNS155, EDNS192, or HNRS115. 2 hours lecture, 3 hours lab; 3 semester hours.

EDNS264. DESIGN II: GEOLOGY GIS. 3.0 Semester Hrs.
Equivalent with EPIC264,
(I, II, S) Design II: GIS builds on the design process introduced in Design I, which focuses on open-ended problem solving in which students integrate teamwork and communication with the use of computer software as tools to solve engineering problems. Computer applications emphasize information acquisition and processing based on knowing what new information is necessary to solve a problem and where to find the information efficiently. There are typically eight geology-based projects in the course, based on the needs of multiple outside clients. Many of the course deliverables are maps with associated data sets. Prerequisites: EDNS151, EDNS155, EDNS192 or HNRS115. 2 hours lecture, 3 hours lab; 3 semester hours.

EDNS269. DESIGN II: ENGINEERING PHYSICS. 3.0 Semester Hrs.
Equivalent with EPIC269,
(I, II, S) Design II: Engineering Physics builds on the design process introduced in Design I, and focuses on open-ended problem solving in which students use teamwork to develop computer software as a tool to solve problems related to engineering physics. Students will learn basic programming skills and apply them to projects that relate to current research and applications of physics. Projects are selected to represent real world physics problems wherein creative and critical thinking skills are necessary. These projects often involve computer-based optimization to obtain a solution. Students will learn how to analyze errors in data, and their effects on data interpretation and decision-making. Engineering Physics majors are encouraged to take this course in the sophomore year. It is open to other students on a space-available basis. 2 hours lecture, 3 hours lab; 3 semester hours. Prerequisite: EDNS151, EDNS155, EDNS192, or HNRS115.

EDNS291. INTEGRATIVE DESIGN STUDIO IIA. 3.0 Semester Hrs.
Equivalent with EGGN291,
(I) Students work on an entrepreneurial or client project that may be a short-duration project or continuation of a multi-year, multi-discipline project with teams consisting of freshman to possibly senior students working on the same project, and typically student-lead designs. The course focuses on technical open-ended problem solving in which students integrate teamwork and communications with the use of computer software tools and inclusion of the greater social, political, cultural, and economic factors that ultimately determine if a design is successful. Case studies or other illustrative approaches are used to facilitate discussions on what constitutes effective or harmful designs in areas of earth, energy and environment. Information gathering and modeling are used to support problem assessment and solution exploration. Prerequisites: EDNS192 or HNRS115 or CSM192 or HASS100 and EDNS151. 3 hours lecture; 3 semester hours.

EDNS292. INTEGRATIVE DESIGN STUDIO IIB. 3.0 Semester Hrs.
Equivalent with EGGN292,
(II) Students focus on significant contribution to a design project, building proficiency as they incorporate their core and distributed science studies, and begin to integrate their studies in distributed engineering as may be appropriate to the project. Communication of the design approach is emphasized. Prerequisite: EDNS291. 3 hours lecture; 3 semester hours.

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. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EDNS301. HUMAN-CENTERED PROBLEM DEFINITION. 3.0 Semester Hrs.
Equivalent with EGGN301.
(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.

EDNS375. ENGINEERING CULTURES. 3.0 Semester Hrs.
Equivalent with LAIS375.
This course seeks to improve students? abilities to understand and assess engineering problem solving from different cultural, political, and historical perspectives. An exploration, by comparison and contrast, of engineering cultures in such settings as 20th century United States, Japan, former Soviet Union and presentday Russia, Europe, Southeast Asia, and Latin America. Prerequisite: HASS100. Corequisite: HASS200. 3 hours lecture; 3 semester hours.

EDNS391. INTEGRATIVE DESIGN STUDIO IIIA. 3.0 Semester Hrs.
Equivalent with EGGN391.
(I) (WI) Design Practicum augments the engineering core and addresses content and depth that students may not have otherwise acquired through separate Engineering Core courses. This design studio is intended as preparation for the Design Practicum/Field Session studio EGGN392 and includes modules on technical engineering drawings, system simulation and optimization. Project management skills are emphasized. Prerequisites: EDNS292 or LAIS 200 and any EPIC 200 Level or MEGN200 or GPQN268, and EDNS200. 3 hours lecture; 3 semester hours.

EDNS392. INTEGRATIVE DESIGN STUDIO IIIB. 3.0 Semester Hrs.
Equivalent with EGGN392.
(II) (WI) Students in Design Practicum incorporate instruction from their Engineering Core to drive technical feasibility assessment of a project for a client. This studio serves as the Field Session experience for students in the BSE program and places students in a professional practice experiential environment. Teaming and leadership skills are emphasized. This course also places strong emphasis on the economic and business aspects of a project, including development of a detailed techno-economic assessment. Prerequisites: EDNS391, PHGN200, and MATH225. 3 hours lecture; 3 semester hours.

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 under different titles.

EDNS401. PROJECTS FOR PEOPLE. 3.0 Semester Hrs.
Equivalent with EGGN401.
(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.

EDNS475. ENGINEERING CULTURES IN THE DEVELOPING WORLD. 3.0 Semester Hrs.
Equivalent with LAIS475.
An investigation and assessment of engineering problem-solving in the developing world using historical and cultural cases. Countries to be included range across Africa, Asia, and Latin America. 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 lecture; 3 semester hours.

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. ENGINEERS ENGAGING COMMUNITIES. 3.0 Semester Hrs.
Equivalent with LAIS479,
(I, II, S) (WI) 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: HASS100. Corequisite: HASS200. 3 hours lecture; 3 semester hours.

EDNS480. ANTHROPOLOGY OF DEVELOPMENT. 3.0 Semester Hrs.
Equivalent with LAIS480,
(I, II, S) (WI) 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. Corequisite: EDNS377 or HASS325. 3 hours lecture; 3 semester hours.

EDNS491. SENIOR 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. Prerequisite: Field session appropriate to the student's specialty, for BSE Mechanical Specialty and BSME students, completion of MEGN481, for BSE Civil Specialty and BSCE students, concurrent enrollment or completion of any one of CEEN443, CEEN445, CEEN440, or CEEN415. 2 hours lecture; 3 hours lab; 3 semester hours.

EDNS492. SENIOR DESIGN II. 3.0 Semester Hrs.
Equivalent with EGGN492,
(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. Prerequisite: EGGN491. 1 hour lecture; 6 hours lab; 3 semester hours.

EDNS498. 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.

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.