Engineering, Design and Society

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. We specialize in sociotechnical integration, design problem framing, and real-world engineering design educational experiences. We seek to educate future leaders who will address the challenges of attaining a thriving, sustainable global society.

Design Engineering Bachelor of Science Degree Program Description

Design Engineering is an interdisciplinary engineering degree program that focuses on the creation of innovative solutions to the challenging problems facing people, societies, and the environment. Through a sequence of Integrated Design Studios that bridge first-year Cornerstone Design and senior-year Capstone Design, Design Engineering 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 degree plans that suit their individual career and personal interests, and it ensures they gain practical skills applying sociotechnical perspectives to maximize impact in their chosen future endeavors.

Program Objectives

The objectives of the 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

The Design Engineering program has adopted the ABET Student Outcomes, establishing that our graduates have:

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

ABET Accreditation

Our degree in Design Engineering has applied for accreditation by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission’s General Criteria.

Program Educational Approach

Design Engineering offers a highly engaging, flexible, career focused program of study that extends from 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 **liberal arts education**, which helps students focus their attention on identification of the most important problems and the best overall solutions
3. Mines' signature strength in **engineering applications**, built upon the fundamentals of mathematics, science, and engineering analysis, and extending to include creativity, professional development, and judgment

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 provides a high degree of curricular flexibility to enable students pursue depth of study in an area of personal interest, emerging technologies, the application of technology to under-served communities, and the creation of new technology-driven startups. Design Engineering program details are provided under the Major tab above.

The Design Engineering program includes Cornerstone Design and Capstone Design, programs offered by EDS that also serve the larger campus.

Cornerstone Design introduces Mines students to the engineering problem-solving process. Cornerstone Design is a component of the Mines core curriculum that teaches open-ended problem solving, project management, professional communication, and team working skills—all within a human-centered design framework. 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.

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 is a culminating, two-semester senior engineering design sequence serving students in Design, Civil, Electrical, Environmental, and Mechanical Engineering. Capstone Design provides unique, client-sponsored, hands-on, interdisciplinary engineering project experiences for participating students.

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The Bachelor of Science in Design Engineering is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria with no applicable program criteria.

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. A unique set of six Integrative Design Studios, culminating in the two-semester Capstone Design Studio
2. An integrated educational experience spanning engineering, design, innovation, social sciences, and the humanities
3. The strength of a Mines' technical degree with coursework in mathematics, science, and engineering fundamentals

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 and creativity to move 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 identities as design engineers.

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 variety of engineering disciplines. This flexibility allows students to chart their own technical engineering, systems innovation, or creative design pathways.

The program also includes a design applications experience (EDNS320) for students to develop a critical understanding of how engineers navigate the social and technical realms of open-ended problem solving, providing an early opportunity to explore the wide-ranging career options available to Design Engineers. It also helps them to 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 provide 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 environment-centered perspective and identify multiple design possibilities before converging on solutions 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 mathematics, basic and advanced sciences, engineering fundamentals, and foundational studies in the social contexts within which engineering practices unfold.

Due to the strong alignment of early coursework across engineering degree programs at Mines, it is easy for most students to enter the Bachelor of Science in Design Engineering degree program at any time during their first two years.

As students progress in their time at Mines, they complete fundamental engineering courses across the breadth of traditional engineering disciplines and pursue advanced disciplinary studies through additional engineering electives. This curricular structure emphasizes engineering's breadth as well as commonalities among different engineering disciplinary approaches. Integrated with these traditional technical engineering requirements, students also learn about the human dimensions of engineering problem solving by drawing on perspectives from the social sciences, humanities, and design. Students will explore creative, social, cultural, political (including policy), economic, and business components of real-world problem solving, all of which is critical for responding to the big challenges facing society and the environment today.

A key differentiator of this degree program is the extensive degree of *integration* of technical and non-technical engineering skillsets in response to real-world problems throughout the Integrative Design Studios. This approach allows students to apply lessons from their other coursework to genuine, complex problems, increasing and solidifying students' understanding of that content and providing an engaging and balanced education. The Integrative Design Studios culminate 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 seven groups of coursework and experiential learning for a total of 126 credits:

Freshman				
Fall		**lec**	**lab**	**sem.hrs**
EDNS151	CORNERSTONE - DESIGN I			3.0
EDNS200	INTRODUCTION TO DESIGN ENGINEERING			3.0
MATH111	CALCULUS FOR SCIENTISTS AND ENGINEERS I			4.0
CHGN121	PRINCIPLES OF CHEMISTRY I			4.0
CSM101	FRESHMAN SUCCESS SEMINAR			1.0
				15.0
Spring		**lec**	**lab**	**sem.hrs**
MATH112	CALCULUS FOR SCIENTISTS AND ENGINEERS II			4.0
PHGN100	PHYSICS I - MECHANICS			4.0
CSCI128	COMPUTER SCIENCE FOR STEM			3.0
HASS100	NATURE AND HUMAN VALUES			3.0
S&W	SUCCESS & WELLNESS ELECTIVE			1.0
				15.0
Sophomore				
Fall		**lec**	**lab**	**sem.hrs**
EDNS210	PHYSICAL PROTOTYPING			3.0
MATH213	CALCULUS FOR SCIENTISTS AND ENGINEERS III			4.0
PHGN200	PHYSICS II-ELECTROMAGNETISM AND OPTICS			4.0
MATH201	INTRODUCTION TO STATISTICS			3.0
HASS215	FUTURES			3.0
CSM202	INTRODUCTION TO STUDENT WELL-BEING AT MINES			1.0
				18.0
Spring		**lec**	**lab**	**sem.hrs**
EDNS220	PROBLEM FRAMING & STAKEHOLDER ENGAGEMENT**			3.0
MATH225	DIFFERENTIAL EQUATIONS			3.0
CEEN241	STATICS#			3.0
MEGN261	THERMODYNAMICS I, CHGN 209, or CBEN 210#			3.0
TE	THEMATIC ELECTIVE##			3.0
FREE	FREE ELECTIVE			3.0
				18.0
Junior				
Fall		**lec**	**lab**	**sem.hrs**
EDNS310	SYSTEMS MODELING & DESIGN			3.0
MEGN212	INTRODUCTION TO SOLID MECHANICS, CEEN 311, or MTGN 202#			3.0
EENG281	INTRODUCTION TO ELECTRICAL CIRCUITS, ELECTRONICS AND POWER or 282#			3.0
EBGN321	ENGINEERING ECONOMICS			3.0
EDNS479	COMMUNITY-BASED RESEARCH###			3.0
				15.0
Spring		**lec**	**lab**	**sem.hrs**
EDNS320	ENGINEERING JUDGMENT			3.0
MEGN351	FLUID MECHANICS, CBEN 307, or CEEN 310#			3.0

EDNS445	PRODUCT REDESIGN###			3.0
TE	THEMATIC ELECTIVE##			3.0
ENGR	ENGINEERING ELECTIVE####			3.0
				15.0
Senior				
Fall		**lec**	**lab**	**sem.hrs**
EDNS491	CAPSTONE DESIGN I			3.0
TE	THEMATIC ELECTIVE##			3.0
ENGR	ENGINEERING ELECTIVE####			3.0
CAS	CULTURE AND SOCIETY (CAS) Mid-Level Restricted Elective**			3.0
FREE	FREE ELECTIVE			3.0
				15.0
Spring		**lec**	**lab**	**sem.hrs**
EDNS492	CAPSTONE DESIGN II			3.0
EDNS450	DESIGN FOR THE BUILT ENVIRONMENT###			3.0
TE	THEMATIC ELECTIVE##			3.0
ENGR	ENGINEERING ELECTIVE####			3.0
CAS	CULTURE AND SOCIETY (CAS) 400-Level Restricted Elective**			3.0
				15.0
Total Semester Hrs: 126.0				

** Culture and Society (CAS) Restricted Elective courses, a minimum of 9 credit hours of upper-level coursework, as described in the Culture and Society Requirements section of the catalog. For Design Engineering students, EDNS220 serves as a mid-level CAS elective.

ENGINEERING FUNDAMENTALS courses are: (1) one of the **thermodynamics** courses MEGN261 or 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.

THEMATIC ELECTIVE courses are a coherent set of courses intended to broaden and deepen your knowledge in a particular passion area. These courses should be at the 300+ level and approved by your faculty advisor.

DESIGN ENGINEERING ELECTIVE courses establish advanced skills in design theory, methodology, and practice.

ENGINEERING ELECTIVES are purposefully drawn from course offerings provided through other engineering programs. These elective courses should deepen your technical skills in areas adjacent to or supporting your DESIGN ENGINEERING ELECTIVES and THEMATIC ELECTIVES. The below list is not exhaustive; alternative courses can be taken upon approval by your advisor.

Bachelor of Science in Design Engineering: Thematic Electives

Thematic elective courses serve as 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. Thematic elective courses are recommended and approved by the Design Engineering Program Director or Design Engineering faculty advisor. This set of courses aims to define a passion area for the student to develop a knowledge that is transferrable to their chosen career path alongside the supporting coursework required in the program.

Bachelor of Science in Design Engineering: Engineering Coursework Requirements

A minimum of 45 credits of engineering content is required to be completed as part of the Design Engineering Coursework. The ENGINEERING FUNDAMENTALS courses, as noted in footnote # above, fulfill 15 credit hours. The DESIGN ENGINEERING ELECTIVE courses, as noted in the footnote ## above, fulfill 6 credit hours. The ENGINEERING ELECTIVE courses, as noted in footnote ### above, fulfill 9 credit hours. This Engineering Coursework requirement combined with specific engineering content in the six INTEGRATIVE DESIGN STUDIOs (allocating 15 credits of the 18 credits for the design studios) and the Capstone Senior Design sequence (EDNS491 and EDNS492) produces 51 credits of engineering course work for this degree program. Students are encouraged to select ENGINEERING ELECTIVES to reinforce and complement the courses within the student's THEMATIC ELECTIVES and DESIGN ENGINEERING ELECTIVES. ENGINEERING ELECTIVES must be chosen from the list below or select 300+ 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 the same course prefix to ensure a reasonable level of disciplinary depth in a single field of engineering. Furthermore, students must have at least 9 credits of engineering/technical content at or above the 400-level between courses within THEMATIC ELECTIVES, DESIGN ENGINEERING ELECTIVES, and ENGINEERING ELECTIVES to establish breadth.

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 at least by 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 9-credit requirement for ENGINEERING ELECTIVES or the 12-credit requirement for THEMATIC 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		
CBEN310	INTRODUCTION TO BIOMEDICAL ENGINEERING	3.0
CBEN312	UNIT OPERATIONS LABORATORY	3.0
CBEN313	UNIT OPERATIONS LABORATORY	3.0
CBEN314	CHEMICAL ENGINEERING HEAT AND MASS TRANSFER	4.0
CBEN315	INTRODUCTION TO ELECTROCHEMICAL ENGINEERING	3.0
CBEN357	CHEMICAL ENGINEERING THERMODYNAMICS	3.0
CBEN358	CHEMICAL ENGINEERING THERMODYNAMICS LABORATORY	1.0
CBEN360	BIOPROCESS ENGINEERING	3.0
CBEN365	INTRODUCTION TO CHEMICAL ENGINEERING PRACTICE	3.0

CBEN372	INTRODUCTION TO BIOENERGY	3.0
CBEN375	CHEMICAL ENGINEERING SEPARATIONS	3.0
CBEN401	PROCESS OPTIMIZATION	3.0
CBEN403	PROCESS DYNAMICS AND CONTROL	3.0
CBEN408	NATURAL GAS PROCESSING	3.0
CBEN409	PETROLEUM PROCESSES	3.0
CBEN415	POLYMER SCIENCE AND TECHNOLOGY	3.0
CBEN416	POLYMER ENGINEERING AND TECHNOLOGY	3.0
CBEN418	KINETICS AND REACTION ENGINEERING	3.0
CBEN420	MATHEMATICAL METHODS IN CHEMICAL ENGINEERING	3.0
CBEN422	CHEMICAL ENGINEERING FLOW ASSURANCE	3.0
CBEN426	ADVANCED FUNCTIONAL POROUS MATERIALS	3.0
CBEN430	TRANSPORT PHENOMENA	3.0
CBEN432	TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS	3.0
CBEN435	INTERDISCIPLINARY MICROELECTRONICS	3.0
CBEN440	MOLECULAR PERSPECTIVES IN CHEMICAL ENGINEERING	3.0
CBEN454	APPLIED BIOINFORMATICS	3.0
CBEN460	BIOCHEMICAL PROCESS ENGINEERING	3.0
CBEN461	BIOCHEMICAL PROCESS ENGINEERING LABORATORY	1.0
CBEN469	FUEL CELL SCIENCE AND TECHNOLOGY	3.0
CBEN470	INTRODUCTION TO MICROFLUIDICS	3.0
CBEN472	INTRODUCTION TO ENERGY TECHNOLOGIES	3.0
CBEN480	NATURAL GAS HYDRATES	3.0
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	
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	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	
EENG311	INFORMATION SYSTEMS SCIENCE II	3.0
EENG350	SYSTEMS EXPLORATION AND ENGINEERING DESIGN LAB	
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
EENG411	DIGITAL SIGNAL PROCESSING	3.0
EENG415	DATA SCIENCE FOR ELECTRICAL ENGINEERING	3.0
EENG417	MODERN CONTROL DESIGN	3.0
EENG423	INTRODUCTION TO VLSI DESIGN	3.0
EENG425	INTRODUCTION TO ANTENNAS	3.0
EENG427	WIRELESS COMMUNICATIONS	3.0
EENG428	COMPUTATIONAL ELECTROMAGNETICS	3.0
EENG433	ACTIVE RF & MICROWAVE DEVICES	
EENG430	PASSIVE RF & MICROWAVE DEVICES	3.0
EENG437	INTRODUCTION TO COMPUTER VISION	3.0
EENG470	INTRODUCTION TO HIGH POWER ELECTRONICS	3.0
EENG475	INTERCONNECTION OF RENEWABLE ENERGY	3.0
EENG480	POWER SYSTEMS ANALYSIS	3.0
PHGN317	SEMICONDUCTOR CIRCUITS- DIGITAL	3.0
Geological Engineering		
GEGN307	PETROLOGY	4.0
GEGN316	FIELD GEOLOGY	5.0
GEGN342	ENGINEERING GEOMORPHOLOGY	3.0
GEGN466	GROUNDWATER ENGINEERING	3.0
GEGN468	ENGINEERING GEOLOGY AND GEOTECHNICS	4.0
GEGN469	ENGINEERING GEOLOGY DESIGN	3.0
GEGN470	GROUND-WATER ENGINEERING DESIGN	3.0
GEGN475	APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS	3.0
GEGN483	MATHEMATICAL MODELING OF GROUNDWATER SYSTEMS	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
GEOL470	APPLICATIONS OF SATELLITE REMOTE SENSING	3.0
Mechanical Engineering		
MEGN315	DYNAMICS	3.0
MEGN324	INTRODUCTION TO FINITE ELEMENT ANALYSIS	3.0
MEGN381	MANUFACTURING PROCESSES	3.0
MEGN391	INTRODUCTION TO AUTOMOTIVE DESIGN	3.0
MEGN412	ADVANCED MECHANICS OF MATERIALS	3.0
MEGN414	MECHANICS OF COMPOSITE MATERIALS	3.0
MEGN416	ENGINEERING VIBRATION	3.0
MEGN417	VEHICLE DYNAMICS & POWERTRAIN SYSTEMS	3.0
MEGN430	MUSCULOSKELETAL BIOMECHANICS	3.0
MEGN435	MODELING AND SIMULATION OF HUMAN MOVEMENT	3.0
MEGN441	INTRODUCTION TO ROBOTICS	3.0
MEGN451	AERODYNAMICS	3.0
MEGN461	THERMODYNAMICS II	3.0
MEGN466	INTRODUCTION TO INTERNAL COMBUSTION ENGINES	3.0
MEGN467	PRINCIPLES OF BUILDING SCIENCE	3.0
MEGN469	FUEL CELL SCIENCE AND TECHNOLOGY	3.0
MEGN471	HEAT TRANSFER	3.0
MEGN481	MACHINE DESIGN	3.0
Metallurgical and Materials Engineering		
MTGN334	CHEMICAL PROCESSING OF MATERIALS	3.0
MTGN314	PROPERTIES AND PROCESSING OF CERAMICS	2.0
MTGN314L	PROPERTIES AND PROCESSING OF CERAMICS LABORATORY	1.0
MTGN315	ELECTRICAL PROPERTIES AND APPLICATIONS OF MATERIALS	3.0
MTGN334L	CHEMICAL PROCESSING OF MATERIALS LABORATORY	1.0
MTGN348	MICROSTRUCTURAL DEVELOPMENT	3.0
MTGN348L	MICROSTRUCTURAL DEVELOPMENT LABORATORY	1.0
MTGN350	STATISTICAL PROCESS CONTROL AND DESIGN OF EXPERIMENTS	3.0
MTGN352	METALLURGICAL AND MATERIALS KINETICS	3.0
MTGN414	ADVANCED PROCESSING AND SINTERING OF CERAMICS	3.0
MTGN419	NON-CRYSTALLINE MATERIALS	3.0
MTGN429	METALLURGICAL ENVIRONMENT	3.0
MTGN430	PHYSICAL CHEMISTRY OF IRON AND STEELMAKING	3.0
MTGN431	HYDRO- AND ELECTRO-METALLURGY	3.0
MTGN442	ENGINEERING ALLOYS	3.0
MTGN445	MECHANICAL PROPERTIES OF MATERIALS	3.0

MTGN445L	MECHANICAL PROPERTIES OF MATERIALS LABORATORY	1.0
MTGN451	CORROSION ENGINEERING	3.0
MTGN456	ELECTRON MICROSCOPY	2.0
MTGN456L	ELECTRON MICROSCOPY LABORATORY	1.0
MTGN461	TRANSPORT PHENOMENA AND REACTOR DESIGN FOR METALLURGICAL AND MATERIALS ENGINEERS	3.0
MTGN465	MECHANICAL PROPERTIES OF CERAMICS	3.0
MTGN467	MATERIALS DESIGN: SYNTHESIS, CHARACTERIZATION AND SELECTION	2.0
MTGN468	MATERIALS DESIGN: SYNTHESIS, CHARACTERIZATION AND SELECTION	2.0
MTGN469	FUEL CELL SCIENCE AND TECHNOLOGY	3.0
MTGN472	BIOMATERIALS I	3.0
MTGN473	COMPUTATIONAL MATERIALS	3.0
MTGN475	METALLURGY OF WELDING	2.0
MTGN475L	METALLURGY OF WELDING LABORATORY	1.0
Mining		
MNGN310	EARTH MATERIALS	3.0
MNGN311	MINING GEOLOGY	3.0
MNGN312	SURFACE MINE DESIGN	3.0
MNGN314	UNDERGROUND MINE DESIGN	3.0
MNGN316	COAL MINING METHODS	3.0
MNGN317	DYNAMICS FOR MINING ENGINEERS	1.0
MNGN321	INTRODUCTION TO ROCK MECHANICS	3.0
MNGN333	EXPLOSIVES ENGINEERING I	3.0
MNGN350	INTRODUCTION TO GEOTHERMAL ENERGY	3.0
MNGN406	DESIGN AND SUPPORT OF UNDERGROUND EXCAVATIONS	3.0
MNGN408	UNDERGROUND DESIGN AND CONSTRUCTION	2.0
MNGN414	MINE PLANT DESIGN	3.0
MNGN418	ADVANCED ROCK MECHANICS	3.0
MNGN422	FLOTATION	2.0
MNGN424	MINE VENTILATION	3.0
MNGN431	MINING AND METALLURGICAL ENVIRONMENT	3.0
MNGN433	MINE SYSTEMS ANALYSIS	3.0
MNGN436	UNDERGROUND COAL MINE DESIGN	3.0
MNGN461	TRANSPORT PHENOMENA AND REACTOR DESIGN FOR METALLURGICAL AND MATERIALS ENGINEERS	3.0
Petroleum Engineering		
PEGN305	COMPUTATIONAL METHODS IN PETROLEUM ENGINEERING	2.0
PEGN308	RESERVOIR ROCK PROPERTIES	3.0
PEGN311	DRILLING ENGINEERING	3.0
PEGN312	PROPERTIES OF PETROLEUM ENGINEERING FLUIDS	3.0
PEGN411	MECHANICS OF PETROLEUM PRODUCTION	3.0
PEGN414	WELL TESTING AND ANALYSIS	3.0
PEGN419	WELL LOG ANALYSIS AND FORMATION EVALUATION	3.0
PEGN423	PETROLEUM RESERVOIR ENGINEERING I	3.0
PEGN424	PETROLEUM RESERVOIR ENGINEERING II	3.0
PEGN426	FORMATION DAMAGE AND STIMULATION	3.0
PEGN438	PETROLEUM DATA ANALYTICS	3.0
PEGN460	FLOW IN PIPE NETWORKS	3.0
PEGN461	SURFACE FACILITIES DESIGN AND OPERATION	3.0
PEGN490	RESERVOIR GEOMECHANICS	3.0

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):		
EDNS315	ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY	3.0
EDNS478	ENGINEERING AND SOCIAL JUSTICE	3.0
EDNS479	COMMUNITY-BASED RESEARCH	3.0
ECD Required Course (3 credits required):		
EDNS477	ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT	3.0
CAS Elective (3 credits from this list):		
ANY 400+ HNRS COURSE		
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
OR AN CAS COURSE APPROVED BY MINOR DIRECTOR AS APPROPRIATE		
Elective (3 credits from this list):		
EDNS401	PROJECTS FOR PEOPLE	3.0
PEGN430	ENVIRONMENTAL LAW AND SUSTAINABILITY	3.0
CEEN401	LIFE CYCLE ASSESSMENT	3.0
CEEN472	ONSITE WATER RECLAMATION AND REUSE	3.0
CEEN493	SUSTAINABLE ENGINEERING DESIGN	3.0
CEEN479	AIR POLLUTION	3.0
CEEN475	HAZARDOUS SITE REMEDIATION ENGINEERING	3.0
CEEN556	MINING AND THE ENVIRONMENT	3.0

MNGN470	SAFETY AND HEALTH MANAGEMENT IN THE MINING INDUSTRY	3.0
EBGN340	ENERGY AND ENVIRONMENTAL POLICY	3.0
OR A COURSE APPROVED BY MINOR DIRECTOR AS APPROPRIATE		

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)

Introductory Courses (9 credits required):		
EDNS315	ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY	3.0
EDNS478	ENGINEERING AND SOCIAL JUSTICE	3.0
EDNS479	COMMUNITY-BASED RESEARCH	3.0
LSR Required Course (3 credits required):		
EDNS430	CORPORATE SOCIAL RESPONSIBILITY	3.0
CAS Elective (3 credits from this list):		
ANY 400+ HNRS COURSE		
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
OR AN CAS COURSE APPROVED BY MINOR DIRECTOR AS APPROPRIATE		
Elective (3 credits from this list):		
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
MNGN470	SAFETY AND HEALTH MANAGEMENT IN THE MINING INDUSTRY	3.0
PEGN430	ENVIRONMENTAL LAW AND SUSTAINABILITY	3.0
OR A COURSE APPROVED BY MINOR DIRECTOR AS APPROPRIATE		

Area of Special Interest in Humanitarian Engineering (12 credits)

Intro Course		**3.0**
EDNS315	ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY	
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 2 D 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 assembly a set of parts into an assembly.
- 8 -Extract two-dimensional views from a three-dimensional model and assembly for detail drafting

EDNS198. SPECIAL TOPCS. 1-6 Semester Hr.
Equivalent with EPIC198A,
(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.

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.
Good design is tuned to a purpose, engages users and rewards their attention with deeper meaning and insight. This course introduces the foundations of user experience design in the context of sociotechnical design engineering. Students examine the influences of human psychology, culture, cognition and perception on user experience design, establish a strong understanding of good design principles and their effective application. Students develop and hone an understanding of user-centered and user experience design concepts through an iterative design process.
Course Learning Outcomes

- Establish a fundamental understanding of the phases of the user experience design cycle.
- Understand the value in user-centered perspectives and the implications of human perception and cognition for user experience and interaction design.
- Explore root causes for strengths and weaknesses of designs and provide suggestions of how to improve design for intended user.
- Apply and evaluate usability testing as a form of design iteration and improvement.

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.

EDNS210. PHYSICAL PROTOTYPING. 3.0 Semester Hrs.
What makes a design "work"? How can design ideas become a reality? This course explores these questions by focusing on how physical prototypes help design engineers explore and communicate ideas. Students gain a better understanding of the process by which they most effectively create design artifacts. Through a progressive series of design, creation, critique and reflection cycles, students complete multiple design challenges. These challenges culminate in systems integration while using data to inform their design decisions. 5 studio hours; 3 semester hours. Prerequisites: HASS100 & ENDS151 or HNRS115 or HNRS120. Co-requisites: EDNS200, PHGN200.
Course Learning Outcomes

- Design engineering solutions that enhance the user experience through solicitation and appropriate use of feedback.
- Prototype to explore ideas and test concepts through iterative data-driven decision making.
- Create artifacts using a range of fabrication techniques and iterations that take appropriate levels of fidelity into consideration.
- Communicate with others, presenting ideas and solutions in ways that are appropriate for the occasion and audience.

EDNS220. PROBLEM FRAMING & STAKEHOLDER ENGAGEMENT. 3.0 Semester Hrs.
How should design engineers frame problems and identify opportunities for change within sociotechnical systems? Students learn design methods to frame problems at multiple levels and scales, from the individual end user to high-level regulatory structures. Students actively engage with diverse stakeholders throughout the process to explore problem spaces, identify opportunities for design interventions, and examine potential avenues for solutions. Thematic areas such as sustainability, regenerative development, socioecological systems, and community engagement will drive students to look beyond the technical dimensions of problems to incorporate social, regulatory and location speci#c experiences into their problem framing methods. Prerequisites: EDNS151, HASS100.
Course Learning Outcomes

- Describe social and technical interconnections of real-world design practice by exploring organizational contexts and stakeholder perspectives.
- Apply sociotechnical, environmental and economic reasoning to consider values in the context of design systems thinking.
- Identify and interpret ethical implications of designs.
- Practice empathy and listening to better understand stakeholder needs and concerns.

EDNS251. CORNERSTONE DESIGN II. 3.0 Semester Hrs.
Equivalent with EPIC251,
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.

EDNS298. SPECIAL TOPICS. 1-6 Semester Hr.
Equivalent with EPIC298A,
(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.
Equivalent with EPIC299A,
(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.
Course Learning Outcomes

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.

EDNS310. SYSTEMS MODELING & DESIGN. 3.0 Semester Hrs.
Complex problems in areas of healthcare, transportation, energy distribution, and communication require integrative solutions spanning

sociotechnical and environmental perspectives. In this course, students explore systems of thinking as a holistic approach to solving complex problems. Students 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 complex sociotechnical problem, describe the problem through modeling techniques, design a holistic solution and improve upon the solution through justification and systems thinking approaches. Prerequisites: EDNS210, EDNS220. Co-requisites: MATH225.
Course Learning Outcomes

- Establish a fundamental understanding of systems thinking terminology, methods, practices and tools.
- Frame complex technical systems models using quantitative and qualitative methods.
- Use a holistic systems thinking approach to understand a complex problem and design a solution.
- Apply systems modeling and integration techniques to evaluate and optimize design solutions.

EDNS315. ENGINEERING FOR SOCIAL AND ENVIRONMENTAL RESPONSIBILITY. 3.0 Semester Hrs.
(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. 3 hours lecture; 3 semester hours.
Course Learning Outcomes

- 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
- Define key terms that relate the engineering professions’ environmental and social responsibilities
- Identify stakeholders in engineering projects, and analyze their roles, perspectives, and implications in environmental and social responsibility from various sectors and disciplines
- 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
- 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

EDNS320. ENGINEERING JUDGMENT. 3.0 Semester Hrs.
Navigating real-world engineering problems demands knowing when and how to apply distinct forms of expertise as well as the limitations of that expertise. We call this engineering judgment. This course develops engineering judgment by focusing on the competencies needed to connect analysis derived from engineering sciences to sociotechnical design projects. Students assess the success of a prior design solution using engineering analysis, relative impacts, identi#cation of the assumptions shaping the solution approach, and the e#ectiveness of supporting communications to relevant audiences. They also apply these skills to future oriented problem solving by crafting a design prompt for an idealized sociotechnical engineering design project. Prerequisites: EDNS310.
Course Learning Outcomes

- Integrate engineering analysis into sociotechnical design problem solving and describe how engineering analysis contributes to solution validation.
- Describe how context informs and de#nes engineering problems and solutions.
- Explore how design outcomes are shaped by contextual attributes associated with ethics and values.
- Identify and deploy appropriate communication strategies for given purpose targeting a speci#c audience.

EDNS398. SPECIAL TOPICS. 1-6 Semester Hr.
Equivalent with EPIC398A,
(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.
Equivalent with EPIC399A,
(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.

EDNS399. INDEPENDENT STUDY. 1-6 Semester Hr.

EDNS399. INDEPENDENT STUDY. 0.5-6 Semester Hr.

EDNS399. INDEPENDENT STUDY. 0.5-6 Semester Hr.

EDNS399. INDEPENDENT STUDY. 0.5-6 Semester Hr.

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: HASS215. 3 hours lecture; 3 semester hours.

EDNS444. INNOV8X. 3.0 Semester Hrs.
Innovate X introduces concepts and tools to accelerate the design, validation and adoption of innovations in support of creative problem solving. Using an entrepreneurial mindset, we learn how to identify and

frame problems that beneficiaries and stakeholders face. We attempt to design and test practical solutions to those problems in collaboration with those who experience the problems. We apply beneficiary discovery, pretotyping, business model design (social, economic and environmental), constrained creativity, efficient experimentation, and rapid iteration. While resolving challenges involves technical solutions, an important aspect of this course is directly engaging beneficiaries and stakeholders in social contexts to develop solutions with strong impact potential. Innov8x is grounded in collaborative creativity theory at the intersection of organizational behavior (social psychology), design principles, entrepreneurship and innovation management.

Course Learning Outcomes

- Frame and translate complex ambiguous problems into actionable opportunities for innovation
- Conduct effective, objective and ongoing beneficiary discovery in efficient ways
- Combine tools and methods to quickly test assumptions and secure beneficiary acceptance
- Develop creative approaches to navigate real and perceived constraints
- Leverage mentor and stakeholder support through credible communication based on research
- Launch innovative solutions with the advocacy of beneficiaries and stakeholders
- Create value by solving complex problems that straddle technical and social domains

EDNS445. PRODUCT REDESIGN. 3.0 Semester Hrs.

Product redesign reimagines existing products, focusing specifically on a systems approach to human-centered design and the crafting of design solutions tailored to meet the needs of their users. Students will progress through an iterative design process, engaging in the analysis of and thoughtful reflection on design opportunities, ensuring enhanced products align with the needs of a specific user group. Emphasizing collaborative learning, students will work in teams, adopting a multi-disciplinary approach to creative problem-solving and design. Multiple prototyping cycles will guide students as they make data-driven design decisions, culminating in the development and communication of a final redesigned product. Prerequisites: Junior standing.

Course Learning Outcomes

- Analyze the needs of a specific group of users in a given context and develop a problem definition that responds to those needs with a clear, concise set of engineering design criteria.
- Create a product design and development plan with a defined timeline that results in an advanced design artifact.
- Propose distinct solution concepts and utilize user feedback, engineering analysis, experimentation, and proven industry practices to make data-driven design decisions.
- Build, test, and analyze solution concepts through a series of design cycles to iterate and refine the advanced artifact.
- Participate equitably on a team with distributed roles and responsibilities, while monitoring individual effectiveness in contributing to the team’s overall progress.

EDNS450. DESIGN FOR THE BUILT ENVIRONMENT. 3.0 Semester Hrs.

What does it take to create meaningful environments, products, services, and experiences? Students will explore the critical role designers play in the creation of impactful, engaging and sustainable outcomes. Spatial design practices and the evolution of universal standards will be examined to provide context regarding the creation of our constructed environments. Through this course, students will incorporate built environment design standards and apply human factors engineering into thoughtful designs with attention to all potential users. Critical readings, analysis of case studies, data assessment, application of design through GIS mapping and parametric modeling, and project-based work will inform student design processes. Students will apply new design techniques through the modeling of a built environment with specific attention to spatial analysis, human factors, standards, community mapping and universal design theory.

Course Learning Outcomes

- Be able to identify and diagnose "mismatched" interactions that are symptomatic of exclusionary practices.
- Explore a range of design contexts—including systems, products, services, experiences—and develop general understanding of universal design theory and how it can be applied to each.
- Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems in association with standards.
- Implement algorithmic modeling as applied to design of the built environment.

EDNS477. ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT. 3.0 Semester Hrs.

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: HASS215. 3 hours seminar; 3 semester hours.

Course Learning Outcomes

- Varies by semester

EDNS478. ENGINEERING AND SOCIAL JUSTICE. 3.0 Semester Hrs.

Equivalent with LAIS478,

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: HASS215. 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: HNRS105, HNRS115 or HASS100 or graduate student standing. Co-requisite: HASS215 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: HASS215. Co-requisite: EDNS477 or EDNS325.

EDNS491. CAPSTONE DESIGN I. 3.0 Semester Hrs.
Equivalent with EGGN491,
(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 BSDE students, EDNS 220 and Senior Standing.
Course Learning Outcomes

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EDNS492. CAPSTONE DESIGN II. 0-3 Semester Hr.
(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.

EDNS497. SPECIAL SUMMER COURSE. 0-6 Semester Hr.
Equivalent with EPIC497A,
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EDNS498. SPECIAL TOPICS. 0-6 Semester Hr.
Equivalent with EPIC498A,
(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.

EDNS498. SPECIAL TOPICS. 1-6 Semester Hr.

EDNS499. INDEPENDENT STUDY. 1-6 Semester Hr.
Equivalent with EPIC499A,
(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.

EDNS499. INDEPENDENT STUDY. 1-6 Semester Hr.

Department Heads

Dean Nieusma, Department Head

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

Professors

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

Jack Bringdardner

Alina Handorean

Teaching Associate Professors

Mirna Mattjik

Mark Orrs

Aubrey Wigner

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Cynthia Athanasiou

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