Humanitarian Engineering

Degrees

- Master of Science in Humanitarian Engineering and Science (Thesis and Non-Thesis options).
- Graduate Certificate in Humanitarian Engineering and Science

Program Description

The MS degrees in Humanitarian Engineering and Science (HES) are a professional MS (non-thesis) and a thesis-based MS. These degrees are targeted to recent graduates or mid-career professionals with a BS in science and engineering who are interested in careers, research opportunities, and/or acquiring skills that will help them work effectively with communities. The degrees include a core HES curriculum plus an approved track of related courses in a science or engineering discipline.

The HES graduate certificate is designed for professionals seeking to attend school part-time or students who are seeking degrees in other departments at Mines but still desire graduate training in humanitarian engineering and science. It consists of four courses.

In both the master's degrees and graduate certificate, a unique mix of social science, applied science, and engineering perspectives prepares students to apply knowledge about the earth to promote more sustainable and just uses of water, energy, and other earth resources and to understand and mitigate potential hazards.

To achieve the Master of Science (MS) degree, students may elect the Non-Thesis option, based exclusively upon coursework and a practicum, or the Thesis option. The thesis option is comprised of coursework in combination with individual research performed under the guidance of two faculty advisors and presented in a written thesis approved by the student's committee. HES students have academic advisors from both the Engineering, Design & Society Division and their disciplinary track (Environmental Engineering, Geological Engineering, or Geophysics). The thesis-based MS usually takes two years to complete, while the non-thesis MS can often be completed in one year.

For more information on program curriculum please refer to the HES website: https://humanitarian.mines.edu/mshes/.

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Program Requirements

The MS degrees in *Humanitarian Engineering and Science (HES)* are a professional MS (non-thesis) and a thesis-based MS. These degrees are targeted to recent graduates or mid-career professionals with a BS in science and engineering who are interested in careers, research opportunities, and/or acquiring skills that will help them work effectively with communities. The degrees include a core HES curriculum plus an approved track of related courses in a science or engineering discipline. A unique mix of social science, applied science, and engineering perspectives prepares students to apply knowledge about the earth to promote more sustainable and just uses of water, energy, and other earth resources and to understand and mitigate potential hazards.

Master of Science (Non-Thesis)

To obtain the 30 credits, students must satisfy the following program requirements: (1) 12 credits of required HES courses; (2) 3 credits of elective HES courses approved by Engineering, Design & Society; and (3) 15 credits of courses (500+ level) approved by the affiliated Department.

HES Courses (15 credits):

EDNS577	ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT	3.0
EDNS479	COMMUNITY-BASED RESEARCH	3.0
EDNS590	RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE	3.0
EDNS580	HUMANITARIAN ENGINEERING AND SCIENCE CAPSTONE PRACTICUM	3.0
ELECTIVES	3 credit hours of approved HES electives from list	3.0

Approved HES Electives List:

EDNS430	CORPORATE SOCIAL RESPONSIBILITY	3.0
EDNS475	ENGINEERING CULTURES IN THE DEVELOPING WORLD	3.0
EDNS478	ENGINEERING AND SOCIAL JUSTICE	3.0
EDNS480	ANTHROPOLOGY OF DEVELOPMENT	3.0
HASS425	INTERCULTURAL COMMUNICATION	3.0
HASS525	ENVIRONMENTAL COMMUNICATION	3.0
HASS565	SCIENCE, TECHNOLOGY, AND SOCIETY	3.0
MNGN482	MINE MANAGEMENT	3.0
MNGN503	MINING TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT	3.0
MNGN510	FUNDAMENTALS OF MINING AND MINERAL RESOURCE DEVELOPMENT	3.0
MNGN565	MINE RISK MANAGEMENT	3.0
MNGN567	SUSTAINABLE DEVELOPMENT AND EARTH RESOURCES	3.0
MNGN571	ENERGY, NATURAL RESOURCES, AND SOCIETY	3.0
PEGN530	ENVIRONMENTAL LAW AND SUSTAINABILITY	3.0
CEEN401	LIFE CYCLE ASSESSMENT	3.0
CEEN472	ONSITE WATER RECLAMATION AND REUSE	3.0
CEEN477	SUSTAINABLE ENGINEERING DESIGN	3.0
CEEN479	AIR POLLUTION	3.0
CEEN475/575	SITE REMEDIATION ENGINEERING	3.0
CEEN556	MINING AND THE ENVIRONMENT	3.0
CEEN570	WATER AND WASTEWATER TREATMENT	3.0
CEEN573	RECLAMATION OF DISTURBED LANDS	3.0
CEEN580	CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT	3.0
CEEN581	WATERSHED SYSTEMS MODELING	3.0

Disciplinary Tracks

Track 1: Geophysics (GPGN) (15 credits):

Degree candidates should have an undergraduate degree in geophysics, physics, quantitative earth sciences and engineering, or equivalent coursework. In addition, candidates will need to complete necessary prerequisite courses for the graduate courses.

GPGN577	HUMANITARIAN GEOSCIENCE	3.0
GPGN533	GEOPHYSICAL DATA INTEGRATION & GEOSTATISTICS	3.0
GPGN570	APPLICATIONS OF SATELLITE REMOTE SENSING	3.0
GPGN574	ADVANCED HYDROGEOPHYSICS	3.0
ELECTIVES	3 credits of approved 500-level GPGN electives	3.0

Approved GPGN Electives List:

GPGN509	PHYSICAL AND CHEMICAL PROPERTIES AND PROCESSES IN ROCK, SOILS, AND FLUIDS	3.0
GPGN511	ADVANCED GRAVITY AND MAGNETIC METHODS	3.0
GPGN520	ELECTRICAL AND ELECTROMAGNETIC EXPLORATION	3.0
GPGN530	APPLIED GEOPHYSICS	3.0
GPGN555	EARTHQUAKE SEISMOLOGY	3.0
GPGN561	SEISMIC DATA PROCESSING I	4.0
GPGN605	INVERSION THEORY	3.0
Other GPGN 500- or 600-level courses as approved by the GNGN program coordinator		

Track 2: Environmental Engineering (CEEN) (15 credits):

A BS degree in a science or engineering discipline is required. Pre-requisites include two semesters of college calculus, one semester of college physics, two semesters of college chemistry, and one semester of college statistics.

Required Courses:

CEEN550	PRINCIPLES OF ENVIRONMENTAL CHEMISTRY	3.0
GPGN577	HUMANITARIAN GEOSCIENCE	3.0
CEEN580	CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT	3.0

One of the Following:

CEEN560	MOLECULAR MICROBIAL ECOLOGY AND THE ENVIRONMENT	
CEEN562	ENVIRONMENTAL GEOMICROBIOLOGY	
CEEN566	MICROBIAL PROCESSES, ANALYSIS AND MODELING	

One of the Following:

CEEN472	ONSITE WATER RECLAMATION AND REUSE	
CEEN570	WATER AND WASTEWATER TREATMENT	
CEEN575	HAZARDOUS WASTE SITE REMEDIATION	

Approved CEEN Electives List:

The following courses can be substituted for required track courses if incoming students have already taken some of the required courses:

CEEN477	SUSTAINABLE ENGINEERING DESIGN	3.0
CEEN479	AIR POLLUTION	3.0
CEEN501	LIFE CYCLE ASSESSMENT	3.0
CEEN/MNGN556	MINING AND THE ENVIRONMENT	3.0
CEEN573	RECLAMATION OF DISTURBED LANDS	3.0
CEEN575	HAZARDOUS WASTE SITE REMEDIATION	3.0
CEEN581	WATERSHED SYSTEMS MODELING	3.0
Other CEEN 500- or 600-level courses as approved by the CEEN Program Coordinator		

Track 3: Geological Engineering (GEGN) (15 credits):

Degree candidates should have an undergraduate degree in engineering or the equivalent coursework. In addition, candidates will need to complete necessary prerequisite courses for the graduate courses, including engineering geology, ground-water engineering, soil mechanics, and rock mechanics.

Required Courses:

GEGN532	GEOLOGICAL DATA ANALYSIS	3.0
GPGN577	HUMANITARIAN GEOSCIENCE	3.0
Candidates must also take at least three of the following courses. The student and the instructor will work together to develop humanitarian themes in the project assignments within each course.		
GEGN563	APPLIED NUMERICAL MODELLING FOR GEOMECHANICS	3.0
GEGN570	CASE HISTORIES IN GEOLOGICAL ENGINEERING AND HYDROGEOLOGY	3.0
GEGN573	GEOLOGICAL ENGINEERING SITE INVESTIGATION	3.0
GEGN575	APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS	3.0
GEGN580	APPLIED REMOTE SENSING FOR GEOENGINEERING AND GEOSCIENCES	3.0
GEGN671	LANDSLIDES: INVESTIGATION, ANALYSIS & MITIGATION	3.0
GEGN673	ADVANCED GEOLOGICAL ENGINEERING DESIGN	3.0

Master of Science (Thesis)

To obtain the 30 credits, students must satisfy the following program requirements: (1) 9 credits of required HES courses; (2) 3 credits of elective HES classes approved by Engineering, Design & Society; (3) 12 credits of approved Disciplinary Track classes (500+ level); and (4) 6 credits of MS thesis research on a thesis topic approved by HES faculty in the Engineering, Design, & Society Division and the affiliated disciplinary track.

HES Courses (12 credits in addition to the 6 credit hour thesis):

EDNS577	ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT	3.0
EDNS479	COMMUNITY-BASED RESEARCH	3.0

EDNS590	RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE	3.0
ELECTIVES	3 credits of approved HES electives from list above	3.0

Disciplinary Tracks

Track 1: Geophysics (GPGN) Courses and Thesis (18 credits):

GPGN577	HUMANITARIAN GEOSCIENCE	3.0
GPGN533	GEOPHYSICAL DATA INTEGRATION & GEOSTATISTICS	3.0
GPGN570	APPLICATIONS OF SATELLITE REMOTE SENSING	3.0
GPGN574	ADVANCED HYDROGEOPHYSICS	3.0
GPGN707	GRADUATE THESIS / DISSERTATION RESEARCH CREDIT	6.0

Track 2: Environmental Engineering (CEEN) Courses and Thesis (18 credits):

GPGN577	HUMANITARIAN GEOSCIENCE	3.0
CEEN707	GRADUATE THESIS / DISSERTATION RESEARCH CREDIT	1-15
Choose three of the following four options:		
CEEN550	PRINCIPLES OF ENVIRONMENTAL CHEMISTRY	3.0
CEEN580	CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT	3.0
One of the following:		
CEEN560	MOLECULAR MICROBIAL ECOLOGY AND THE ENVIRONMENT	
CEEN562	ENVIRONMENTAL GEOMICROBIOLOGY	
CEEN566	MICROBIAL PROCESSES, ANALYSIS AND MODELING	
One of the following:		
CEEN472	ONSITE WATER RECLAMATION AND REUSE	
CEEN570	WATER AND WASTEWATER TREATMENT	
CEEN575	HAZARDOUS WASTE SITE REMEDIATION	

Approved CEEN Electives:

The courses listed in the Approved CEEN Electives List above can be substituted for required track courses if incoming students have already taken some of the required courses.

Track 3: Geological Engineering Courses and Thesis (18 credits):

GPGN577	HUMANITARIAN GEOSCIENCE	3.0
GEGN707	GRADUATE THESIS / DISSERTATION RESEARCH CREDIT	1-15
Students must take two of the following courses:		
GEGN563	APPLIED NUMERICAL MODELLING FOR GEOMECHANICS	3.0
GEGN570	CASE HISTORIES IN GEOLOGICAL ENGINEERING AND HYDROGEOLOGY	3.0
GEGN573	GEOLOGICAL ENGINEERING SITE INVESTIGATION	3.0
GEGN575	APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS	3.0
GEGN580	APPLIED REMOTE SENSING FOR GEOENGINEERING AND GEOSCIENCES	3.0
GEGN671	LANDSLIDES: INVESTIGATION, ANALYSIS & MITIGATION	3.0
GEGN673	ADVANCED GEOLOGICAL ENGINEERING DESIGN	3.0

Mines' Combined Undergraduate / Graduate Degree Program

Students enrolled in Mines' combined undergraduate/graduate program may double count up to six hours of credits which were used in fulfilling the requirements of their undergraduate degree at Mines, towards their graduate program. Any courses that count towards the graduate degree requirements as either "Required Coursework" or "Elective Coursework", as defined above, may be used for the purposes of double-counting at the discretion of the advisor (MS Non-Thesis) or thesis committee (MS Thesis or PhD.). These courses must have been passed with a "B-" or better and meet all other University, Department, Division, and Program requirements for graduate credit.

Graduate Certificate

The HES certificate is an online or residential program designed for working professionals as well as graduate students who are enrolled in other degrees at Mines but wish to gain knowledge in humanitarian engineering and science. To obtain a graduate certificate, students must complete a minimum of 9 credit hours of the following courses. Students may not double-count courses from their undergraduate degrees. Students who have already taken one of the classes as undergraduates must find a suitable replacement, to be approved by the HES Director. Students are encouraged to take 12 credit hours of coursework if possible.

Required HES certificate courses (9 credits):

EDNS577	ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT	3.0
EDNS479	COMMUNITY-BASED RESEARCH	3.0
EDNS590	RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE	3.0

Courses

EDNS515. INTRODUCTION TO ENGINEERING IN SOCIETY. 3.0 Semester Hrs.

This course engages scholarship on the inextricable link between engineering and the various social contexts within which engineers work. We begin by critically reflecting on the question, ?What is engineering for?? We then explore key conceptual domains in the social scientific study of engineering, including knowledge, agency, and expertise. We will learn from a diverse set of social scientific experts who study and collaborate with engineers. Students will leave the course with a better understanding of how social scientific inquiry can aid in understanding, and practicing, engineering. They will also have a clearer articulation of their individual professional commitments and how those fit with more traditional understandings of engineering.

EDNS577. ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT. 3.0 Semester Hrs.
Analyzes the relationship between engineering and sustainable community development (SCD) from historical, political, ethical, cultural, and practical perspectives. Students will study and analyze different dimensions of sustainability, development, and "helping", and the role that engineering might play in each. Will include critical explorations of strengths and limitations of dominant methods in engineering problem solving, design and research for working in SCD. Through case-studies, students will analyze and evaluate projects in SCD and develop criteria for their evaluation. 3 hours lecture and discussion; 3 semester hours.

EDNS580. HUMANITARIAN ENGINEERING AND SCIENCE CAPSTONE PRACTICUM. 3.0 Semester Hrs.
(I, II, S) This course allows students to practice the concepts, theories and methods learned in HES courses with the goal of making relevant their academic training to real world problems. This practicum can be achieved through a number of possibilities approved by HES director, including supervision and/or shadowing in HES-related activities, engaging in a social enterprise where they do problem definition, impact gap analysis and layout a business canvas, and designing and carrying out a project or fieldwork of their own, etc. Prerequisite: EDNS570, EDNS479. 3 hours research; 3 semester hours.

EDNS590. RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE. 3.0 Semester Hrs.
(I) This course provides students with opportunities learn about risk and ways of analyzing engineering and scientific projects in relation to risks, and to develop multiple mitigation steps. The students will learn tools to develop their own designs while also evaluating associated risks along multiple dimensions and searching out synergies. 3 hours lecture; 3 semester hours.

EDNS598. SPECIAL TOPICS IN ENGINEERING DESIGN & SOCIETY. 6.0 Semester Hrs.
(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Prerequisite: none. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

EDNS599. INDEPENDENT STUDY. 0.5-6 Semester Hr.
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: 0.5 to 6 credit hours. Repeatable for credit under different topics/experience and maximums vary by department. Contact the Department for credit limits toward the degree. Independent Study form must be completed and submitted to the Registrar.

EDNS479. COMMUNITY-BASED RESEARCH. 3.0 Semester Hrs.
Engineers and applied scientists face challenges that are profoundly socio-technical in nature, and communities are increasingly calling for greater participation in the decisions that affect them. Understanding the diverse perspectives of communities and being able to establish positive working relationships with their members is therefore crucial to the socially responsible practice of engineering and applied science. This course provides students with the conceptual and methodological tools to conduct community-based research. Students will learn ethnographic field methods and participatory research strategies, and critically assess the strengths and limitations of these through a final original research project. Prerequisite: HASS100 or graduate student standing. Co-requisite: HASS200 or graduate student standing.