Humanitarian Engineering

Degrees

- Graduate Certificate in Humanitarian Engineering and Science

Program Description

The Humanitarian Engineering and Science degree programs are part of the division of Engineering, Design, and Society (EDS). The mission of the Division of Engineering, Design, and Society (EDS) is to engage in research, education, and outreach that inspires and empowers engineers and applied scientists to become innovative and impactful leaders in sociotechnical problem definition, solution, and design who can address the challenges of attaining a sustainable global society.

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) 9 credits of required HES courses; (2) 6 credits of elective HES courses approved by Engineering, Design & Society (500+ level); and (3) 15 credits of courses (500+ level) approved by the affiliated Department.

HES Courses (15 credits):

- EDNS577  ADVANCED ENGINEERING AND SUSTAINABLE 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
- CEEEN401  LIFE CYCLE ASSESSMENT  3.0
- CEEEN472  ONSITE WATER RECLAMATION AND REUSE  3.0
- CEEEN477  SUSTAINABLE ENGINEERING DESIGN  3.0
- CEEEN479  AIR POLLUTION  3.0
- CEEEN475/575  SITE REMEDIATION ENGINEERING  3.0
- CEEEN556  MINING AND THE ENVIRONMENT  3.0
- CEEEN570  WATER AND WASTEWATER TREATMENT  3.0
- CEEEN573  RECLAMATION OF DISTURBED LANDS  3.0
- CEEEN576  POLLUTION PREVENTION: FUNDAMENTALS AND PRACTICE  3.0
- CEEEN580  CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT  3.0
- CEEEN581  WATERSHED SYSTEMS MODELING  3.0
- CEEEN592  ENVIRONMENTAL LAW  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  3.0
- 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):

- CEEEN570  WATER AND WASTEWATER TREATMENT  3.0
- CEEEN573  RECLAMATION OF DISTURBED LANDS  3.0
- CEEEN576  POLLUTION PREVENTION: FUNDAMENTALS AND PRACTICE  3.0
- CEEEN580  CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT  3.0
- CEEEN581  WATERSHED SYSTEMS MODELING  3.0
- CEEEN592  ENVIRONMENTAL LAW  3.0
A BS degree in a science or engineering discipline is required. Prerequisites include two semesters of college calculus, one semester of college physics, two semesters of college chemistry, and one semester of college statistics.

**Required Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN550</td>
<td>PRINCIPLES OF ENVIRONMENTAL CHEMISTRY</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN577</td>
<td>HUMANITARIAN GEOSCIENCE</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN580</td>
<td>CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**One of the Following:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN560</td>
<td>MOLECULAR MICROBIAL ECOLOGY AND THE ENVIRONMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN562</td>
<td>ENVIRONMENTAL GEOMICROBIOLOGY</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN566</td>
<td>MICROBIAL PROCESSES, ANALYSIS AND MODELING</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN477</td>
<td>SUSTAINABLE ENGINEERING DESIGN</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN479</td>
<td>AIR POLLUTION</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN501</td>
<td>LIFE CYCLE ASSESSMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN/MNGN556</td>
<td>MINING AND THE ENVIRONMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN573</td>
<td>RECLAMATION OF DISTURBED LANDS</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN575</td>
<td>HAZARDOUS WASTE SITE REMEDIATION</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN576</td>
<td>POLLUTION PREVENTION: FUNDAMENTALS AND PRACTICE</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN581</td>
<td>WATERSHED SYSTEMS MODELING</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN592</td>
<td>ENVIRONMENTAL LAW</td>
<td>3.0</td>
</tr>
<tr>
<td>Other CEEN 500- or 600-level courses as approved by the CEEN Program Coordinator</td>
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<td></td>
</tr>
</tbody>
</table>

**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:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEGN532</td>
<td>GEOLOGICAL DATA ANALYSIS</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN577</td>
<td>HUMANITARIAN GEOSCIENCE</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**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:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEGN563</td>
<td>APPLIED NUMERICAL MODELLING FOR GEOMECHANICS</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN570</td>
<td>CASE HISTORIES IN GEOLOGICAL ENGINEERING AND HYDROGEOLOGY</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**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 (500+ level); (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):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS577</td>
<td>ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>EDNS479</td>
<td>COMMUNITY-BASED RESEARCH</td>
<td>3.0</td>
</tr>
<tr>
<td>EDNS590</td>
<td>RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE</td>
<td>3.0</td>
</tr>
<tr>
<td>ELECTIVES</td>
<td>3 credits of approved HES electives from list above</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Disciplinary Tracks**

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

<table>
<thead>
<tr>
<th>Course Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>GPGN577</td>
<td>HUMANITARIAN GEOSCIENCE</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN533</td>
<td>GEOPHYSICAL DATA INTEGRATION &amp; GEOSTATISTICS</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN570</td>
<td>APPLICATIONS OF SATELLITE REMOTE SENSING</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN574</td>
<td>ADVANCED HYDROGEOPHYSICS</td>
<td>3.0</td>
</tr>
<tr>
<td>GPGN707</td>
<td>GRADUATE THESIS / DISSERTATION RESEARCH CREDIT</td>
<td>6.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPGN577</td>
<td>HUMANITARIAN GEOSCIENCE</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN707</td>
<td>GRADUATE THESIS / DISSERTATION RESEARCH CREDIT</td>
<td>1-15</td>
</tr>
</tbody>
</table>

**Choose three of the following four options:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN550</td>
<td>PRINCIPLES OF ENVIRONMENTAL CHEMISTRY</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN580</td>
<td>CHEMICAL FATE AND TRANSPORT IN THE ENVIRONMENT</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**One of the following:**

<table>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN560</td>
<td>MOLECULAR MICROBIAL ECOLOGY AND THE ENVIRONMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN562</td>
<td>ENVIRONMENTAL GEOMICROBIOLOGY</td>
<td>3.0</td>
</tr>
</tbody>
</table>
HES courses (12 credits):

<table>
<thead>
<tr>
<th>One of the following:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN472</td>
<td>ONSITE WATER RECLAMATION AND REUSE</td>
</tr>
<tr>
<td>CEEN570</td>
<td>WATER AND WASTEWATER TREATMENT</td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
<tr>
<th>Approved CEEN Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GEGN577</td>
<td>HUMANITARIAN GEO SCIENCE 3.0</td>
</tr>
<tr>
<td>GEGN707</td>
<td>GRADUATE THESIS / DISSERTATION RESEARCH CREDIT 1-15</td>
</tr>
</tbody>
</table>

Students must take two of the following courses:

| GEGN563              | APPLIED NUMERICAL MODELLING FOR GEO MECHANICS 3.0 |
| GEGN570              | CASE HISTORIES IN GEOLOGICAL ENGINEERING AND HYDRO GEOLOGY 3.0 |
| GEGN573              | GEOLOGICAL ENGINEERING SITE INVESTIGATION 3.0 |
| GEGN575              | APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS 3.0 |
| GEGN580              | APPLIED REMOTE SENSING FOR GEOENGINEERING AND GEO SCIENCES 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 (meaning uninterrupted registration from the time the student earns a Mines undergraduate degree to the time the student begins a Mines graduate degree) 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

This option is for graduate students who are interested in HES-related topics yet do not have the inclination to complete a full MS degree program. To obtain a graduate certificate, students must complete the following twelve (12) credits:

<table>
<thead>
<tr>
<th>Electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EDNS577</td>
<td>ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT 3.0</td>
</tr>
<tr>
<td>EDNS479</td>
<td>COMMUNITY-BASED RESEARCH 3.0</td>
</tr>
<tr>
<td>EDNS590</td>
<td>RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE 3.0</td>
</tr>
</tbody>
</table>

Courses

EDNS577. ADVANCED ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT. 3.0 Semester Hrs.
Equivalent with LAIS577.
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, II, S) 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.
Equivalent with LAIS479,
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. Co-requisite: HASS200.