

Engineering, Design, and Society

Degrees

- Master of Science in Humanitarian Engineering and Science (thesis and non-thesis options)
- Graduate Certificate in Humanitarian Engineering and Science

Program Description

The mission of the Department 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 socio-technical design, problem definition, and problem solution. Our graduates are prepared to address the challenges of attaining a thriving, sustainable global society. Humanitarian Engineering and Science (HES) is a set of graduate program offerings within EDS.

HES connects students with a passion for contributing to social and environmental problem solving to Mines faculty who lead the field of applying engineering to pressing social, environmental, and community challenges. Integrating engineering with social sciences and design, HES offers courses that teach students how to work *with* the communities they seek to serve by co-creating solutions that promote justice, responsibility, and sustainability. HES serves students who have diverse career goals spanning NGOs, government agencies and research groups, start-ups, and established companies. Seminar-style courses offered by EDS, along with selected technical courses offered by other academic units across campus, provide students a balance of breadth and depth in applying engineering to social, environmental, and community challenges.

Information on the Humanitarian Engineering and Science degree programs can be found in the Interdisciplinary Programs section of the catalog.

Courses

EDNS515. INTRODUCTION TO SCIENCE AND TECHNOLOGY STUDIES. 3.0 Semester Hrs.

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

Course Learning Outcomes

- By the end of this course, students will have demonstrated the ability to:
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EDNS544. INNOV8X. 3.0 Semester Hrs.

Innov8x 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, prototyping, 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
- Launch innovative solutions with the advocacy of beneficiaries and stakeholders

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.

Course Learning Outcomes

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EDNS579. COMMUNITY-BASED RESEARCH METHODS. 3.0 Semester Hrs.

Engineers and applied scientists face challenges that are profoundly sociotechnical 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 graduate students with the conceptual and methodological tools to conduct community-based research. Graduate 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 related to their ongoing independent research or practicums.

Course Learning Outcomes

- During this course students will learn to:

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.

Course Learning Outcomes

- Identify successful practices for humanitarian projects in real settings (ABET a,h,j) • Determine different ways in which previous humanitarian projects could have been improved to yield more successful technical and social results (ABET a,b,h,j) • Determine effective engineering methods for different humanitarian applications (ABET b,c,h,j) • Work in teams to design, execute and evaluate a project with stakeholders (ABET a,b,c,d,e,j,k) • Gain experience in engaging and communicating with community members and stakeholders (ABET c,d,f,h,i,j,k) • Develop stronger professional communication skills through written assignments, group projects, discussions, presentations, and community engagement (ABET g,f,h,i,j,k)

EDNS590. RISKS IN HUMANITARIAN ENGINEERING AND SCIENCE. 3.0 Semester Hrs.

(I) This course provides students with opportunities to consider the risks related to humanitarian projects?or any projects that effect and involve people. These risks might include things that different scientific and engineering disciplines typically consider, as well as those that may be pertinent to project stakeholder perspectives. Guided by social scientific insights related to risk, students in this class will gain new tools for defining problems in ways that are relevant and appropriate for multiple contexts. Students will read, discuss, and analyze material together and to undertake independent research to deepen their understandings of chosen topics. 3 semester hours.

Course Learning Outcomes

- Analyze humanitarian science and engineering projects using established evaluation criteria (ABET a,h,j) • Identify the most successful practices for humanitarian science and engineering (ABET a,h,j) • Determine different ways in which previous engineering or scientific projects could have been improved to yield more successful technical and social results (ABET a,b,h,j) • Gain conceptual tools for and experience in engaging and communicating with community members and stakeholders (ABET c,d,f,h,i,j,k) • Develop stronger professional communication skills through written assignments, group projects, discussions, presentations, and community engagement (ABET g,f,h,i,j,k)

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.

Department Leadership

Dean Nieuwma, Department Head

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

Professors

Juan Lucena, Humanitarian Engineering Director of Undergraduate Programs and Outreach

Kevin Moore, Executive Director of Humanitarian Engineering

Jessica Smith

Assistant professors

Elizabeth Reddy, Assistant Director of Humanitarian Engineering and Science Interdisciplinary Graduate Program

Marie Stettler Kleine

Teaching Professors

Yosef Allam, Director of Cornerstone Design Program

Alina Handorean

Teaching Associate Professors

Jack Bringardner

Mirna Mattjik

Mark Orrs

Sid Saleh, Director of McNeil Center for Entrepreneurship & Innovation

Kate Youmans, Presidential Faculty Fellow for Diversity, Inclusion & Access

Teaching Assistant Professors

Cynthia Athanasiou

Duncan Davis-Hall

Michael Sheppard

Aubrey Wigner

Professors of Practice

Donna Bodeau

Garrett Erickson

Antonie Vandenberge

Staff

Becky Buschke, Program Assistant

Leah Fitzgerald, Stakeholder Relations Manager

Kirsten Kelly, Capstone Administrative Assistant

Julia Roos, Associate Director of Humanitarian Engineering

Kimberly Walker, Department Manager