HUMAN CENTERED ENGINEERING DESIGN

Human Centered Engineering Design (HCED) is concerned with the interactive, iterative, and creative problem solving and/or product and system development by building empathy with the customer to better understand their needs. The human centered design approach is widely being adopted by different industries, including automotive, aerospace, healthcare, information technology, software, consumer electronics, e-commerce, and digital marketing. These industries are actively looking for design professionals with the technical background who can research, identify, translate and document user needs; generate creative product/process design ideas that address user requirements; and implement and evaluate the usability of products or services in a scientific way. Human Centered Engineering Design is an interdisciplinary and inclusive field of study that bridges engineering design, art design, social sciences and business principles.

Undergraduate Degree Program

The Bachelor of Science Engineering in Human Centered Engineering Design requires a total of 128 credit hours and provides first, a strong basis in the foundations of engineering: natural and physical sciences, mathematics, the behavioral sciences and the basic engineering sciences which begin the emphasis on creative problem solving. Then, the program develops strong foundation on which human centered design engineering work is founded. This includes studies in design process and creative problem solving, design communication, art design, qualitative and quantitative research methods in need finding, usability engineering, human factors engineering, and prototyping. Innovative problem solving, product/process design and prototyping skills are progressively developed and applied through a 4-year (freshman, sophomore, junior and senior year) individual and team based immersive design project experiences. The program creates an environment that inspires brainstorming for innovative and aesthetic solutions while emphasizing the theoretical, technological and design knowledge.

Educational Objectives of the BSE (Human Centered Engineering Design) Program

Consistent with providing a strong academic foundation in the field of Human Centered Engineering Design, the program educational objectives for our graduates are:

- To remain gainfully employed in Human-Centered Engineering Design related fields,
- To continue to develop professionally, and
- To serve in leadership roles.

Student Outcomes

To achieve the educational objectives, the graduates of the program will 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.

Human Centered Design and Engineering 4+1 Option

The accelerated undergraduate/master's studies option in human-centered design and engineering (including 4+1 option) allows the most qualified UM-Dearborn undergraduate human-centered engineering design (BS HCED) students to pursue a program of study in which BSE and MS degrees are earned in a five-year accelerated format. This is achieved by combining a portion of undergraduate and graduate coursework as described below.

Eligibility:

To be eligible for the option, a student must:

- Be enrolled in the undergraduate HCED program at the University of Michigan-Dearborn.
- Have earned 60 credit hours in the undergraduate program.
- The applicant to the accelerated option should have completed the following courses with grades of B+ or better: HCED 370 and HCED 380.
- Have a 3.2 cumulative GPA or better.
- Not be enrolled in two undergraduate programs or in a dual-degree program in either their undergraduate or graduate program.
- Deferred enrollment by 4+1 students into the Master's program is not permitted.
- Students must attain a grade of B or better in each 500-level class taken as an undergraduate student and used for graduate credit in the accelerated option. Failure to do so may result in removal from the accelerated option.

Applying to the 4+1/Accelerated option is a two-stage process coordinated with both your undergraduate and graduate advising teams. For detailed instructions and application links, please visit the central 4+1 programs webpage (https://umdearborn.edu/academics/program/41-programs/).

Double Counting and Transfer Credits:

1. The accelerated option allows current UM-Dearborn BS HCED majors to complete both the BSE HCED and MS human-centered design and engineering (MS HCDE) degrees in an accelerated format. Admitted students can double-count up to 9 credits of 500-level or above HCDE core or concentration courses taken during their junior or senior years.
2. In practice with the usual graduate student program rules, students may also transfer a maximum of 6 additional 500-level credits toward the 31-credit hours master's degree. These additional transfer credits

can be taken during the junior and senior years and cannot be used for any portion of the undergraduate degree.

3. Depending on the number of double-counted and transfer credits, 16-22 credits of graduate coursework would be needed to complete the master's program after completion of the undergraduate degree.

Dearborn Discovery Core (General Education)

All students must satisfy the University's Dearborn Discovery Core requirements (https://catalog.umd.umich.edu/undergraduate/gen_ed_ddc/), in addition to the requirements for the major

Major Requirements

Code	Title	Credit Hours
Basic Preparation Requirements		
COMP 105	Writing & Rhetoric I	3
COMP 106	Writing & Rhetoric II	3
or COMP 270	Tech Writing for Engineers	
ANTH 101	Introduction to Anthropology	3
MATH 115	Calculus I	4
MATH 116	Calculus II	4
MATH 228	Diff Eqns with Linear Algebra	4
IMSE 317	Eng Probability and Statistics	3
CHEM 134	General Chemistry IA	4
BIOL 203	Anatomy and Physiology I	4
PHYS 150	General Physics I	3
PHYS 150L	General Physics I Lab/Dis	1
PHYS 151	General Physics II	3
PHYS 151L	General Physics II Lab/Dis	1
ENGR 100	Introduction to Engineering and Engineering Design	3
Select one course from the following:		2-4
IMSE 255	Computer Programming for Eng	
CIS 150	Computer Science I	
CIS 1501	CS I for Data Scientists	
ECE 270	Computer Methods in ECE I	
ENGR 216	Computer Meth for Engineers	
ECE 210	Circuits	4
ENGR 250	Principles of Engineering Materials	3
ME 260	Design Stress Analyses	4
or ME 265	Applied Mechanics	
Engineering Design Core		
HCED 220	Engineering Design Communication	2
ENGR 360	Design Thinking : Process, Method & Practice	4
HCED 370	Needfinding and Research Methods in Design	3
HCED 380	Product Prototyping: Tools and Methods	3
HCED 380L	Prototyping Tools and Techniques	1
IMSE 382	Manufacturing Processes	4
IMSE 421	Eng Economy and Dec Anlys	3
IMSE 4425	Human Factors and Ergonomics	4
HCED 450	Product Realization: Design and Making	3
HCED 450L	Product Realization: Design and Making (lab)	1
HCED 4951	Capstone Project in HCED: Needfinding and Conceptualization	2
HCED 4952	Capstone Project in HCED: Design and Implementation	2
ART 210	Beginning Digital Design	3
ART 410	Advanced Digital Design	3
Select 1 course from the following:		4
ARTH 101	Understand Art-Ancient to 1400	
ARTH 102	Understanding Art 1400 to Now	
ARTH 103	Arts of Asia	
ARTH 106	Architecture & Society in Western Civilization	
ARTH 221	Ancient Monuments then and Now	
ARTH 241	Encountering the Renaissance	
ARTH 261	Art and Film	
ARTH 305	The Arts & Culture of Detroit	
ARTH 312	Art of Japan	
ARTH 313	Chinese Painting	
ARTH 315	Early Chinese Art and Culture	
ARTH 327	Gods, Myth and Worship	
ARTH 333	Gothic Art and Architecture	
ARTH 335	Women in Medieval Art	
ARTH 343	Renaissance & Reformation Art	
ARTH 352	Baroque Art and Architecture	
ARTH 362	Impressionism and Post-Impressionism	
ARTH 363	Arts of the Twentieth Century	
ARTH 367	Contemporary Art	
ARTH 368	Global History of Photography	
Select 2 courses from the following: [1]		6
MKT 382	Understanding Customers	
OB 354	Behavior in Organizations	
ENT 400	Entrepreneurial Thinking&Behav	
BA 320	Project Management and Leadership Skills	

[1] Students in the 4+1 program may use the following courses: IMSE 515 or IMSE 516, MKT 515, MKT 620.

Students admitted to the 4+1 Option may substitute ART 510 for ART 410, HCDE 520 for HCED 370, IMSE 545 for IMSE 445, IMSE 577 for IMSE 477.

To successfully achieve the 4+1 option within a five-year timeframe, students can look forward to completing 2 core courses, 2 capstone courses, and 2 electives, which may even include up to 6 credits of thesis work. Additionally, for those who opt not to use the six transfer credit options, there is an opportunity to engage in 4 graduate courses during the final year of study, providing an enriching academic experience. In this case, students should plan on completing the master's degree in three terms after the BSE degree is completed.

HCED students must choose a concentration in Mechanical Engineering Design, Electrical Engineering Design, Software Engineering and HCI Design, Systems Engineering Design, or Individualized Design. Concentration requirements are listed below.

Mechanical Engineering Design Concentration - 17-19 credits

Code	Title	Credit Hours
Select a minimum of four courses from the following		
ENGR 350	Nanoscience and Nanotechnology	4
ME 345	Engineering Dynamics	4
ME 3601	Design and Analysis of Machine Elements	4
ME 4191	Structural Mech & Design	4
ME 460	Design for Manufacturing	3
ME 4981	Automotive Engineering	4
ENGR 299	Experiential Learning in Engineering & Computer Science 1	1
ENGR 399	Experiential Learning in Engineering & Computer Science 2	1
ENGR 499	Experiential Learning in Engineering & Computer Science 3	1
Other Technical Electives (see "Recommended Electives" list)		0-4

Code	Title	Credit Hours
Recommended elective list: COMM 300 Communication Research Methods (3), COMM 340 Professional Communication (3), ESCI 275 Introduction to Environmental Sustainability (3), ENST 340 Remote Sensing (3), ESCI 490 Topics in Environmental Sci (3), ANTH 470 Doing Anthropology: Ethnographic Methods and Applied Practice (4)		

Electrical Engineering Design Concentration - 17-19 credits

Code	Title	Credit Hours
Select a minimum of four courses from the following		
ECE 273	Digital Systems	4
ECE 311	Electronic Circuits I	4
ECE 329	Intro to Computer Music	4
ECE 3731	Microproc and Embedded Sys	4
ECE 413	Intro to VLSI Design	3
ECE 450	Analog and Digital Comm Sys	4
ECE 460	Automatic Control Systems	4
ECE 471	Comp Networks/Data Comm	4
ECE 473	Embedded System Design	4
ECE 4951	Sys Desgn and Microcontrollers	3
IMSE 477	Human Computer Interaction for UI & UX Design [1]	3
ENGR 299	Experiential Learning in Engineering & Computer Science 1	1
ENGR 399	Experiential Learning in Engineering & Computer Science 2	1
ENGR 499	Experiential Learning in Engineering & Computer Science 3	1
Other Technical Electives (see "Recommended Electives" list)		0-4

[1] Students in the 4+1 program may substitute IMSE 577 for IMSE 477.

Code	Title	Credit Hours
Recommended elective list: COMM 300 Communication Research Methods (3), COMM 340 Professional Communication (3), ESCI 275 Introduction to Environmental Sustainability (3), ENST 340 Remote Sensing (3), ESCI 490 Topics in Environmental Sci (3), ANTH 470 Doing Anthropology: Ethnographic Methods and Applied Practice (4)		

Software Engineering and HCI Design Concentration - 17-19 credits

Code	Title	Credit Hours
Take a minimum of four courses from the following		
CIS 200	Computer Science II	4
or CIS 2001	CS II for Data Scientists	
CIS 275	Discrete Structures I	4
CIS 285	Software Engineering Tools	3
CIS 350	Data Struc and Algorithm Anlys	4
or CIS 3501	Data Struc & Alg Anlys for SE	
CIS 375	Software Engineering I	4
CIS 411	Introduction to Natural Language Processing	3
CIS 435	Web Technology	3
CIS 436	Mobile App Des & Impl	3
CIS 479	Intro to Artificial Intel	3
IMSE 477	Human Computer Interaction for UI & UX Design [1]	3
ENGR 299	Experiential Learning in Engineering & Computer Science 1	1
ENGR 399	Experiential Learning in Engineering & Computer Science 2	1
ENGR 499	Experiential Learning in Engineering & Computer Science 3	1
Other Technical Electives (see "Recommended Electives" list)		0-4

[1] Students in the 4+1 program may substitute IMSE 577 for IMSE 477.

Code	Title	Credit Hours
Recommended elective list: COMM 300 Communication Research Methods (3), COMM 340 Professional Communication (3), ESCI 275 Introduction to Environmental Sustainability (3), ENST 340 Remote Sensing (3), ESCI 490 Topics in Environmental Sci (3), ANTH 470 Doing Anthropology: Ethnographic Methods and Applied Practice (4)		

Systems Engineering Design Concentration - 17-19 credits

Code	Title	Credit Hours
Select a minimum of four courses from the Following		
IMSE 3005	Intro to Operations Research	4
IMSE 440	Applied stat models in engin	3
IMSE 445	Vehicle Ergonomics I [1]	3
IMSE 4585	Simulation in Systems Design	4
IMSE 477	Human Computer Interaction for UI & UX Design	3
IMSE 4795	Prod, Inven Control & Lean Mfg	4

IMSE 4835	Comp.-Aided Prcs Desgn & Mfg	4
BA 320	Project Management and Leadership Skills	3
ENGR 299	Experiential Learning in Engineering & Computer Science 1	1
ENGR 399	Experiential Learning in Engineering & Computer Science 2	1
ENGR 499	Experiential Learning in Engineering & Computer Science 3	1
Other Technical Electives (see "Recommended Electives" list)		0-4

[1] Students in the 4+1 program may substitute IMSE 545 for IMSE 445.

Code	Title	Credit Hours

Recommended elective list: COMM 300 Communication Research Methods (3), COMM 340 Professional Communication (3), ESCI 275 Introduction to Environmental Sustainability (3), ENST 340 Remote Sensing (3), ESCI 490 Topics in Environmental Sci (3), ANTH 470 Doing Anthropology: Ethnographic Methods and Applied Practice (4)

Individualized Concentration - 17-19 credits

Code	Title	Credit Hours

Choose 3 courses in CIS,ECE, IMSE, or ME from the other concentrations (9-12 credits):

Recommended/General Electives: 5-10 credits		

Code	Title	Credit Hours

Recommended elective list: COMM 300, COMM 340, ESCI 275, ENST 340, ESCI 401, ANTH 460, ENGR 399, ENGR 492, ENGR 493

Learning Goals

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.

HCED 220 Engineering Design Communication 2 Credit Hours
This course examines the fundamentals of researching, writing, and presenting technical information for diverse audiences and purposes. Students learn to plan, analyze and prepare for different types of communications; differentiate between audience types and their needs for information; conduct research, understand authority of sources, and provide citations; develop effective listening techniques in business and technical situations. Techniques for writing communication documents, developing and delivering effective presentations and design portfolio, along with the media and technologies commonly used for design communication is also covered in this class. (F).
Prerequisite(s): COMP 105*

HCED 370 Needfinding and Research Methods in Design 3 Credit Hours
This course surveys qualitative and quantitative need finding and research methods in human-centered engineering design including usability engineering. Different data collection and measurement techniques are covered for different types of data, including subjective, behavioral, and physiological data. Human subject involved experiment design is also covered in this course. Students learn to formulate research questions and hypotheses, design and conduct a design related research study, and present research results through various case studies. (W).
Prerequisite(s): ENGR 360

HCED 380 Product Prototyping: Tools and Methods 3 Credit Hours
This course introduces the techniques and toolset necessary for developing low and medium fidelity prototypes to support the human-centered engineering design process. This includes CAD modeling, rapid prototyping, 3D printing, inventive problem solving techniques, sketching, storyboards, role-playing, visualization, virtual reality, and interaction prototyping techniques. Prototype testing techniques and tools are also covered in this course. Students work on individual and semester-long team based design projects in the Design Studio Lab by developing various product prototypes that fulfill customer needs using knowledge, methodology and skills obtained in the class. (W).
Prerequisite(s): ENGR 360 and (IMSE 255 or CIS 150 or CIS 1501 or ECE 270 or ENGR 216) and HCED 370* and HCED 220*

HCED 450 Product Realization: Design and Making 3 Credit Hours
Students will build on the foundation created in HCED 380 and will work on a single semester long project that executes the entire design process from conceptualization through presentation of a customer ready prototype, and creation of a project based portfolio. Different high fidelity engineering design and prototyping tools and techniques will also be covered in this class, including CAD/CAE, microcontrollers, process simulation, software platforms, risk analysis methods, virtual reality, data visualization, and 3D printing. (F, W).
Prerequisite(s): HCED 380 and ENGR 250* and (ME 260* or ME 265*) and ECE 210*

HCED 4951 Capstone Project in HCED: Needfinding and Conceptualization 2 Credit Hours
Summary project using knowledge, methodology, and skills obtained in Human Centered Engineering Design major. Students implement an original design concept and present it to a professional jury. (F, W).
Prerequisite(s): HCED 450
Restriction(s):
Can enroll if Program is

HCED 4952 Capstone Project in HCED: Design and Implementation 2 Credit Hours
This course is a continuation of HCED 4951. Students will complete the development process to conceive a functional product. Students present their final design to a professional jury. (F, W).
Prerequisite(s): HCED 4951* and IMSE 4425* and IMSE 421* and IMSE 382*
Restriction(s):
Can enroll if Program is

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally