SOFTWARE ENGINEERING

Software Engineering is the computer discipline that is concerned with the theoretical and practical aspects of building high quality software systems, on time, and within budget. Software engineers are tasked with the detailed analysis, design, implementation, testing, maintenance, and management of software product development projects for a broad range of computing applications across society.

The increasing pressure to deliver high-quality, reliable software products in less time is rapidly fueling the demand for computer professionals with specific preparation in software engineering and experience in working on teams. These pressures stem from such widespread development as

- The use of software for demanding and safety-critical applications that make it imperative to avoid the serious, indeed sometimes fatal, consequences of poorly understood design.
- The need to create consumer and entertainment applications like computer games, in the face of a highly competitive global marketplace.
- The increasing need to develop useful, easy-to-use software tools that reliably meet customer needs and whose features and documentation can be used and understood by their intended user with a high degree of consistency and confidence.
- The need to re-engineer or replace aging legacy software systems to take advantage of modern computer hardware capabilities.

Recent advances in the practice and technology of software engineering have made it possible to offer undergraduate and graduate degree programs in software engineering itself. Notable among these advances are:

- The availability of proven computer tools and processes to standardize the development of software products and automate software engineering tasks.
- The increasing importance of formal methods and software quality measurement techniques to ensure more thorough testing of software.
- The success of the agile and object-oriented software engineering methods, as well as the move toward technical and managerial practices that cover the full software development cycle.

Software engineers must know the subset of computer science that is relevant to software development. They must also have knowledge of the principles of effective and reliable design, of mathematics and other sciences that are traditionally known by engineers, and of the skills and applications of project management.

Software engineering includes:

- Software design and development; that is, building commercial, industrial-strength software by the application of validated knowledge and experience that have been codified into formal methods of best practices.
- Software process and quality assurance; that is, the systematic discipline of consciously improving the quality, cost, and timeliness of the process itself by which large software systems are designed and developed.
- Software development project management; that is, how to manage large software design projects and bring development to a timely and efficient completion.

The Software Engineering (SWE) degree program offered by the Department of Computer and Information Science stresses the range of technical, systematic, and managerial aspects of the software engineering process but places primary emphasis on the technical facets of designing, building, and modifying large and complex software systems. This program concentrates on all software development lifecycle phases, including program management, requirements engineering, software architecture design, software implementation, software configuration management, software quality assurance, and software process maturity measurements and improvements. It balances both theoretical and practical aspects by covering fundamentals in the classroom and evaluating student knowledge by implementing team-based work projects. Students complete a minimum of 120 credits and receive a BS degree in Software Engineering. The degree prepares graduates for immediate employment in the software engineering field and for graduate study.

The Bachelor of Science in Software Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org (https://www.abet.org/)

Program Educational Objectives

1. Our graduates will be successfully employed in Software Engineering—related fields or other career paths, including industrial, academic, governmental, and non-governmental organizations, or will be successful graduate students in a program preparing them for such employment.
2. Our graduates will lead and participate in culturally diverse and inclusive teams, becoming global and ethical collaborators.
3. Our graduates will continue their professional development through, for example, obtaining continuing education credits, professional registration or certifications, or post-graduate study credits or degrees.

Student Outcomes

To achieve the educational objectives of the program, graduates of the BS in SWE program will have an ability to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. 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. Communicate effectively with a range of audiences.
4. 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. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

Dearborn Discovery Core (General Education)

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

Major Requirements

A candidate for the degree Bachelor of Science in Software Engineering is required to pursue scholastic quality and to complete satisfactorily the following program of study:

In addition to completion of the Dearborn Discovery Core, the following courses are required to earn a BS degree in Software Engineering from UM-Dearborn.

Code	Title	Credit Hours
Prerequisite Courses		
COMP 105	Writing & Rhetoric I	3
COMP 270	Tech Writing for Engineers (Also fulfills 3 credits of DDC Written and Oral Communication)	3
ECON 201	Prin: Macroeconomics (Also fulfills 3 credits of DDC Social and Behavioral Analysis)	3
MATH 115	Calculus I	4
MATH 116	Calculus II	4
MATH 227	Introduction to Linear Algebra	3
CIS 150	Computer Science I	4
CIS 200	Computer Science II	4
CIS 275	Discrete Structures I	4
CIS 306	Discrete Structures II	4
IMSE 317	Eng Probability and Statistics	3
Select one laboratory science sequence from the following:		8
BIOL 130 & BIOL 320	Intro Org and Environ Biology and Field Biology	
CHEM 134 & CHEM 136	General Chemistry IA and General Chemistry IIA	
GEOL 118 & GEOL 218	Physical Geology and Historical Geology	
PHYS 125 & 125L & PHYS 126 & PHYS 126L	Introductory Physics I and Introductory Physics I Lab/Dis and Introductory Physics II and Intro Physics II Lab/Dis	
PHYS 150 & 150L & PHYS 151 & PHYS 151L	General Physics I and General Physics I Lab/Dis and General Physics II and General Physics II Lab/Dis	
Additional 4 credit science. Course must be from a different subject than the laboratory science sequence.		
ASTR 130 & ASTR 131	Introduction to Astronomy and Introductory Astronomy Lab	
BIOL 130	Intro Org and Environ Biology	
BIOL 320	Field Biology	
CHEM 134	General Chemistry IA	
CHEM 136	General Chemistry IIA	
CHEM 225	Organic Chemistry I	
CHEM 226	Organic Chemistry II	
CHEM 227	Organic Chemistry Laboratory	
GEOL 118	Physical Geology	
GEOL 218	Historical Geology	
PHYS 125 & 125L	Introductory Physics I and Introductory Physics I Lab/Dis	
PHYS 126 & 126L	Introductory Physics II and Intro Physics II Lab/Dis	
PHYS 150 & 150L	General Physics I and General Physics I Lab/Dis	
PHYS 151 & 151L	General Physics II and General Physics II Lab/Dis	
Software Engineering Major Requirements		
CIS 285	Software Engineering Tools	3
CIS 310	Computer Org and Assembly Lang	4
CIS 3501	Data Struc & Alg Anlys for SE	4
CIS 375	Software Engineering I	4
CIS 376	Software Engineering II	4
CIS 427	Comp Networks and Dis Process	4
CIS 450	Operating Systems	4
CIS 476	Soft Arch & Design Patterns	3
CIS 4961	Design Seminar for SE I	2
CIS 4962	Design Seminar for SE II	2
OB 354	Behavior in Organizations	3
Application Sequence [1]		
Choose from one of the following:		7-9
Information Systems Sequence		
CIS 425	Information Systems	4
CIS 447	Intro Computr & Ntwrk Security	3
Computer Game Design Sequence		
CIS 297	Intro to C Sharp [2]	3
CIS 487	Computer Game Design & Implem	3
CIS 488	Computer Game Design II	3
Web Engineering Sequence		
CIS 421	Database Mgmt Systems	4
Take one of the following two courses:		3
CIS 435	Web Technology	
CIS 436	Mobile App Des & Impl	
Artificial Intelligence Sequence		
CIS 411	Introduction to Natural Language Processing	3
CIS 479	Intro to Artificial Intel	3
CIS 481	Computational Learning	3
Technical Electives [1]		
Select 5-7 additional credits from the following. Only one course from CIS 296, CIS 297 or CIS 298 may be used towards the 120 credits of the degree:		5-7
CIS 296	Java Programming	
CIS 297	Intro to C Sharp	
CIS 298	Intro to Python	
CIS 316	Prac. Comp. Sec.	
CIS/IMSE 381	Industrial Robots	
CIS 387	Introduction to Digital Forensics	
CIS 400	Programming Languages	
CIS 405	Algorithm Analysis & Design	

CIS 411	Introduction to Natural Language Processing
CIS 412	Introduction to Quantum Computing
CIS 421	Database Mgmt Systems [4]
or CIS 422	Massive Data Management
CIS 425	Information Systems
CIS 435	Web Technology
CIS 436	Mobile App Des & Impl
CIS 437	Advanced Networking
CIS 439	Text Mining and Information Retrieval
CIS 446	Wireless & Mobi Comp Security
CIS 447	Intro Computr & Ntwrk Security
CIS 449	Intro to Software Security
CIS 451	Computer Graphics and Visual Computing
CIS 452	Information Visualization with Parallel Computing
CIS 467	Network and Mobile Forensics
CIS 474	Compiler Design
CIS 479	Intro to Artificial Intel
CIS 481	Computational Learning
CIS 482	Trustworthy Artificial Intelligence
CIS 483	Deep Learning
CIS 487	Computer Game Design & Implem
CIS 488	Computer Game Design II
CIS 489	Edge Computing
CIS 4851	Data Security and Privacy
ECE 372	Intro to Microprocessors
ECE 473	Embedded System Design
ENGR 360	Design Thinking : Process, Method & Practice
or ENGR 400	Appl Business Tech for Engr
or ENT 400	Entrepreneurial Thinking&Behav
ENGR 399	Experiential Honors Prof. Prac
ENGR 492	Exper Honors Directed Research
ENGR 493	Exper Hnrs Dir Dsgn
General Electives	
Any 100 to 400 level course, as needed, to get a minimum of 120 credits for graduation. [3]	

1 The Application Area and Technical Electives must total 14 hrs. Any courses taken in the Application Area cannot also be used for Technical Electives credit.

2 CIS 296 or CIS 298 cannot count as Technical Electives since CIS 297 is required of the Game Design Sequence

3 Any for-credit courses; that is, courses not on the No Credit list, which is found at the end of the CECS Student Handbook.

4 Only one course from CIS 421 or CIS 422 may be used towards the 120 credits of the degree.

Learning Goals

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- An ability function on multidisciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- A recognition of the need for, and an ability to engage in, life-long learning.
- A knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- An ability to program.
- An ability to manage a project.