COMPUTER SCIENCE, BS

Computer science is the study and design of computer systems, networks, software, and computing techniques. But more importantly, it is a dynamic field with a growing impact on the world today. According to the U.S. Bureau of Labor Statistics, employment in computer and information technology occupations is projected to grow 13 percent from 2020 to 2030, faster than average for all occupations.

Sample Courses

- Artificial Intelligence
- Programming Language Design and Implementation
- Software Engineering
- Computer Networking
- Algorithm Design

Research

Work with faculty (http://uwm.edu/engineering/classification/faculty/computer-science/)engaged in leading-edge research in areas such as:

- Object-oriented programming
- Cryptography
- Computational robotics
- Intelligent dialog systems
- Artificial intelligence
- Extensible languages

Career Paths

Computer Science opens up a multitude of career options with great income potential within both the public and private sectors.

- Software Engineer
- Systems Integration Consultant
- Information Technology Manager
- Game Developer
- Application Developer/Programmer
- Data Analyst

Accreditation

The Computer Science program is accredited by the Computing Accreditation Commission of ABET (https://www.abet.org/).

New Freshmen

Admission to the College of Engineering and Applied Science is based on an overall assessment of both academic and non-academic qualifications. The primary review factors for admission are the strength and quality of the high school curriculum, high school class percentile, grade point average, and the result of the ACT or SAT. Well-prepared freshman applicants will have four years of mathematics (including one-and-a-half years of algebra, one year of geometry, and one-half year of trigonometry) and four years of natural science (including biology, chemistry, and physics). The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity.

Transfer Students

Transfer student admission is based on an overall assessment of both academic and non-academic qualifications. For transfer applicants, the primary factors considered for admission are the grade point average on transferable courses and the level of curriculum completion. The College also will consider non-academic qualifications such as leadership skills, diversity in personal background, work experience, motivation, and maturity.

Applicants who do not meet the requirements for admission to the College of Engineering & Applied Science will automatically be considered for admission to the Pre-Engineering program in the UWM College of General Studies.

The Pre-Engineering program is an Associate degree level program offered jointly by the College of General Studies and the College of Engineering & Applied Science. The curriculum is designed to prepare students for the engineering program with emphasis on mathematics.

Questions on admission to CEAS or choosing a major should be directed to the Office of Student Services, (414) 229-4667.

Laptop Requirement

A laptop is required hardware for Computer Science and Computer Engineering students beginning in the sophomore year, and for all graduate students. The specific requirements can be found here (https://uwm.edu/engineering/laptop-requirement-cs-and-ce/).

Computer Science Curriculum

The minimum number of credits required to complete the Bachelor of Science in Computer Science with a major in Computer Science is 120.

Code	Title	Credits
Major Requirements		
COMPSCI 150	Survey of Computer Science	3
COMPSCI 250	Introductory Computer Programming	4
COMPSCI 251	Intermediate Computer Programming	4
COMPSCI 317	Discrete Information Structures	4
COMPSCI 337	System Programming	3
COMPSCI 351	Data Structures and Algorithms	4
COMPSCI 361	Introduction to Software Engineering	3
COMPSCI 395	Social, Professional, and Ethical Issues	3
COMPSCI 431	Programming Languages Concepts	3
COMPSCI 458	Computer Architecture	3
COMPSCI 535	Algorithm Design and Analysis	3
COMPSCI 537	Introduction to Operating Systems	3
COMPSCI 594	Capstone Project Preparation	1
COMPSCI 595	Capstone Project	3
EAS 200	Professional Seminar	1
Mathematics Requirement		**4**
Select one of the following:		
MATH 211	Survey in Calculus and Analytic Geometry I	
MATH 213	Calculus with Life Sciences Applications	
MATH 221	Honors Calculus I	
MATH 231	Calculus and Analytic Geometry I	

Natural Science Requirement - Complete 6 credits including 1 laboratory credit from approved list.		**6**
Technical Electives - Complete 9 credits from approved list.		**9**
Applied Mathematics Electives - Complete 9 credits from approved list.		**9**
Free Electives		**32**
GER Distribution Requirement		
Arts		3
Humanities		3
Social Science		6
ENGLISH 310	Writing, Speaking, and Technoscience in the 21st Century	3
Cultural Diversity - Arts, Humanities, or Social Science course must also satisfy UWM Cultural Diversity Requirement		
Students must also satisfy Oral and Written Communication (OWA) Part A [1]		0-6
Students must also Satisfy the UWM Foreign Language requirements (0-8) [1]		0-8
Total Credits		**120**

Approved Natural Science Courses

Code	Title	Credits
Select 6 credits from the following including at least 1 laboratory credit:		
Natural Science courses with laboratory (NS+)		
ASTRON 104	Astronomy Laboratory	
BIO SCI 150	Foundations of Biological Sciences I	
BIO SCI 152	Foundations of Biological Sciences II	
BIO SCI 201	Human Structure and Function	
BIO SCI 203	Anatomy and Physiology II	
CHEM 102	General Chemistry	
CHEM 104	General Chemistry and Qualitative Analysis	
CHEM 105	General Chemistry for Engineering	
GEO SCI 100	Introduction to the Earth	
GEO SCI 102	Evolution of the Earth	
GEO SCI 120	Geology of the Planets	
GEO SCI 151	Ocean Sciences Laboratory	
GEOG 120	Our Physical Environment	
PHYSICS 121	General Physics Laboratory I (Non-Calculus Treatment)	
PHYSICS 123	General Physics Laboratory II (Non-Calculus Treatment)	
PHYSICS 214	Lab Physics I (Calculus Treatment)	
PHYSICS 215	Lab Physics II (Calculus Treatment)	
PHYSICS 219	Physics I: Calculus-Based, Studio Format	
PHYSICS 220	Physics II: Calculus-Based, Studio Format	
Natural Science courses without laboratory (NS)		
ASTRON 103	Survey of Astronomy	
ATM SCI 194	First-Year Seminar:	
ATM SCI 297	Study Abroad:	
ATM SCI 381	Honors Seminar:	
ATM SCI 497	Study Abroad:	
BIO SCI 194	First-Year Seminar:	
BIO SCI 206	Biology of Women	
BIO SCI 380	Honors Seminar:	
CES 210	Introduction to Conservation and Environmental Science	
CHEM 100	Chemical Science	
GEOG 125	Introduction to Environmental Geography	
GEO SCI 150	Introduction to Ocean Sciences	
GEO SCI 194	First-Year Seminar:	
GEO SCI 381	Honors Seminar:	
PHYSICS 120	General Physics I (Non-Calculus Treatment)	
PHYSICS 122	General Physics II (Non-Calculus Treatment)	
PHYSICS 209	Physics I (Calculus Treatment)	
PHYSICS 210	Physics II (Calculus Treatment)	

Technical Electives

Code	Title	Credits
Select 9 credits from the following list. All non-required CompSci courses numbered 400-699 are Technical Electives.		
COMPSCI 315	Introduction to Computer Organization and Assembly Language Programming	
COMPSCI 417	Introduction to the Theory of Computation	
COMPSCI 422	Introduction to Artificial Intelligence	
COMPSCI 423	Introduction to Natural Language Processing	
COMPSCI 425	Introduction to Data Mining	
COMPSCI 443	Intelligent User Interfaces and Usability Assessment	
COMPSCI 444	Introduction to Text Retrieval and Its Applications in Biomedicine	
COMPSCI 459	Fundamentals of Computer Graphics	
COMPSCI 469	Introduction to Computer Security	
COMPSCI 481	Server-side Internet Programming	
COMPSCI 482	Rich Internet Applications	
COMPSCI 511	Symbolic Logic	
COMPSCI 520	Computer Networks	
COMPSCI 530	Computer Networks Laboratory	
COMPSCI 536	Software Engineering	
COMPSCI 552	Advanced Object-Oriented Programming	
COMPSCI 557	Introduction to Database Systems	
COMPSCI 581	Web Languages and Standards	
COMPSCI 599	Senior Thesis	
COMPSCI 654	Introduction to Compilers	
COMPSCI 655	Compiler Implementation Laboratory	
COMPSCI 657	Topics in Computer Science:	
COMPSCI 658	Topics in Applied Computing:	
COMPSCI 699	Independent Study	
ELECENG 301	Electrical Circuits and Electronics I	

ELECENG 305	Electrical Circuits II
ELECENG 310	Signals and Systems
ELECENG 330	Electrical Circuits and Electronics II
ELECENG 340	Embedded Systems I: C and C++ Programming for Embedded Applications
ELECENG 354	Digital Logic
ELECENG 440	Embedded Systems II: Advanced Embedded Systems
ELECENG 367	Introduction to Microprocessors
ELECENG 451	Introduction to VLSI Design
ELECENG 457	Digital Logic Laboratory

Applied Mathematics Electives

Code	Title	Credits
Select 9 credits from the following:		
IND ENG 367	Engineering Statistics [2]	
MATH 205	Introductory Finite Mathematics	
MATH 212	Survey in Calculus and Analytic Geometry II	
MATH 222	Honors Calculus II	
MATH 232	Calculus and Analytic Geometry II	
MATH 233	Calculus and Analytic Geometry III	
MATH 234	Linear Algebra and Differential Equations [3,4]	
ELECENG 234	Analytical Methods in Engineering [3,4]	
MATH 240	Matrices and Applications [3]	
MATH 320	Introduction to Differential Equations [4]	
MATH 305	Introduction to Mathematical and Computational Modeling	
MATH 313	Linear Programming and Optimization	
MATH 315	Mathematical Programming and Optimization	
MATH 341	Seminar: Introduction to the Language and Practice of Mathematics	
MATH 405	Mathematical Models and Applications	
MATH 431	Modern Algebra with Applications	
MATH 451	Axiomatic Geometry	
MTHSTAT 215	Elementary Statistical Analysis [2]	
MTHSTAT 361	Introduction to Mathematical Statistics I	
MTHSTAT 563	Regression Analysis	

[1] See General Education Requirements (https://catalog.uwm.edu/policies/undergraduate-policies/#bachelorsdegreegeneraleducation) for details.

[2] A student cannot use more than one of IND ENG 367 and MTHSTAT 215.

[3] Must include exactly one of MATH 240, MATH 234, ELECENG 234.

[4] May include only one of MATH 320, MATH 234, ELECENG 234.

Computer Science Program Objectives and Outcomes

Program Educational Objectives

The Computer Science program educational objectives prepare students to:

Objective 1: Alumni of the program will have successful careers built on their understanding of formal and applied methods for solving problems using computer theory, hardware, and software.

Objective 2: In their professional lives, alumni of the program will demonstrate problem-solving and design skills including the ability to formulate problems and their solutions, think creatively, communicate effectively, and work collaboratively.

Objective 3: Alumni of the program will exercise professional responsibility and be able to adapt to an ever-changing professional environment.

Student Outcomes

The BSE program in Computer Science will prepare students to attain:

- an ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- an ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- an ability to communicate effectively in a variety of professional contexts.
- an ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- an ability to function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- an ability to apply computer science theory and software development fundamentals to produce computing-based solutions.

Minimum Requirements

Students must maintain an average GPA of at least 2.00 on all work attempted at the University and in all courses offered by the College. Students majoring in biomedical engineering, computer engineering, computer science, industrial engineering, and materials engineering must maintain an average GPA of at least 2.00 in all 300-level and above courses in the student's major department. Students majoring in civil engineering, electrical engineering, and mechanical engineering must maintain an average GPA of at least 2.50 in all 300-level and above courses in the major department. Transferable courses will be included as appropriate. Advancement to major status is required for graduation.

In order to provide maximum flexibility while preserving the institutional identity of a UWM degree, the College requires residence:

1. during the last 30 credits, or
2. during 45 of the last 60 credits, or
3. during any 90 credits of a student's undergraduate career.

At least 15 credits of advanced work in the major must be completed in residence at UWM.

For the Engineering BS program only:

1. complete at least 30 credits at UWM; and
2. complete at least 15 credits in upper-division (numbered 300 or above) courses in the major at UWM.

A student who does not maintain continuous registration during the academic year and is re-admitted to the College must meet the program and graduation requirements in effect at the time of re-entry.

Degree and major requirements must be completed within 10 years of initial enrollment at UW-Milwaukee. Should students not complete the major within the 10-year time frame, the students will switch to the most current degree and major requirements. A new 10-year time frame would then begin.

Dual Majors

Students wishing to major in more than one field can do so in two ways:

1. Complete the requirements for more than one major before receiving a degree from the College. In this case, the degree will list both majors.
2. Be admitted to the College as a second degree candidate (after earning a bachelor's degree in any field), providing University and College entrance requirements are met. Such a student must meet all undergraduate degree requirements in the College and present a minimum of 30 credits beyond the previous bachelor's degree.

Concurrent Registration at Other Institutions

CEAS students wishing to establish concurrent enrollment at another institution must obtain prior permission from their academic advisor.

Student Academic Appeals

Students may appeal an academic action to the Office of Student Services. An appeal is a request for an exception to an established policy or rule. The content of each appeal is carefully reviewed in order to reach a decision. Appeals should be submitted in writing to the Office of Student Services. The appeals committee considers individual cases concerning the degree requirements and other academic rules and regulations established by the College of Engineering and Applied Science faculty.

The College of Engineering and Applied Science has established written procedures for undergraduate student academic grievances. Copies of the grievance procedure are available in the Office of Student Services. As a first step, students must discuss the grievance with the faculty member or administrator as soon as possible to attempt to resolve the issue, but not later than 30 days after the action that prompted the grievance/appeal.

Computer Science and Engineering Programs

Detailed descriptions of the CEAS undergraduate programs are provided in this catalog. All courses are not offered every semester. A few technical elective courses may be offered only once every three to four semesters. In addition, since computer science and engineering curricula are continually evolving to keep current, students are encouraged to consult with their advisors to plan each semester's list of classes. Part-time students should always maintain a plan that looks ahead two to three semesters to avoid scheduling difficulties.

The curricula outlined in the pages are applicable to new students entering CEAS in fall 2016 or later. Students who enrolled in computer science or engineering programs prior to that date should consult with the appropriate previous editions of this catalog for information about their program requirements. As a general rule, when program changes occur, continuing students have the choice of continuing in their existing program or following the new requirements. Occasionally, a program change will be required of all students regardless of their date of matriculation, so long as it does not increase the total credits needed for graduation.

These program descriptions represent the minimum requirements for graduation from UWM in computer science or engineering. In all cases, it is important that students consult with their advisor before making course selections to avoid errors in programming.

Academic Advising

The Office of Student Services in the College of Engineering and Applied Science, located in Room E386 of the Engineering and Mathematical Sciences Building, offers undergraduate students academic advising from professional advisors who are familiar with the curriculum, College requirements, and the special needs of engineering and computer science students. These advisors provide services such as freshman orientation, course selection, program planning, and credit transfer evaluation. Students are assigned to a permanent professional advisor as soon as they are accepted into the College, and are urged to confer with their advisor at least once each semester. Students also are assigned to a faculty advisor who provides technical expertise specific to the student's area of study.

We understand that it can be a delicate balance managing school, work, family, and active social lives. The College of Engineering and Applied Science advisors are here to help you achieve that balance.

You will be assigned a professional academic advisor upon being admitted to the College of Engineering & Applied Science. Your advisor will work with you throughout your undergraduate experience, providing guidance on:

- course registration,
- graduation planning,
- career preparation,
- and serving as a liaison to the many other resources available on our campus.

Advisors are also a great source of information on student organizations, tutoring and scholarship opportunities.

In addition to professional academic advisors, you will also have access to faculty advisors. These advisors can provide insights into the technical aspects of the engineering and computer science curricula while mentoring you as you define your professional goals.

Joint Programs with Other Campuses
Pre-engineering

Qualified students may enroll in coordinated pre-engineering programs at UW-Green Bay, UW-Parkside, and UW-Waukesha for two years of pre-engineering coursework. These coordinated programs ensure equivalent

coursework, appropriate advising, and early access to the Cooperative Education Program at UWM.

Dual Degree Programs

Qualified students may enroll in coordinated dual degree programs at Alverno College, Carroll University, UW-Eau Claire, UW-Green Bay, UW-La Crosse, UW-Oshkosh, UW-Stevens Point, UW-Whitewater and Wisconsin Lutheran College. Students in these programs will earn a bachelor's degree at both universities in five years. Students transfer to UWM after three years at the partner university. For more information, contact the Office of Student Services at (414) 229-4667.

Joint Programs with Wisconsin Technical Colleges

Gateway Technical College

An agreement with GTC allows those students having associate degrees in the Electrical Engineering - Technology the opportunity to be given credit for courses required in the UWM bachelor of science in engineering program. For more information, contact the Office of Student Services at (414) 229-4667.

Milwaukee Area Technical College

An agreement with MATC allows joint admission and enrollment at MATC and CEAS. Qualified students may take English, mathematics, chemistry, and general education courses at MATC. The program ensures equivalent coursework and appropriate advising. Students complete a bachelor of science degree in engineering or computer science at UWM.

Waukesha County Technical College

An agreement with WCTC allows those students having associate degrees in the Industrial Occupations Division at WCTC the opportunity to be given credit for courses required in the UWM bachelor of science in engineering or bachelor of science in computer science program. For more information, contact the Office of Student Services at (414) 229-4667.

Honors in the Major

Students in Computer Science who meet all of the following criteria can be awarded honors in the major upon graduation:

1. A 3.000 cumulative GPA in all UWM graded credits;
2. A 3.500 GPA over all upper-division (300 level and higher) Computer Science courses; and
3. At least one of the following:
   a. Successful completion of 3 credits of research experience via senior thesis (COMPSCI 599) and/or an approved independent study (COMPSCI 699).
   b. Participation in the Accelerated MS program with successful completion of 6 credits in approved courses for the Master of Science in Computer Science program.
   c. Successful completion of 4 credit team-based, faculty supervised, research experience via a capstone via (COMPSCI 594) and (COMPSCI 595), subject to approval by supervising faculty.

Students who believe they may qualify for honors in Computer Science should apply to the College of Engineering & Applied Science during their last semester of study.

College of Engineering and Applied Science Dean's Honor List

GPA of 3.500 or above, earned on a full-time student's GPA on 12 or more graded credits in a given semester.

Honors College Degree and Honors College Degree with Distinction

Granted to graduating seniors who complete Honors College requirements, as listed in the Honors College (https://catalog.uwm.edu/honors-college/) section of this site.

Commencement Honors

Students with a cumulative GPA of 3.500 or above, based on a minimum of 40 graded UWM credits earned prior to the final semester, will receive all-university commencement honors and be awarded the traditional gold cord at the December or May Honors Convocation. Please note that for honors calculation, the GPA is **not** rounded and is truncated at the third decimal (e.g., 3.499).

Final Honors

Earned on a minimum of 60 graded UWM credits: Cum Laude - 3.500 or above; Magna Cum Laude - 3.650 or above; Summa Cum Laude - 3.800 or above.