

SOFTWARE ENGINEERING, B.S.

Begin Campus: Any Penn State Campus

End Campus: Erie, World Campus

Program Description

This major provides students with a strong foundation in software engineering through combination of classroom study, software development experience, and design projects. Design, analysis, verification, and maintenance of software systems are stressed. Built upon a core of science and mathematics courses, this major has the objective of educating graduates to be problem solvers. Students acquire the ability to work as members of a team toward successful attainment of a common goal, preparing them for work in industry or further study in graduate school. In addition, written and oral communication skills are developed from an early stage, culminating in a senior design project that stresses communication as well as engineering content.

In addition to completing a broad-based science core in mathematics, chemistry, and physics, students pursue their interest in software engineering by studying principles in computer programming, object-oriented design, software design, software verification, information systems, operating systems, and data communications. The program has a capstone software design project that requires students to work together on teams to design, plan, manage, and implement a software design project.

What is Software Engineering?

Software engineering applies scientific and technological knowledge to the design, implementation, verification, and documentation of software. The study of software engineering teaches you the newest approaches to create, maintain, and improve software systems in economical, reusable, and extendable ways. Software engineers are creative problem solvers who put the functionality (and fun!) into our technology. Without software engineers there would be no Internet, no social networking, no apps, no streaming, no virtual or augmented reality, and no interactive entertainment.

You Might Like This Program If...

- You are patient in the face of a challenge.
- You are a creative thinker.
- You are interested in coding and programming, and also in mathematics, chemistry, and physics.
- You enjoy working on team-based projects.

Entrance To Major

In addition to the Carnegie unit and minimum GPA requirements described by University policies, all students applying for entrance to any of the engineering majors at The Behrend College must have at least a 2.0 cumulative GPA by the end of the semester prior to applying for entrance to the major and have completed, with a minimum grade of C: CHEM 110, MATH 140, MATH 141, and PHYS 211. These courses must be completed by the end of the semester during which the admission to major process is carried out.

Degree Requirements

For the Bachelor of Science degree in Software Engineering, a minimum of 126 credits is required:

Requirement	Credits
General Education	45
Electives	0-1
Requirements for the Major	101-102

21 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GWS courses; 3 credits of GS courses.

Per Senate Policy 83.80.5, the college dean or campus chancellor and program faculty may require up to 24 credits of coursework in the major to be taken at the location or in the college or program where the degree is earned.

Requirements for the Major

A student enrolled in this major must earn a grade of C or better in each 300- and 400-level course in the major.

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44>).

Code	Title	Credits
Prescribed Courses		
CHEM 111	Experimental Chemistry I	1
CMPEN 275	Digital Design Laboratory	1
CMPSC 121	Introduction to Programming Techniques	3
MATH 220	Matrices	2
MATH 250	Ordinary Differential Equations	3
PHYS 212	General Physics: Electricity and Magnetism	4
<i>Prescribed Courses: Require a grade of C or better</i>		
CHEM 110	Chemical Principles I	3
CMPEN 271	Introduction to Digital Systems	3
CMPEN 351	Microprocessors	3
CMPEN 441	Operating Systems	3
CMPEN 461	Communication Networks	3
CMPSC 122	Intermediate Programming	3
CMPSC 360	Discrete Mathematics for Computer Science	3
CMPSC 431W	Database Management Systems	3
CMPSC 461	Programming Language Concepts	3
CMPSC 465	Data Structures and Algorithms	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
MGMT 301	Basic Management Concepts	3
PHYS 211	General Physics: Mechanics	4
STAT 318	Elementary Probability	3
SWENG 311	Object-Oriented Software Design and Construction	3
SWENG 411	Software Engineering	3
SWENG 421	Software Architecture	3

SWENG 431	Software Verification, Validation, and Testing	3
SWENG 452W	Embedded Real Time Systems	3
SWENG 480	Software Engineering Design	3
SWENG 481	Software Engineering Project	3

Additional Courses

ECON 102	Introductory Microeconomic Analysis and Policy	3
or ECON 104	Introductory Macroeconomic Analysis and Policy	
EE 210	Circuits and Devices	3-4
or EE 211	Electrical Circuits and Power Distribution	

Supporting Courses and Related Areas

Select 9 credits of technical elective courses from school-approved list	9
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General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (<https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/>) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

University Degree Requirements**First Year Engagement**

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

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World Campus

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Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2022-23 academic year. To access previous years' suggested academic plans, please visit the archive (<https://bulletins.psu.edu/undergraduate/archive/>) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contains suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

Software Engineering, B.S. at Erie Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits
CHEM 110 ^{##†}	3 CMPSC 122 [*]	3
CHEM 111 [†]	1 ECON 102 or 104 [†]	3
CMPSC 121 [†]	3 MATH 141 ^{†##}	4
ENGL 15 or 30H ^{††}	3 MATH 220 [†]	2
MATH 140 ^{†##}	4 PHYS 211 ^{##†}	4
PSU 7	1	
	15	16

Second Year

Fall	Credits Spring	Credits
CAS 100 ^{††}	3 CMPEN 271 [*]	3
MATH 250	3 CMPEN 275	1
PHYS 212 [†]	4 CMPSC 360 or SWENG 311 [*] 2	3
SWENG 311 or CMPSC 360 ^{*2}	3 EE 210 or 211	3-4
General Education Course (GA/GH/GS)	3 ENGL 202C ^{††}	3
	STAT 318 [*]	3
	16	16-17

Third Year

Fall	Credits Spring	Credits
CMPEN 351 [*]	3 CMPSC 431W ^{*1}	3
CMPEN 441 [*]	3 SWENG 421 [*]	3
CMPSC 465 [*]	3 SWENG 431 [*]	3
SWENG 411 [*]	3 SWENG 452W ^{*1}	3
Technical Elective (300, 400-level) [*]	3 General Education Course	3

General Education Courses (GHW)	1.5	
	16.5	15
Fourth Year		
Fall	Credits Spring	Credits
CMPEN 461 [*]	3 MGMT 301 [*]	3
CMPSC 461 [*]	3 SWENG 481 [*]	3
SWENG 480 [*]	3 Technical Elective (300, 400-level) [*]	3
Technical Elective (300, 400-level) [*]	3 General Education Course (GA/GH/GS)	3
General Education Course (GA/GH/GS)	3 General Education Course (GA/GH/GS)	3
General Education Course (GHW)	1.5	
	16.5	15

Total Credits 126-127

- * Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † Course satisfies General Education and degree requirement

¹ Course will satisfy Writing Across the Curriculum requirement.

² CMPEN 271, CMPEN 275, and CMPSC 360 must be completed prior to the third-year to ensure that fall semester third-year prerequisites are met.

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

Program Notes:

- Only students who have gone through the entrance to major (ETM) process and have been accepted into this major may register for third- and fourth-year courses.

School-Approved Electives for Software Engineering:

- Technical electives allow students to choose areas of interest to explore. Technical electives come in two flavors, primary and secondary. Primary technical electives are those courses offered to CSSE majors which are not required for the Software Engineering major. Secondary technical electives are offered outside your home

department and give you broader latitude. Students must complete at least two primary technical electives, and, at most, one secondary technical elective.

• **Primary Technical Electives:**

- Any 300 or 400-level EE course
- Any 300 or 400-level CMPEN course not already required for the major
- Any 300 or 400-level CMPSC (except for CMPSC 474 and CMPSC 335) course not already required for the major
- Any 300 or 400-level SWENG course not already required for the major
- GAME 450 – Advanced GAME Programming
- GAME 480 – GAME Development Project

• **Secondary Technical Electives:**

- SWENG 395 – Internship (Fall/Spring)
- SWENG 495 – Internship (Fall/Spring)
- MIS 430 – Systems Analysis (Fall/Spring)
- MIS 435 – Systems Design and Implementation (Fall/Spring)
- MIS 445 – Management Report Systems (Fall)
- MIS 470 – Advanced Applications Development (Spring)
- MGMT 409 – Project Management for Engineers (Fall/Spring)
- PSYCH 444 – Engineering Psychology (Fall)
- ECON 481 – Business Forecasting Techniques (Fall)
- ECON 485 – Econometric Techniques (Fall)
- MATH 455 – Introduction to Numerical Analysis I (Fall)
- MATH 456 – Introduction to Numerical Analysis II (Spring – Even Years)
- ENTR 430 – Entrepreneurship & New Product Development (Fall)

Software Engineering, B.S. at World Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits
CHEM 110 ^{*#†}	3 CMPSC 122 [*]	3
CHEM 111 [†]	1 ECON 102 or 104 [†]	3
CMPSC 121 [†]	3 MATH 141 ^{*†##}	4
ENGL 15 or 30H ^{††}	3 MATH 220 [†]	2
MATH 140 ^{*†##}	4 PHYS 211 ^{*#†}	4
PSU 7	1	
	15	16

Second Year

Fall	Credits Spring	Credits
CAS 100 ^{††}	3 CMPEN 271 [*]	3
MATH 250	3 CMPEN 275	1
PHYS 212 [†]	4 CMPSC 360 or SWENG 311 [*]	3
SWENG 311 or CMPSC 360 ^{*2}	3 EE 210 or 211	3-4
General Education Course (GA/GH/GS)	3 ENGL 202C ^{*††}	3
	STAT 318 [*]	3
	16	16-17

Third Year

Fall	Credits Spring	Credits
CMPEN 351 [*]	3 CMPSC 431W ^{*1}	3
CMPEN 441 [*]	3 SWENG 421 [*]	3
CMPSC 465 [*]	3 SWENG 431 [*]	3
SWENG 411 [*]	3 SWENG 452W ^{*1}	3
Technical Elective (300, 400-level) [*]	3 General Education Course (GA/GH/GS)	3
General Education Courses (GHW)	1.5	
	16.5	15

Fourth Year

Fall	Credits Spring	Credits
CMPEN 461 [*]	3 MGMT 301 [*]	3
CMPSC 461 [*]	3 SWENG 481 [*]	3
SWENG 480 [*]	3 Technical Elective (300, 400-level) [*]	3
Technical Elective (300, 400-level) [*]	3 General Education Course (GA/GH/GS)	3
General Education Course (GA/GH/GS)	3 General Education Course (GA/GH/GS)	3
General Education Course (GHW)	1.5	
	16.5	15

Total Credits 126-127

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

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GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

Program Notes:

- Only students who have gone through the entrance to major (ETM) process and have been accepted into this major may register for junior and senior-level courses.

School-Approved Electives for Software Engineering:

Students should contact their academic adviser or World Campus Academic Advising for list of electives.

Career Paths

Software engineering is a relatively young discipline but has great buzz—the field consistently tops Best Jobs lists because it offers great pay, broad and growing demand, and opportunities for advancement. Penn State Behrend has a comprehensive support system to help you identify and achieve your goals for college and beyond. Meet with your academic adviser often and take advantage of the services offered by the Academic and Career Planning Center beginning in your first semester.

Careers

Students who major in software engineering work as developers, programmers, product managers, quality assurance engineers, network architects, support specialists, database administrators, and information security analysts. Software engineering skills are highly transferable and prepare you for careers in applications development, systems development, web development, and embedded systems development. Recent employers of Penn State Behrend's B.S. in Software Engineering graduates include Apple, Google, IBM, Intel, Lockheed Martin, Microsoft, Northrop Grumman, and Progressive Insurance.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE SOFTWARE ENGINEERING PROGRAM (<http://behrend.psu.edu/school-of-engineering/academic-programs/software-engineering/>)

Opportunities for Graduate Studies

Graduate study allows you to delve deeper into the subdisciplines of software engineering that interest you most. Examples of master's-level study include data science, network security, artificial intelligence, systems architecture, applications engineering, requirements engineering, project management, assessment and appraisal, or technical and managerial leadership.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (<http://behrend.psu.edu/school-of-engineering/academic-programs/software-engineering/>)

Professional Resources

- ABET (<http://www.abet.org/>)
- IEEE (<https://www.computer.org/>)
- Association for Computing Machinery (<https://www.acm.org/>)
- Society of Women Engineers (<http://societyofwomenengineers.swe.org/>)
- National Society of Black Engineers (<http://www.nsbe.org/home.aspx>)

Accreditation

The B.S. in Software Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (<http://www.abet.org>).

ABET is a nonprofit, non-governmental accrediting agency for programs in applied and natural science, computing, engineering and engineering technology and recognized as an accreditor by the Council for Higher Education Accreditation. ABET accreditation is voluntary and provides assurance that a college or university program meets the quality standards of the profession for which that program prepares graduates. The School of Engineering at Penn State Behrend consistently places in the Top 50 in U.S. News & World Report's rankings of the nation's undergraduate engineering programs.

MORE INFORMATION ABOUT ABET ACCREDITATION (<http://www.abet.org/>)

Professional Licensure/Certification

Many U.S. states and territories require professional licensure/certification to be employed. If you plan to pursue employment in a licensed profession after completing this program, please visit the Professional Licensure/Certification Disclosures by State (<https://psu.edu/state-licensure-disclosures/>) interactive map.

Contact

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