Software Engineering

Undergraduate Study

For the undergraduate curriculum in Software Engineering (http://www.se.iastate.edu) leading to the degree Bachelor of Science. This curriculum is accredited under the General Criteria and Software Engineering Program Criteria by the Engineering Accreditation Commission of ABET, http://www.abet.org.

This curriculum is jointly administered by the Department of Computer Science and the Department of Electrical and Computer Engineering at Iowa State University. The Software Engineering program provides undergraduate students with the opportunity to learn software engineering fundamentals, to study applications of state-of-the art software technologies and to prepare for the practice of software engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The software engineering curriculum offers emphasis areas in software engineering principles, process and practice. Students may also take elective courses in computer engineering and computer science.

Program Educational Objectives

Within five years of graduation, the graduates should:

1. attain a productive career in Software Engineering or related fields;
2. attain leadership roles and become effective collaborators to advance professional and organizational goals;
3. engage in continuous learning and professional development.

We expect that these objectives will be manifested in our graduates through the following five key attributes: (a) peer-recognized expertise, (b) engagement in professional practice, (c) sustained learning, (d) leadership and (e) teamwork.

Demonstration of expertise involves applying state-of-the-art practices for solving problems in the design, development, validation, evolution and sustainment of (software) products. Demonstration of professional engagement involves contributing locally and globally to the use of ethical, competent, and creative practices in industry, academia or the public sector. Demonstration of sustained learning involves the ability to adapt to rapid technological, environmental, and organizational changes through self-study and group study and through opportunities of professional development or graduate study. Demonstration of leadership involves the ability to take initiative, and to facilitate the advancements of individuals and the community by influencing others and by having a widespread, positive impact on critical issues and projects. Finally, demonstration of teamwork involves the ability to work with collaborators who have varied expertise, and with diverse cultural and interdisciplinary backgrounds.

As a complement to the instructional activity, the Department of Computer Science and the Department of Electrical and Computer Engineering provide opportunities for each student to have experience with broadening activities. Students have the opportunity to gain practical industry experience in the cooperative education and internship program. Students have the opportunity to participate in advanced research activities. Through international exchange programs, students learn about engineering practices in other parts of the world.

Curriculum in Software Engineering

Administered by the Department of Electrical and Computer Engineering in the College of Engineering and the Department of Computer Science in the College of Liberal Arts and Sciences.

Leading to the degree bachelor of science.

Total credits required: 125 cr. See also Basic Program and Special Programs. Note: Pass/Not Pass credits cannot be used to meet graduation requirements.

International Perspectives: 3 cr.  
U.S. Diversity: 3 cr.

Communication Proficiency/Library requirement:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication (C or better in this course)</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition (C or better in this course)</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 309</td>
<td>Report and Proposal Writing (C or better in this course)</td>
</tr>
<tr>
<td>ENGL 314</td>
<td>Technical Communication (C or better in this course)</td>
</tr>
</tbody>
</table>

Total Credits 10

General Education Electives: 15 cr.  
Choose 1 course from the following: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 101</td>
<td>Principles of Microeconomics</td>
</tr>
<tr>
<td>ECON 102</td>
<td>Principles of Macroeconomics</td>
</tr>
<tr>
<td>I E 305</td>
<td>Engineering Economic Analysis</td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>6</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Additional Arts and Humanities or Social Sciences course</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits 15

Basic Program: 27 cr.

A minimum GPA of 2.00 is required for this set of courses, including any transfer courses. See Requirement for Entry into Professional Program in College of Engineering Overview section.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 167</td>
<td>General Chemistry for Engineering Students</td>
</tr>
<tr>
<td>or CHEM 177</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Orientation</td>
</tr>
<tr>
<td>or S E 101</td>
<td>Software Engineering Orientation</td>
</tr>
<tr>
<td>S E 185</td>
<td>Problem Solving in Software Engineering</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
</tr>
<tr>
<td>MATH 165</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH 166</td>
<td>Calculus II</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Classical Physics I</td>
</tr>
</tbody>
</table>

Total Credits 27

Math and Physical Science: 11 cr.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM S 227</td>
<td>Introduction to Object-oriented Programming</td>
</tr>
<tr>
<td>COM S 228</td>
<td>Introduction to Data Structures</td>
</tr>
<tr>
<td>MATH 267</td>
<td>Elementary Differential Equations and Laplace Transforms</td>
</tr>
</tbody>
</table>

Total Credits 11

Software Engineering Core: 34 cr.

A minimum GPA of 2.00 is required for this set of courses, including any transfer courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR E 281</td>
<td>Digital Logic</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td>3</td>
</tr>
<tr>
<td>COM S 327</td>
<td>Advanced Programming Techniques</td>
</tr>
<tr>
<td>CPR E 288</td>
<td>Embedded Systems I: Introduction</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td>3</td>
</tr>
<tr>
<td>COM S 321</td>
<td>Introduction to Computer Architecture and Machine-Level Programming</td>
</tr>
<tr>
<td>CPR E 381</td>
<td>Computer Organization and Assembly Level Programming</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td>3</td>
</tr>
<tr>
<td>COM S 352</td>
<td>Introduction to Operating Systems</td>
</tr>
<tr>
<td>CPR E 308</td>
<td>Operating Systems: Principles and Practice</td>
</tr>
<tr>
<td>Choose one of the following:</td>
<td>3</td>
</tr>
<tr>
<td>COM S 330</td>
<td>Discrete Computational Structures</td>
</tr>
<tr>
<td>CPR E 310</td>
<td>Theoretical Foundations of Computer Engineering</td>
</tr>
<tr>
<td>COM S 311</td>
<td>Design and Analysis of Algorithms</td>
</tr>
<tr>
<td>COM S 363</td>
<td>Introduction to Database Management Systems</td>
</tr>
<tr>
<td>COM S 309</td>
<td>Software Development Practices</td>
</tr>
<tr>
<td>S E 319</td>
<td>Software Construction and User Interfaces</td>
</tr>
<tr>
<td>S E 329</td>
<td>Software Project Management</td>
</tr>
</tbody>
</table>
S E 339. Software Architecture and Design 3
Note: CPR E 288, CPR E 381 and CPR E 308 are 4-credit courses. The core credit requirement (34 credits) is given in terms of 3-credit courses. If the 4-credit courses are taken instead, then the extra credits will be used as credits for Supplementary Electives.

Total Credits 34

Other Remaining Courses: 38 cr.
S E 491. Senior Design Project I and Professionalism 3
S E 492. Senior Design Project II 2
SP CM 212. Fundamentals of Public Speaking 3
One of the following STAT courses 3
STAT 330. Probability and Statistics for Computer Science
STAT 305. Engineering Statistics
One of the following ENGL courses (with a C or better in this course) 3
ENGL 309. Report and Proposal Writing
ENGL 314. Technical Communication
Math Elective: Choose one from the following list 3
MATH 207. Matrices and Linear Algebra
MATH 304. Combinatorics
MATH 314. Graph Theory
MATH 317. Theory of Linear Algebra
Software Engineering Elective 2 6
Technical Elective 2 3
Supplementary Elective 2 9
Open Elective 2 3
Total Credits 38

Seminar/Co-op/Internships
S E 166. Careers in Software Engineering R
S E 494. Software Engineering Portfolio Development R
Co-op or internship (S E 396, S E 397, S E 398) is optional

Transfer Credit Requirements
The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in software engineering. These 30 credits must include S E 492 Senior Design Project II and credits in the core professional curriculum and/or in technical electives. The software engineering degree program requires a grade of C or better for any transfer credit course that is applied to the degree program.

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S. Diversity and International Perspectives courses may not be taken Pass/Not Pass.
2. Choose from department approved lists. (https://www.se.iastate.edu/academics/resources/)
3. See Basic Program for Professional Engineering Curriculum for accepted substitutions for curriculum designated courses in the Basic Program.

See also: A 4-year plan of study grid showing course template by semester.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives (http://www.se.iastate.edu/academics/resources/#general).

Courses primarily for undergraduates:
Cr. R.
Introduction to the procedures, policies, and resources of Iowa State University and the department of Computer Science and Electrical and Computer Engineering. Information on engineering and computer-based professions.
S E 166. Careers in Software Engineering.
Cr. R.
Overview of the nature and scope of the software engineering profession. Relationship of coursework to careers. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

(3-1) Cr. 3. Prereq: Credit or enrollment in MATH 142.
Introduction to software engineering and computer programming. Systematic thinking process for problem solving in the context of software engineering. Group problem solving. Solving software engineering problems and presenting solutions through computer programs, written documents and oral presentations. Introduction to principles of programming, software design, and extensive practice in design, writing, running, debugging, and reasoning about programs.
S E 296. Cooperative Education.
Cr. R. F.S.SS. Prereq: Permission of department and Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.
S E 319. Software Construction and User Interfaces.
(Cross-listed with COM S). (3-0) Cr. 3. F. Prereq: COM S 228
S E 329. Software Project Management.
(Cross-listed with CPR E). (3-0) Cr. 3. Prereq: COM S 309
(Cross-listed with CPR E). (3-0) Cr. 3. Prereq: S E 319
S E 342. Principles of Programming Languages.
(Cross-listed with COM S). (3-1) Cr. 3. F.S. Prereq: Minimum of C- in COM S 228, COM S 330 or CPR E 310
Study of concepts in programming languages and major programming paradigms, especially functional programming. Special emphasis on design tradeoffs that enable students to make sound choices of programming languages for a given software development task. Programming projects.
(Cross-listed with CPR E). (3-2) Cr. 4. Prereq: CPR E 288
Contemporary programming techniques for event driven systems. Mobile platforms and operating systems. Location and motion sensors based user interfaces. Threading and scheduling. Resource management - measurement and control techniques - for memory and energy. Client-server application design. Distributed applications. Laboratory includes exercises based on a mobile platform.
S E 396. Summer Internship.
Cr. R. SS. Prereq: Permission of department and Career Services
Summer professional work period.
S E 397. Software Engineering Internship.
Cr. R. F.S. Prereq: Permission of department and Career Services
One semester maximum per academic year professional work period.
S E 398. Cooperative Education.
Cr. R. F.S.SS. Prereq: S E 298, permission of department and Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work.
S E 409. Software Requirements Engineering.  
(Cross-listed with COM S). (3-0) Cr. 3. F. Prereq: COM S 309  
The requirements engineering process including identification of stakeholders  
requirements elicitation techniques such as interviews and prototyping, analysis  
fundamentals, requirements specification, and validation. Use of Models: State- 
oriented, Function-oriented, and Object-oriented. Documentation for Software  
Requirements. Informal, semi-formal, and formal representations. Structural,  
informational, and behavioral requirements. Non-functional requirements. Use  
of requirements repositories to manage and track requirements through the life  
cycle. Case studies, software projects, written reports, and oral presentations will  
be required.

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. S. Prereq: COM S 330 or CPR E  
310; COM S 311, STAT 330  
A study of formal techniques for model-based specification and verification of  
software systems. Topics include logics, formalisms, graph theory, numerical  
computations, algorithms, and tools for automatic analysis of systems. Graduate 
credit requires in-depth study of concepts.

S E 416. Software Evolution and Maintenance.  
(Cross-listed with CPR E). (3-0) Cr. 3. Prereq: COM S 309  
Practical importance of software evolution and maintenance, systematic defect  
analysis and debugging techniques, tracing and understanding large software,  
impact analysis, program migration and transformation, refactoring, tools for  
software evolution and maintenance, experimental studies and quantitative  
measurements of software evolution. Written reports and oral presentation.

(Cross-listed with COM S). (3-0) Cr. 3. S. Prereq: COM S 309; COM S 330 or  
CPR E 310; ENGL 260, SP CM 212  
Comprehensive study of software testing, principles, methodologies, management  
strategies and techniques. Test models, test design techniques (black box and  
white box testing techniques), test adequacy criteria, integration, regression,  
system testing methods, and software testing tools.

S E 419. Software Tools for Large Scale Data Analysis.  
(Cross-listed with CPR E). (3-0) Cr. 3. Prereq: CPR E 308 or COM S 352, COM S  
309  
Software tools for managing and manipulating large volumes of data, external  
memory processing, large scale parallelism, and stream processing, data  
interchange formats. Weekly programming labs that involve the use of a parallel  
computing cluster.

S E 490. Independent Study.  
Cr. arr. Prereq: Senior classification in software engineering  
Investigation of an approved topic.

S E 491. Senior Design Project I and Professionalism.  
(2-3) Cr. 3. Prereq: S E 329, completion of 29 credits in the S E core professional  
program, ENGL 314  
Preparing for entry to the workplace. Selected professional topics. Use of  
technical writing skills in developing project plan and design report; project  
poster. First of two-semester team-oriented, project design and implementation  
experience.

S E 492. Senior Design Project II.  
(1-3) Cr. 2. Prereq: S E 491  
Second semester of a team design project experience. Emphasis on the  
successful implementation and demonstration of the design completed in S E 491  
and the evaluation of project results. Technical writing of final project report; oral  
presentation of project achievements.

S E 494. Software Engineering Portfolio Development.  
Cr. R. F.S. Prereq: Credit or enrollment in S E 491  
Portfolio assessment for Software Engineers. Guidelines and Advice to improve  
software engineering portfolios and to better use portfolios as a tool to enhance  
career opportunities.

S E 498. Cooperative Education.  
Cr. R. Repeatable. F.S.SS. Prereq: S E 398, permission of department and  
Career Services  
Third and subsequent professional work periods in the cooperative education  
program. Students must register for this course before commencing work.