

# COMPUTER ENGINEERING

## UNDERGRADUATE STUDENT HANDBOOK

### For Academic Year 2009-2010

Department of Electrical Engineering and  
Computer Science

L.C. Smith College of Engineering and Computer Science  
Syracuse University

This document describes the requirements for an undergraduate major in Computer Engineering. It applies to students entering in the Fall 2009 and Spring 2010 semesters.

**Disclaimer:** The *Syracuse University Bulletin*: Undergraduate Course Catalog has the Official description of the program. This document is *intended* to contain a restatement and an elaboration on what is in the catalog. However, if on some point this document and the catalog are in conflict, the catalog has precedence over the handbook.

## 1. INTRODUCTION

The Bachelor of Science in Computer Engineering (BSCE) program at Syracuse was originally established in 1969 through the former Department of Electrical Engineering and was the second such program of its kind in the nation. This program has been accredited by the Accreditation Board for Engineering and Technology (ABET) since 1973. Currently the BSCE program is housed in the Department of Electrical Engineering and Computer Science (EECS) which is a department in the College of Engineering and Computer Science (ECS).

Computer Engineering (CE) at Syracuse University has two primary foci: Computer Hardware Design: including an understanding of design methodologies for electronic circuits, digital systems, computer architecture and integrated circuits, and Computer Software Design: including an understanding of design methodologies for algorithms and data structures, operating systems, and a wide variety of software applications across various computer languages. In addition to design methodologies, test and verification principles are studied, as well as performance estimation and the underlying computation theory. There is an excellent opportunity in laboratories to put the theory and design methods into practice by using digital components, design simulators, and microcontrollers.

Part of the department's mission is to enable CE graduates to use computer engineering and other knowledge to solve relevant societal problems as described by the BSCE Educational Objectives. This is accomplished by a rigorous curriculum that prepares students to achieve the BSCE Educational Outcomes prior to graduation and the BSCE Educational Objectives after graduation.

## 2. EDUCATIONAL OBJECTIVES FOR THE BSCE PROGRAM

The educational objective of the bachelor of science in computer engineering (BSCE) program in the Department of Electrical Engineering and Computer Science (EECS) at Syracuse University is to prepare **well-rounded** graduates that are **ready for work** and **ready for change**.

- **Well-rounded** graduates of the BSCE program are known by their professional competence, innovative thinking, ability to work individually and in diverse teams, leadership abilities, communication skills, and integrity.
- Graduates of the BSCE program who are **ready for work** are engaged in applying the knowledge acquired in their major, combined with their problem solving abilities, to produce feasible solutions to problems, in a timely manner, which are deemed important in industry, government, or academia.
- Graduates of the BSCE program who are **ready for change** exhibit the intellectual flexibility necessary to solve new problems in innovative ways by integrating multiple viewpoints from several disciplines in search of the best possible solutions.

### **3. EDUCATIONAL OUTCOMES FOR THE BSCE**

In addition to successfully completing the requirements for the BSCE program which are described further on in this handbook, graduates from this program must also achieve the following educational outcomes prior to graduation:

#### **BSCE EDUCATIONAL OUTCOMES**

- (a) An ability to apply knowledge of mathematics and science.
- (b) An ability to design and conduct experiments, and analyze and interpret data.
- (c) An ability to design systems to meet specifications.
- (d) An ability to function independently and on teams.
- (e) An ability to identify, formulate, and solve engineering and scientific problems.
- (f) An understanding of professional, ethical, and safety considerations.
- (g) An ability to communicate effectively, both orally and in writing.
- (h) An understanding of the role of science and engineering in society.
- (i) A recognition of the necessity of lifelong learning.
- (j) An understanding of contemporary issues through a broad liberal arts education.
- (k) An ability to use the modern tools necessary for professional practice.
- (l) An ability to think critically as evidenced by skills in interpretation, analysis, evaluation, inference, argumentation, and reflection.
- (m) An understanding of principles of construction of computing systems.
- (n) An understanding of abstraction and refinement of computing systems.
- (o) An ability to predict and reason about design correctness and performance of computing systems.
- (p) An ability to use methods and practices to design correct and reliable computing systems.
- (q) An ability to test and verify that computing systems are in fact correct and reliable.

## 4. BSCE REQUIREMENTS

### 4.1 Program Components

The BSCE program has four fundamental educational components: mathematics and sciences, engineering, social sciences and humanities, and general education. A liberal number of courses have been set-aside as electives in order to allow students, with the guidance of their advisors, to customize their education according to their personal and career objectives. A summary of required and elective credits within each component is as follows:

*Math and Science Education* : 33 required, 0 elective; for a total of 33 credits:

*Engineering Education*: 48 required, 15 elective; for a total of 63 credits:

*General Education*: 12 required, 9 elective; for a total of 21 credits:

*Social Science and Humanities Education*: 6 required, 6 elective; for a total of 12 credits.

**Total Credits 129**

### 4.2 A Typical Program of Study Presented by Semester

<i>First Year, Fall Semester</i>	<i>Credits</i>
ECS 101 Introduction to Engineering & Computer Science .....	3
MAT 295 Calculus I .....	4
CHE 106 General Chemistry I .....	3
CHE 107 General Chemistry II.....	1
PHI 251 Logic .....	3
WRT 105 Writing Studio I .....	<u>3</u>
	17

<i>First Year, Spring Semester</i>	<i>Credits</i>
ECS 102 Introduction to Computing .....	3
MAT 296 Calculus II.....	4
PHY 211 General Physics I .....	3
PHY 221 General Physics Lab I .....	1
Social Science/Humanities elective.....	3
Non-Eng./Comp. Science elective.....	<u>3</u>
	17

<i>Second Year, Fall Semester</i>	<i>Credits</i>
CIS 275 Introduction to Discrete Mathematics.....	3
CSE 283 Introduction to Object-Oriented Design .....	3
MAT 397 Calculus III .....	4
ELE 231 EE Fundamentals I.....	3
ELE 291 EE Lab I .....	1
PHY 212 General Physics II .....	3
PHY 222 General Physics Lab II .....	<u>1</u>
	18

<i>Second Year, Spring Semester</i>	<i>Credits</i>
CSE 261 Digital Logic Design.....	3
CSE 382 Algorithms and Data Structures .....	3
ELE 232 EE Fundamentals II .....	3
ELE 292 EE Lab II.....	1
MAT 485 Differential Equations & Matrix Algebra.....	3
WRT 205 Writing Studio II.....	<u>3</u>
	16

<i>Third Year, Fall Semester</i>	<i>Credits</i>
CSE 281 Comp. Org. & Assembly Lang.....	3
CSE 397 Computer Lab I.....	3
ELE 331 Digital Circuits and Systems .....	3
MAT 521 Introduction to Prob. And Stat * .....	3
Social Science/Humanities elective.....	<u>3</u>
	15

<i>Third Year, Spring Semester</i>	<i>Credits</i>
ELE 558 Data Networks: Basic Principles .....	3
CSE 381 Computer Architecture.....	3
CSE 398 Computer Lab II .....	3
WRT 307 Professional Writing.....	3
ECS 392 Ethical Aspects of ECS.....	<u>3</u>
	15

<i>Fourth Year, Fall Semester</i>	<i>Credits</i>
CSE 497 Senior Design Project.....	3
CSE 486 Design of Operating Systems .....	3
Technical electives .....	6
Non-Eng./Comp. Science Electives .....	<u>3</u>
	15

<i>Fourth Year, Spring Semester</i>	<i>Credits</i>
CSE 497 Senior Design Project.....	1
WRT 407 Adv. Workshop in Prof. Tech.,or Disc. Writing.....	3
Technical electives .....	9
Non-Eng./Comp. Science elective.....	<u>3</u>
	16

**Total 129**

\* CIS 321 Introduction to Probability and Statistics (4 credits) can be substituted if a student does not want to pursue a mathematics minor

### 4.3 A Typical Program of Study Presented by Subject

	CREDIT GRADE	FIRST-YEAR		SOPHOMORE		JUNIOR		SENIOR		VAR i/
		F	S	F	S	F	S	F	S	
<b>MATHEMATICS (21)</b>										
CIS275 Intro to Discrete Mathematics	(3)___			3						
MAT295 Calculus 1	(4)___	4								
MAT296 Calculus 2	(4)___		4							
MAT397 Calculus 3	(4)___			4						
MAT485 Diff. Equations & Matrix Algebra	(3)___				3					
MAT521 Intro. to Probability and Statistics*	(3)___					3				
<b>SCIENCES (12)</b>										
CHE106 General Chemistry 1	(3)___	3								
CHE107 General Chemistry Lab 1	(1)___	1								
PHY211 General Physics 1	(3)___		3							
PHY221 General Physics Lab 1	(1)___		1							
PHY212 General Physics 2	(3)___			3						
PHY222 General Physics Lab 2	(1)___			1						
<b>ENGLISH (12)</b>										
WRT105 Studio 1: Practices of Academic Writing	(3)___	3								
WRT205 Studio 2: Critical Research and Writing	(3)___			3						
WRT307 Adv. Wrt Studio: Professional Writing	(3)___					3				
WRT407 Adv. Wrkshp in Prof, Tech, or Disc. Writing	(3)___							3		
<b>SOC. SCIENCE/HUMANITIES/GEN. ED. (12)</b>										
ECS392 Ethical Aspects of ECS	(3)___					3				
PHI 251 Logic	(3)___	3								
SSH Elective _____	(3)___		3							
SSH Elective _____	(3)___					3				
<b>ENGINEERING (20)</b>										
ECS101 Intro. to Engr. & Comp. Sci.	(3)___	3								
ECS102 Intro. to Computing	(3)___		3							
ELE231 Electrical Engr. Fundamentals I	(3)___			3						
ELE232 Electrical Engr. Fundamentals II	(3)___				3					
ELE291 Electrical Lab. 1	(1)___			1						
ELE292 Electrical Lab. 2	(1)___				1					
ELE331 Digital Circuits & Systems	(3)___					3				
ELE 558 Data Networks: Basic Principles	(3)___						3			
<b>COMPUTER ENGINEERING (28)</b>										
CSE261 Digital Logic Design	(3)___				3					
CSE281 Comp. Org. & Assem. Lang.	(3)___					3				
CSE283 Intro. To Object-Oriented Design	(3)___			3						
CSE381 Computer Architecture	(3)___						3			
CSE382 Algorithms & Data Structures	(3)___				3					
CSE397 Computer Laboratory 1	(3)___					3				
CSE398 Computer Laboratory 2	(3)___						3			
CSE 486 Design of Operating Systems	(3)___							3		
CSE497 Senior Design Project	(3)___							3		
CSE497 Senior Design Project	(1)___								1	
<b>TECHNICAL ELECTIVES (15)</b>										
Tech Elective _____	(3)___							3		
Tech Elective _____	(3)___							3		
Tech Elective _____	(3)___								3	
Tech Elective _____	(3)___								3	
Tech Elective _____	(3)___								3	
<b>NON-ENG./COMP. SCIENCE ELECTIVES (9)</b>										
Non-Eng./Comp. Sci. Elective _____	(3)___		3							
Non-Eng./Comp. Sci. Elective _____	(3)___							3		
Non-Eng./Comp. Sci. Elective _____	(3)___								3	
<b>TOTAL CREDITS</b>		<b>129</b>	<b>17</b>	<b>17</b>	<b>18</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>16</b>

\*CIS 321 Introduction to Probability and Statistics (4 credits) can be substituted if a student does not want to pursue a mathematics minor.

## 4.4 General Information

Note that you **cannot** take **CIS 554 – Object-Oriented Programming in C++**, to fulfill any requirement in the Computer Engineering undergraduate program. This is because a considerable amount of material covered in this course overlaps with the material covered in the core course CSE 283 – Introduction to Object-Oriented Design.

Note that **CPS courses cannot be taken** to fulfill any of the requirements for the Computer Engineering undergraduate program. These courses are designed for non-majors in Computer Engineering or in Computer Science.

## 4.5 Elective Courses

### *Technical Electives*

Students fulfill 15 credits of technical electives by completing at least one of the tracks specified below. Each track is completed by taking at least 15 credit hours of courses specified by the track:

#### **Hardware Systems (HWS) Track:**

- Students must take the following 3-credit hour courses:
  - ❖ CSE 464 - Introduction to VLSI Design
  - ❖ CSE 561 - Digital Machine Design
  - ❖ CSE 565 - Digital Design Test and Verification
- Students select at least one of the following 3-credit hour courses:
  - ❖ CSE 471 - Introduction to Embedded System Design
  - ❖ CSE 591 - Topics in Computer Systems Engineering: Topics Related to Hardware
  - ❖ CIS 483 - Introduction to Computer and Network Security
  - ❖ CIS 543/ELE 516 - Control of Robots
  - ❖ ELE 333 - Analog Circuits
  - ❖ ELE 346 - Semiconductor Devices
  - ❖ ELE 351 - System and Signal Analysis
  - ❖ ELE 424 - Fundamentals of RF and Microwaves
  - ❖ ELE 431 - Analog Circuits and Systems
- Students select at least one technical course, 300-level or above, from the Department of Electrical Engineering and Computer Science (EECS) or one technical course, 300-level or above, from the Department of Mathematics

#### **Software Systems (SWS) Track:**

- Students must take the following 3-credit hour courses:
  - ❖ CIS 453 - Software Specification and Design
  - ❖ CIS 454 - Software Implementation
- Students select at least two of the following 3-credit hour courses:
  - ❖ CSE 482 - Principles of Software Engineering
  - ❖ CSE 483 - Windows Programming
  - ❖ CSE 581 - Introduction to Database Management Systems
  - ❖ CSE 588 - Translator Design

- ❖ CSE 591 - Topics in Computer Systems Engineering: Topics Related to Software
- ❖ CIS 352 - Programming Languages: Theory and Practice
- ❖ CIS 373 - Introduction to Automata Theory
- ❖ CIS 401 - Multimedia Systems and Tools
- ❖ CIS 425 - Introduction to Computer Graphics
- ❖ CIS 467 - Introduction to Artificial Intelligence
- ❖ CIS 473 - Logic and Computability Theory
- ❖ CIS 483 - Introduction to Computer and Network Security
- ❖ CIS 500 - Programming in Java 5.0
- ❖ CIS 543/ELE 516 - Control of Robots
- ❖ CIS 581 - Concurrent Programming
- Students select at least one technical course, 300-level or above, from the Department of Electrical Engineering and Computer Science (EECS) or one technical course, 300-level or above, from the Department of Mathematics

### **Hardware/Software Systems (HSS) Track:**

- Students must take the following 3-credit hour courses:
  - ❖ CIS 453 - Software Specification and Design
  - ❖ CIS 454 - Software Implementation
  - ❖ CSE 464 - Introduction to VLSI Design
  - ❖ CSE 561 - Digital Machine Design
  - ❖ CSE 565 - Digital Design Test and Verification

### **Interdisciplinary (INT) Track:**

- **Objective:** To allow students to have a more broad education by being able to take more courses outside of the Department of Electrical Engineering and Computer Science (EECS).
- **Requirements to complete this track:**
  - ❖ Student must be awarded a minor or a second major in a discipline outside of the Department of Electrical Engineering and Computer Science (EECS), excluding a minor in Mathematics\*;
  - ❖ Student may substitute up to 9 credit hours of technical elective courses to fulfill this minor or second major;
  - ❖ All of the remaining credit hours (six or more) of technical electives must be taken from one of the following tracks:
    - **Hardware Systems (HWS) Track:** In this case, student needs to take at least two core courses of the HWS Track if the remaining number of credits of technical electives the student must fulfill is six credit hours, or all the core courses of this track if the remaining number of credit hours of technical electives required is more than six;

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\* Students can fulfill the requirements for a minor in Mathematics within 129 credit hours required by the BSCE program if they opt to fulfill the Hardware Systems Track, the Software Systems Track, or the Hardware/Software Systems Track.

- **Software Systems (SWS) Track:** In this case, students need to take at least all the core courses of the SWS Track.

The Computer Engineering Program Committee will determine if a specific CSE 591 course can be used to fulfill one of the tracks.

Note that **you cannot take CIS 554 – Object-Oriented Programming in C++**, to fulfill any requirement in the Computer Engineering undergraduate program. This is because a considerable amount of material covered in this course overlaps with the material covered in the core course CSE 283 – Introduction to Object-Oriented Design.

Note that **CPS courses cannot be taken** to fulfill any of the requirements for the Computer Engineering undergraduate program. These courses are designed for non-majors in Computer Engineering or in Computer Science.

### ***Social Sciences and Humanities Electives***

This 6-credit requirement may be fulfilled by any combination of courses whose contents are in the social science and humanities area. A glossary of course designations with such contents can be found in the Humanities Division and the Social Sciences Division of the College of Arts and Sciences with the exception of the following Anthropology - Physical courses: ANT 131, 331, 431, 432, and 433. These glossaries are given in The College of Arts and Sciences section of the Undergraduate Catalog.

### ***Non-Engineering/Computer Science Electives***

The purpose of this 9-credit requirement of general education elective courses is to provide students with a broad educational experience in a diversity of subjects. These elective courses--either by themselves or in combination with social science and humanities electives--present an attractive opportunity to complete one of the many non-technical minors offered in the University.

Courses that cannot be used to satisfy this requirement include technical courses offered by (or crosslisted with) the College of Engineering and Computer Science (ECS), remedial math courses, and courses with engineering or computer science content that are taught by academic units outside the College of ECS. A list of non-conforming courses appears in Appendix A.

At most three conforming courses of 1-credit each can be used to satisfy this 9-credit requirement of non-engineering/computer science elective courses. However, if you want these courses to be used to fulfill this requirement, they must receive a letter grade and, therefore, cannot be taken under the pass/fail option.

## **4.6 Minors**

The Computer Engineering curriculum is flexible enough to allow a student to complete minors without taking additional credits or by taking only a few extra courses. Today's computer engineers work in an environment where they are expected to know not only computer hardware

and software, but also material from a collection of other subject areas—from device technology or computer science to management and how computers affect the world. The computer engineering curriculum responds to this need by providing students with a strong basis in the fundamentals of computer engineering coupled with additional courses drawn from electrical engineering and computer science. There is also an opportunity to broaden the scope of a student's education.

- **Minor in Electrical Engineering (EE)** Students majoring in computer engineering are required to take 11 credits of EE courses. By taking nine additional credits of EE courses at the 300 or above levels, a student can earn a minor in EE. Of these nine credits, six are to be taken in addition to the 129 credits required by the computer engineering curriculum.
- **Non-Technical Minor** A student who would like to complete a non-technical minor has six credits of social sciences and humanities electives, nine credits of non-engineering/computer science electives, and up to nine credits of technical electives if the student completes the Interdisciplinary Track which can be used toward any one of more than 70 minors offered at Syracuse University. Since these minors usually require 18 credits, students need to take three credits beyond the 129 credits required by the computer engineering program.
- **Minor in Mathematics** The computer engineering curriculum requires students to take 18 credits of courses from the mathematics department. This does not quite meet the requirements of a mathematics minor. To complete a minor in mathematics, students must take one math course: MAT 525 or MAT 526. This course can be taken as a non-engineering/computer science elective. Therefore, students may complete a minor in mathematics within the minimum 129 credits required by the computer engineering program.

#### 4.7 Graduation Requirements

- students must complete their program of study satisfying all the course requirements described in Sections 4.2, 4.3, 4.4, and 4.5;
- students cannot graduate with courses having missing grades or incompletes;
- students must have earned an average GPA of at least 2.0 (C) in all the engineering, mathematics and science courses. In addition, the overall GPA of all courses taken at Syracuse University must be at least 2.0 (C);
- Students must have achieved all the BSCE Educational Outcomes (stated in Section 3) in the course CSE 497-Senior Design Project at least at a marginal level.

## **4.8 Monitoring Student's Progress**

### ***Advising***

Each student is assigned an academic advisor. A list of advisors can be found at the board adjacent to Room 220 in Link Hall.

## **4.9 Helpful Advice**

- If you designate a minor in your program of study and you decide not to pursue it any longer, you must drop it before graduation. Otherwise, you will not be able to be certified for graduation because you have not fulfilled the requirements for this minor.

## **APPENDIX A**

Glossary of course designators which **cannot** be taken to fulfill the non-engineering/computer science elective requirement

<b>AEE</b>	Aerospace Engineering	<b>MAE</b>	Mechanical and Aerospace Engineering
<b>ASC</b>	Aerospace Studies	<b>MAT</b>	Mathematics: remedial math courses (200-level or below)
<b>BEN</b>	Bioengineering	<b>MEE</b>	Mechanical Engineering
<b>CEN</b>	Chemical Engineering	<b>MFE</b>	Manufacturing Engineering
<b>CGR</b>	Computer Graphics	<b>MTS</b>	Materials Science
<b>CIE</b>	Civil Engineering	<b>NEU</b>	Neuroscience
<b>CIS</b>	Computer and Information Science	<b>STS</b>	Science, Technology, and Society; courses with contents in engineering/computer science (STS/ECS 203, STS/HNR/ECS 318)
<b>CPS</b>	Computational Science	<b>SST</b>	Solid State Technology
<b>CSE</b>	Computer Engineering	<b>URP</b>	Undergraduate Research Program (unless approved by petition)
<b>ECS</b>	Engineering and Computer Science		
<b>EGR</b>	Engineering		
<b>ELE</b>	Electrical Engineering		
<b>IST</b>	Information Studies: courses with technical contents engineering/computer science (IST 195, 200, 233, 256, 257, 300, 356, 430, 433, 442, 449, 452, 454, 459, 463, 475, 476, 555, 556, 565)		