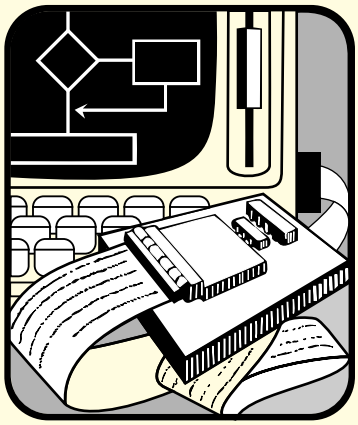

ENGINEERING— COMPUTER ENGINEERING

BACHELOR OF SCIENCE

PROGRAM DESCRIPTION

Computer Engineering is a program of study, administered jointly by the Departments of Computer Science and Electrical and Electronic Engineering, targeted for the student interested in designing software and hardware for computer applications, or interested in designing computer systems themselves. Computer Engineering, a unique course of study and degree, is widely recognized in industry as a fast paced, exciting field of engineering that has many employment opportunities.

The Bachelor of Science degree in Computer Engineering is a four-year program that emphasizes engineering design of both computer hardware and computer software. A two semester Senior Design Project ties many of the topics together into an experience that is highly acclaimed by industries hiring Computer Engineering graduates.

Students interested in Computer Engineering should note that the Computer Engineering lower division courses differ from those taken by electrical, civil and mechanical engineering majors. Computer Engineering majors take more computer science courses, fewer engineering service courses and different mathematics and statistics courses. Most community colleges offer the appropriate computer science courses. Students with questions are urged to call the Computer Engineering office, 278-6844, and speak to the Coordinator, Dr. Ron Becker.

The Engineering and Computer Science building has well equipped laboratories and modern computing equipment. Much of the equipment and software have been donated by industry to the School. In some areas, the faculty and CPE program offer leading edge technology to other campuses.

FACULTY

Ronald Becker, *Coordinator*

Senad Busovaca; John Clevenger; Nikrouz Faroughi; Katherine Ferrara; Isaac Ghansah; Kwai-Ting Lan; Karl Stoffers; Suresh Vadhva

Barbara Dietrich, *Program Secretary*
Department Office, ECS-3018, 278-6844

FEATURES

Computer Engineering, as a discipline in itself, is still relatively young in the engineering world. While most universities now have a degree in Computer Engineering, CSUS was one of the first within the CSU system to award this degree. Many schools have a Computer Engineering program either with Electrical Engineering or with Computer Science. CSUS chose to build on the strength of both departments by building a joint program supported by CSC and EEE Departments. Naturally, the program has it's own set of courses in addition to those from CSC and EEE.

CSUS's CPE program has been ABET accredited since 1988. The CPE program has been used as a model program for other universities! Local industry, as well as state and nation wide industries, eagerly seek graduates from this program. Intel, Folsom and Hewlett Packard, Roseville are two employers that hire large number of CSUS CPE graduates. Smaller, lesser known companies in northern California and the Bay Area often offer exciting careers.

While most graduates seek employment after the BS degree, the program also prepares students for advanced work in the area of computer engineering. CSUS offers advanced computer engineering studies through the Master's Degree programs in the Computer Science Department and in the Electrical and Electronic Engineering Department. Graduate students in either program can select courses from the other department.

CAREER POSSIBILITIES

Computer Engineer • Computer Architect • ASIC Designer • Chip Architect • VLSI Layout Engineer • Real Time System Design Engineer • Design Engineer • Hardware Engineer • Software Engineer • Systems Engineer • Applications Engineer • Networking Engineer • Control Engineer • Marketing Engineer • Data Communications Engineer • Project Engineer • Research Engineer • Consulting Engineer • Test Engineer • Production Engineer • Telecommunications Engineer • Solid State Engineer

MAJOR REQUIREMENTS • BS

Total units required for BS: 134
Total units required for Major: 51
Total units required for Pre-Major: 47
Courses in parentheses are prerequisites.

A. Required Lower Division Courses (Pre-major)

1. First Semester Freshman Year (15 units)

(5)	CHEM 1A	General Chemistry
(3)	CSC 15	Programming Concepts & Methodology I (CSC 1, 1A, or programming experience)
(4)	MATH 30	Calculus I (MATH 29)
(3)	General Education course	

2. Second Semester Freshman Year (17 units)

(3)	CSC 20	Programming Concepts & Methodology II (CSC 15)
(3)	CSC 35	Assembly Language Programming (CSC 15)
(4)	MATH 31	Calculus II (MATH 30)
(4)	PHYS 11A	General Physics: Mechanics (MATH 30, 31)
(3)	General Education course	

3. First Semester Sophomore Year (16 units)

(3)	CSC 60	C Programming in UNIX Environment (CSC 20)
(3)	ENGL 20	Expository Writing (ENGL 1A)
(3)	MATH 45	Differential Equations for Science & Engineering (MATH 31)
(4)	PHYS 11C	General Physics: Electricity & Magnetism, Modern Physics (PHYS 11A, MATH 31)
(3)	General Education course	

4. Second Semester Sophomore Year (17 units)

(4)	CPE 64	Introduction to Logic Design
(3)	ENGR 17	Introductory Circuit Analysis (PHYS 11C, MATH 45)
(4)	STAT 50	Introduction to Probability & Statistics (MATH 26A or 30)
(3)	ECON 1B	Introduction to Microeconomic Analysis
(3)	General Education course	

B. Required Upper Division Courses (Major)

Students are not permitted to enroll in upper division courses until lower division requirements are completed and they have been accepted as a Computer Engineering major.

1. First Semester Junior Year (18 units)

(3)	CSC 130	Data Structures & Algorithm Analysis (CSC 20)
(4)	CPE 166	Advanced Logic Design (CPE 64, Writing Proficiency Exam)
(4)	CPE 185	Computer Interfacing (CPE 64, CSC 35, 60)
(4)	EEE 120	Electronic Instrumentation (ENGR 17)
(3)	General Education course	

2. Second Semester Junior Year (17 units)

(3)	CPE 186	Computer System Hardware Design (CPE 184 or 185)
(2)	CPE 187	Microprocessor Design Lab (CPE 185, Writing Proficiency Exam)
(3)	CSC 139	Operating System Principles (CSC 60, 137; or CPE 185)
(3)	CPE elective	
(3)	General Education course	
(3)	MATH 101	Discrete Mathematics (MATH 26B or 31)

3. First Semester Senior Year (17 units)

(3)	CPE 142	Advanced Computer Organization (CPE 185)
(3)	CPE 151	CMOS & VLSI (CPE 64, ENGR 17)
(3)	CPE 159	Operating System Pragmatics (CSC 139)
(2)	CPE 190	Senior Design Project I (CPE 185)
(3)	General Education course	
(3)	General Education course	

4. Second Semester Senior Year (17 units)

(3)	CPE 175	Data Communication Systems (CPE 185)
(3)	One of the following:	
	MATH 100	Applied Linear Algebra (MATH 26B or 31)
	MATH 150	Introduction to Numerical Analysis (MATH 32 or 45)
(3)	CPE	Technical elective
(2)	CPE 191	Senior Design Project II (CPE 190)
(3)	General Education course	
(3)	General Education course	

Computer Engineering Electives

CPE 153	VLSI Design
CSC 131	Computer Software Engineering (CSC 130)
CSC 134	File Organization for Data Management
CSC 151	Compiler Construction (CSC 135)
CSC 154	Computer Graphics Systems Design (CSC 130)
CSC 155	Intermediate Computer Graphics
EEE 118	Electronic Networks II
EEE 155	Application of Integrated Circuits
EEE 180	Signals & Systems
EEE 181	Introduction to Digital Signal Processing
EEE 184	Introduction to Feedback System
EEE 185	Modern Communication Systems
EEE 187	Robotics

Note: Students are expected to satisfy the general education requirements of the Accreditation Board for Engineering and Technology (ABET) as well as the University's General Education requirements. Students should consult the Program Coordinator for specific General Education requirements. A second year foreign language course (2A or equivalent) may also satisfy 3 units of GE when the course is being taken to comply with the CSUS foreign language requirement. Students should consult with an advisor for exact GE eligibility of these courses.

Cooperative Education

The Computer Engineering Program encourages students to participate in the Cooperative Education Program which provides alternate periods of University Study and major-related, paid off-campus work experience in private industry or government. The experience will enhance the student's employment prospects upon graduation. Most participants in this program will complete the equivalent of two six-month work periods, one in their junior year and the other in their senior year. Students must enroll in the appropriate Professional Practice course (CPE 195A, 195B, 195C, or 195D) and are awarded a Certificate of satisfactory completion of the two work periods. However, the credits for this course do not replace the curricular requirements of the BS Computer Engineering degree. Students interested in this program should apply in the Cooperative Education Program office, Lassen Hall 2008.

LOWER DIVISION COURSE

64. Introduction to Logic Design. This course covers the following topics: logic gates, binary number system, conversions between number systems, Boolean algebra, Karnaugh maps, digital logic design, flip-flops, counters, registers, memories, state machine design techniques, designing with MSI circuits, basic computer architecture, operational amplifier fundamentals and applications, and analog-to-digital and digital-to-analog conversions. The lab has both basic experiments and design assignments. Sophomore standing. Lecture three hours per week, laboratory three hours per week. 4 units.

UPPER DIVISION COURSE

142. Advanced Computer Organization. Design and performance issues of computers: CPU, I/O interface and memory. Design alternatives for arithmetic functions, CPU internal architecture, instruction set, instruction cycle, I/O, interrupt, direct memory access, and bus and memory hierarchy. CAD tools for schematic capture and simulations. Students will design and simulate a micro-computer. Cross-listed as CSC 142, and can only be taken once for credit. **Prerequisite:** CPE 185. 3 units.

151. CMOS and VLSI. This course begins with an introduction to CMOS gates and design of CMOS combinational and sequential functions at the gate level, including CMOS memory. The theory of MOS transistors is covered including: DC equations, threshold voltage, body effect, subthreshold region, channel length modulation, tunneling, punch through, basic CMOS invertor, and the CMOS transmission gate. A basic exposure to VLSI includes the following topics: CMOS processing technology, CMOS layout, CMOS circuit design and CMOS logic design. Simulations on SPICE and basic VLSI layouts using LEDIT will be included. **Prerequisites:** CPE 64, ENGR 17. 3 units.

153. VLSI Design. Basic n-MOS technology, transistor, inverter, logic gates, three layer layouts, layout language and other CAD/CAM tools, outline of IC fabrication steps. System building blocks, two-phase clock, registers, shift register, programmable logic array, finite state machines. Chip example—the OM-2 data path chip. Floor plan, register array, busses, barrelshifter, arithmetic/logic unit, I/O ports, control. **Prerequisites:** CPE 64 or CSC 137. 3 units.

159. Operating System Pragmatics. The application of operating system principles to the design and implementation of a multi-tasking operating system. Students will write an operating system for a computer system. Topics include scheduling of processes, control and allocation of computer resources and user interfacing. Cross-listed as CSC 159, and can only be taken once for credit. **Prerequisites:** CSC 139. 3 units.

166. Advanced Logic Design. Synchronous state machine review, coverage of pulse mode state machines, fundamental mode state machines, study of hazards and races, timing simulations, testability, boundary scan, focus on design use of PLDs and FPGAs, routing and logic partitioning. Lab coverage includes PLD implementation projects, design and construct of FPGA projects, large scale designs on both PLDs and FPGAs, and interface experiments between various technologies. **Prerequisites:** CPE 64, Writing Proficiency Exam. 4 units.

175. Data Communication Systems. Fundamentals of data communications. Topics include classification of data communication systems, layered architectures, protocol suites, hardware elements, software elements, communication media and the interfaces, and roles and inter-relationships of the system elements, users, analysts and designers. Course is cross-listed as CSC 175 and may be taken only once for credit. **Prerequisite:** CPE 185 and CSC 139; 139 may be taken concurrently. 3 units.

184. Introduction to Microprocessors. Topics in this course include: microcomputer systems, microprocessor architecture, machine and assembly language programming, timing operations, bus arbitration and exception processing logic, addressing modes, parallel and serial ports, memory, assemblers and development systems. The lab portion uses development systems and target systems in the Computer Engineering Laboratory to assemble, link, test and debug and run various assignments. Lecture three hours per week, laboratory three hours per week. May not be taken for credit by Computer Engineering majors. **Prerequisites:** junior standing, CPE 64. 4 units.

185. Computer Interfacing. Course content includes: design of 16 and 32 micro-computer systems including memory systems, parallel and serial input/output, timer modules and interrupt structures; designing "C" language code, in laboratory, to exercise interface modules of parallel and serial input/output, timer modules and interrupts; extensive study of interrupt handlers, assemblers, linkers and loaders. Practical features of interfaces; handshaking techniques, displays, keypads, trackballs, ADCs and DACs, are included. **Prerequisites:** CPE 64, CSC 35, 60. 4 units.

186. Computer Hardware System Design. This course includes: study of synchronous and asynchronous bus structures, interrupt structures, transmission line effect on buses, shielding and grounding, bus arbitration protocols, memory design considerations, DMA controllers, CRT controllers, floppy and hard disk controllers, graphics controllers, serial I/O protocols and recommended standards, modems, parallel port structures, and GPIB instrumentation bus. Five design projects will be assigned. **Prerequisite:** CPE 184 or 185. 3 units.

187. Microprocessor Design Laboratory. This lab begins with an introduction to logic and state analyzers and the use of commercial hardware emulators. Each student will do two designs involving microprocessor interfacing, complete system design and software development. Oral presentations and design reviews will be given. Each student will then build one project, design the testing, and eventually provide the finished product for demonstration. One lecture per week and one three hour laboratory per week. **Prerequisites:** CPE 184 or 185, Writing Proficiency Exam. 2 units.

190. Senior Design Project I. This course centers on developing hardware and software project planning and engineering design skills. Emphasis is placed on design philosophies, problem definition, project planning and budgeting, written and oral communication skills, working with others in a team arrangement, development of specifications and effective utilization of available resources. Lecture one hour per week, laboratory three hours per week. **Prerequisite:** CPE 185. 2 units.

191. Senior Design Project II. A continuation of the project started by design teams in CPE 190. The hardware will be completed, tested and redesigned if necessary. At the same time, software for the project will be finished and debugged. The final results of the team project will be presented to the CPE faculty and students at a prearranged seminar. Lecture one hour, laboratory three hours. **Prerequisite:** CPE 190. 2 units.

195. Fieldwork in Computer Engineering. Directed observations and work experience in computer engineering with firms in the industry or public agencies. Supervision is provided by the instructional staff and the cooperating agencies. Faculty approval required. May be repeated for credit. Graded Credit/No Credit. 1-3 units.

195A-D. Professional Practice. Supervised employment in a professional engineering or computer science environment. Placement arranged through the School of Engineering and Computer Science. Requires satisfactory competition of the work assignment and a written report. **Prerequisite:** consent of instructor. Credit/No Credit. 1-12 units.

199. Special Problems. Individual projects or directed reading. **Note:** open only to those students who appear competent to carry on individual work. Admission to this course requires approval of the faculty member under whom the individual work is to be conducted, in addition to the approval of the advisor. May be repeated for credit. Graded Credit/No Credit. 1-3 units.