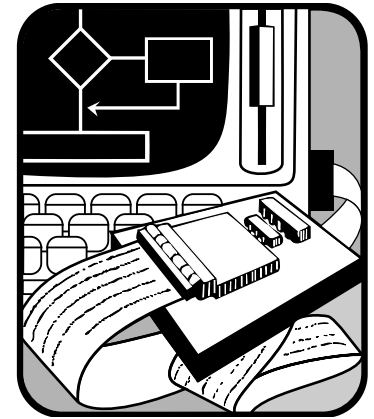




NOTE:

This document is specific to the
2002-2004 printed catalog.

engineering — computer engineering



BACHELOR OF SCIENCE

PROGRAM DESCRIPTION

Computer Engineering is one of the newest areas of engineering. In the high technology areas of the USA, Sacramento included, Computer Engineering has experienced tremendous growth. It has become one of the major driving forces behind the rapidly advancing electronics and computer industry. Employment projections consistently predict that computer engineering and computer science will continue to experience more than a doubling of growth in a ten-year period.

Nationally, nearly all engineering universities offer a degree in Computer Engineering. Being close in course content to electrical engineering and to computer science, these degrees are found in various departmental and program configurations. At CSUS, Computer Engineering enjoys the advantage of both areas since it is a program jointly supported by the Electrical and Electronic Engineering Department and the Computer Science Department.

Lower division preparation in Computer Engineering parallels that of Computer Science, with the addition of a basic electrical circuits course and a logic design course. Except for the logic design course, most community colleges offer sufficient courses in mathematics, chemistry, physics, and most importantly, computer science.

All questions about the Computer Engineering program should be directed to Dr. Ron Becker, the program coordinator. His address is rbecker@csus.edu; his phone is (916) 278-7944.

CSUS does not offer a separate Master's degree in Computer Engineering. The Electrical and Electronic Engineering Department and the Computer Science Department each offer a computer engineering option within their respective Master's degree.

FACULTY

Ronald Becker, *Coordinator*

Behnam Arad, Ronald Becker, John Clevenger, Nikrouz Faroughi, Isaac Ghansah, Richard Smith, Suresh Vadha

James Wilson, *Administrative Support Assistant*
Department Office, Riverside Hall 3018, (916) 278-4238

FEATURES

Computer Engineering is a dynamic engineering field that thrives on innovation and challenges. Business, industry, and home applications create the need for products that often can be used both for "work" as well as for "entertainment." Due to numerous generous donations from supportive industries, the computer engineering labs are well equipped with Unix and NT servers and workstations, and with software development tools for VLSI application-specific integrated circuits. Industries donate large electronic devices (FPGAs, CPUs) to each student in computer engineering laboratories.

The BS degree in Computer Engineering is a four-year program that emphasizes engineering design of computer hardware and systems at all levels. Engineering design begins with logic design taught to entering students during their first semester. The thread of design continues through the study of architecture, CMOS and VLSI technology, ASIC design, operating systems, computer hardware design, and networking hardware. To complete their degree, students take a two-semester senior design and project course.

The CSUS Computer Engineering BS degree is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone (410) 347-7700. Computer Engineering faculty value accreditation very highly. A mechanism of maintaining currency in technology, curriculum review, and outcomes assessment is in place to assure the university and graduates of the continued growth and high quality of the program.

CAREER POSSIBILITIES

Computer Engineer • Computer Architect • ASIC Designer • Chip Architect • VLSI 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 • DSP Engineer

PROGRAM EDUCATIONAL OBJECTIVES

The objectives of this program are to prepare graduates to:

- enter professional employment and/or graduate study in computer engineering areas, such as, logic design, computer architecture, processor hardware, and computer systems;
- identify, analyze, and solve practical computer engineering problems using both hardware and software design tools and techniques;
- work cooperatively and communicate effectively through speaking, writing, and graphics, with peers, with multi-disciplinary teams, and with the general public;
- practice computer engineering in a professionally responsible and ethical manner; and
- anticipate changes in one's own career with respect to changing technology and shifting societal needs for the application of computer engineering.

DEGREE REQUIREMENTS • BS

Units required for Major: 101

Minimum total units required for BS: 137

Additional units may be required to meet the CSUS foreign language requirement. See page 86.

Courses in parentheses are prerequisites.

A. Required Lower Division Courses (22 units)

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|-----|----------|---|
| (4) | CPE 064 | Introduction to Logic Design (CSC 015 or CSC 025) |
| (3) | CSC 015 | Programming Concepts and Methodology I (CSC 010 or programming experience) |
| (3) | CSC 020 | Programming Concepts and Methodology II (CSC 015) |
| (3) | CSC 028 | Discrete Structures for Computer Science (MATH 029; Corequisite: CSC 020) |
| (3) | CSC 035 | Assembly Language Programming (CSC 015) |
| (3) | CSC 060 | Introduction to Systems Programming (CSC 020) |
| (3) | ENGR 017 | Introductory Circuit Analysis (PHYS 011C, MATH 045; either the math or physics may be taken concurrently, but not both) |

B. Required Mathematics Courses (18 units)

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|-----|----------|---|
| (4) | MATH 030 | Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test) |
| (4) | MATH 031 | Calculus II (MATH 030 or appropriate high school based AP credit) |
| (3) | MATH 045 | Differential Equations for Science and Engineering (MATH 031) |
| (4) | STAT 050 | Introduction to Probability and Statistics (MATH 026A, MATH 030, or appropriate high school based AP credit) |
| (3) | MATH 100 | Applied Linear Algebra (MATH 026B or MATH 031) OR |
| | MATH 150 | Introduction to Numerical Analysis (MATH 032 or MATH 045; some computer programming experience is desirable) |

C. Additional Required Courses (13 units)

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|-----|-----------|---|
| (5) | CHEM 001A | General Chemistry (High school algebra (two years) and high school chemistry; or equivalent) |
| (4) | PHYS 011A | General Physics: Mechanics (MATH 030, MATH 031; or equivalent certificated high school courses. MATH 031 may be taken concurrently) |
| (4) | PHYS 011C | General Physics: Electricity and Magnetism, Modern Physics (MATH 031, PHYS 011A) |

D. Required Upper Division Courses (42 units)

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|-----|----------|--|
| (3) | CPE 138 | Computer Networks and Internets (CSC 035, CSC 060, CSC 130) |
| (3) | CPE 142 | Advanced Computer Organization (CPE 166, CPE 185) |
| (3) | CPE 151 | CMOS and VLSI (CPE 064, EEE 102 or EEE 108) |
| (3) | CPE 159 | Operating System Pragmatics (CSC 139) |
| (4) | CPE 166 | Advanced Logic Design (CPE 064) |
| (4) | CPE 185 | Computer Interfacing (CPE 064, CSC 035, CSC 060) |
| (3) | CPE 186 | Computer Hardware System Design (CPE 185 or EEE 174) |
| (2) | CPE 187 | Embedded Processor System Design (CPE 166, CPE 185, passing score on the WPE) |
| (2) | CPE 190 | Senior Design Project I (CPE 142, CPE 166, CPE 186, CPE 187 and passing score on the WPE) |
| (2) | CPE 191 | Senior Design Project II (CPE 190) |
| (3) | CSC 130 | Data Structures and Algorithm Analysis (CSC 020, CSC 028; CSC 028 may be taken concurrently) |
| (3) | CSC 139 | Operating System Principles (CSC 060, CSC 137, or equivalents) |
| (3) | EEE 102 | Analog/Digital Electronics (ENGR 017; Corequisite: EEE 102L) |
| (1) | EEE 102L | Analog/Digital Electronics Lab (ENGR 017; Corequisite: EEE 102) |
| (3) | ENGR 181 | Electronic Materials (CHEM 001A, PHYS 011A, MATH 045) |

E. Technical Electives (6 units)

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|-----|--------------------------------|---|
| (6) | Select two from the following; | |
| | CPE 144 | DSP Architecture Design (CPE 142) |
| | CPE 153 | VLSI Design (CPE 151) |
| | CSC 131 | Computer Software Engineering (CSC 130; may be taken concurrently) |
| | CSC 133 | Object-Oriented Computer Graphics Programming (CSC 060 and CSC 130) |
| | CSC 134 | Database Management and File Organization (CSC 130) |
| | CSC 151 | Compiler Construction (CSC 136, CSC 145) |
| | CSC 155 | Advanced Computer Graphics (CSC 133) |
| | EEE 108 | Electronics I (EEE 117, EEE 166; Corequisite: EEE 108L) |
| | EEE 117 | Network Analysis (ENGR 017; Corequisite: EEE 064, EEE 117L) |
| | EEE 180 | Signals and Systems (EEE 117) |
| | EEE 187 | Robotics (EEE 180 or equivalent, or instructor permission) |

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, CPE 195B, CPE 195C, or CPE 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, Riverside Hall 2008.

LOWER DIVISION COURSES

CPE 064. Introduction to Logic Design. Covers the following topics: logic gates, binary number system, conversion between number systems, Boolean algebra, Karnaugh maps, combinational logic, digital logic design, flip-flops, programmable logic devices (PLDs), counters, registers, memories, state machines, designing combinational logic and state machines into PLDs, and basic computer architecture. Lab emphasizes the use of software equation entry design tools, the use of a schematic entry, and the use of a logic simulation design tool. Lab assignments are design-oriented. Lecture three hours; laboratory three hours. **Prerequisite:** CSC 015 or CSC 025. Cross-listed as EEE 064; only one may be counted for credit. 4 units.

CPE 064W. Introduction to Logic Design Workshop. Designated to assist students in developing a more thorough understanding of logic simulation and logic design. Focus is on problem solving and design. Activity two hours. **Corequisite:** CPE 064. Cross-listed as EEE 064W; only one may be counted for credit. Graded Credit/No Credit. 1 unit.

CPE 096. Experimental Offerings in Computer Engineering. Current topics in computer engineering. Topics will vary. May be repeated for credit. 1-4 units.

UPPER DIVISION COURSES

CPE 138. Computer Networks and Internets. An overview of the fundamentals of computer networks and connections between networks, from the physical layer up through peer-to-peer communications at the application level. Lower layer characteristics including serial vs. parallel, capacity issues, high-speed connections, LAN framing and error handling. LAN vs. WAN characteristics, network architecture and the ISO network model. Internetworking components including LANs, repeaters, routers, bridges, and gateways. Internet addresses, TCP/IP, and the Domain Name System. Common Internet client/server application protocols including SMTP and FTP. Client/Server programming involving sockets. World Wide Web characteristics including CGI and HTTP protocol, Web pages, Web browsers, Web servers, and Applets. Introduction to advanced Web issues such as Web security, Search engine operations, and Web database operations. **Prerequisite:** CSC 035, CSC 060, CSC 130. Cross-listed as CSC 138; only one may be counted for credit. 3 units.

CPE 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. **Prerequisite:** CPE 166 and CPE 185. Cross-listed as CSC 142; only one may be counted for credit. 3 units.

CPE 144. DSP Architecture Design. Fundamental principles of Digital Signal Processing (DSP): sampling theory, aliasing effects, frequency response, Finite Impulse Response filters, Infinite Impulse Response filters, spectrum analysis, Z transforms, Discrete Fourier Transform, and Fast Fourier Transform. Emphasis on hardware design to achieve high-speed real and complex multiplications and additions. Pipelining, Harvard, and modified Harvard architectures are included. Concludes with architectural overviews of modern DSP applications: modems, speech processing, audio and video compression and expansion, and cellular. **Prerequisite:** CPE 142. 3 units.

CPE 151. CMOS and VLSI. 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 inverter, 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. **Prerequisite:** CPE 064, EEE 102 or EEE 108. 3 units.

CPE 153. VLSI Design. Review basic CMOS VLSI technology, circuit characterization and performance estimation, and provides detailed information on synthesis, placing and routing, clocking strategies, quality and reliability, and I/O structures. Design examples, design techniques, and testing techniques will be presented via current EDA design tools. Students assigned one project from concept design through validation. **Prerequisite:** CPE 151. 3 units.

CPE 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. **Prerequisite:** CSC 139. Cross-listed as CSC 159; only one may be counted for credit. 3 units.

CPE 166. Advanced Logic Design. VHDL and Verilog Hardware Description Languages are studied and used on the following advanced level logic design topics: synchronous state machines, asynchronous state machines, metastability, hazards, races, testability, boundary scan, scan chains, and built-in self-tests. Commercial Electronic Design Automation (EDA) toolsets are used to synthesize lab projects containing a hierarchy of modules into Field Programmable Gate Arrays (FPGAs). Post synthesis simulations by these same tools verify the design before implementation on rapid prototyping boards in the lab. **Prerequisite:** CPE 064. 4 units.

CPE 185. Computer Interfacing. Design of microcomputer 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, and trackballs are included. **Prerequisite:** CPE 064, CSC 035 and CSC 060. 4 units.

CPE 186. Computer Hardware System Design. Study of Intel and Motorola architectures, bus structures, interrupts, memory interface and controllers, bus arbitration, DMA controllers, I/O interface, bridges and microcontroller. Electromagnetic compatibility and regulations, cabling and shielding, grounding, digital circuit noise and layout. **Prerequisite:** CPE 185 or EEE 174. 3 units.

CPE 187. Embedded Processor System Design. Students will design, construct and test an embedded processor system project. All address decoding, control functions, input and output ports, handshaking signals and interrupt control will be implemented in an FPGA. The system will interface to a microcontroller system. Students will use an assembler, a C compiler and either VHDL or Verilog to fully test their project. Laboratory techniques include oscilloscopes, logic analyzers, protocol analyzers and programmers for EPROMs, FLASH and microcontrollers. One lecture per week and one three-hour laboratory per week. **Prerequisite:** CPE 166, CPE 185, passing score on the WPE. 2 units.

CPE 190. Senior Design Project I. 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 142, CPE 166, CPE 186, CPE 187, passing score on the WPE. 2 units.

CPE 191. Senior Design Project II. A continuation of CPE 190. Students are expected to continue 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.

CPE 194. Career Development in Computer Engineering. Designed for Computer Engineering students making career decisions. Instruction will include effective career planning strategies and techniques including skill assessments, employment search strategy, goal setting, time management, interview techniques and resume writing. Lecture one hour. **Prerequisite:** CPE 190, may be taken concurrently. Graded Credit/No Credit. 1 unit.

CPE 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.

CPE 195A. Professional Practice. Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report. **Prerequisite:** Instructor permission. Graded Credit/No Credit. 1-12 units.

CPE 195B. Professional Practice. Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report. **Prerequisite:** Instructor permission. Graded Credit/No Credit. 1-12 units.

CPE 195C. Professional Practice. Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report. **Prerequisite:** Instructor permission. Graded Credit/No Credit. 1-12 units.

CPE 195D. Professional Practice. Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report. **Prerequisite:** Instructor permission. Graded Credit/No Credit. 1-12 units.

CPE 196. Experimental Offerings in Computer Engineering. Current topics in computer engineering. Topics will vary. May be repeated for credit. 1-4 units.

CPE 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.