



CALIFORNIA STATE UNIVERSITY  
**FULLERTON**

**INTEGRATED BACHELOR AND  
MASTER OF SCIENCE  
IN  
COMPUTER ENGINEERING**

**Computer Engineering Program  
College of Engineering & Computer Science  
California State University, Fullerton**

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# COMPUTER ENGINEERING PROGRAM

## GRADUATE HANDBOOK

### TABLE OF CONTENTS

<b>Introduction.....</b>	<b>1</b>
<b>Program Mission Statement .....</b>	<b>1</b>
<b>Program Educational Objectives.....</b>	<b>1</b>
<b>Student Outcomes .....</b>	<b>2</b>
<b>Advisement .....</b>	<b>2</b>
First-Time Freshmen.....	2
Credit by Examination .....	2
<b>Admission Requirements .....</b>	<b>3</b>
General Requirements.....	3
Additional Information for International Students .....	3
<b>Degree Requirements .....</b>	<b>3</b>
Minimum Academic Requirements .....	3
Required Courses.....	3
Technical Electives .....	4
Upper Division Writing Requirements .....	6
Mathematics and Science Foundation Courses .....	6
General Education Requirements .....	7
Requirement in Graduate Writing .....	8
<b>Curriculum Flowchart .....</b>	<b>9</b>
<b>Classified Graduate Standing.....</b>	<b>10</b>
<b>Culminating Experience Requirements .....</b>	<b>10</b>
<b>Other Information.....</b>	<b>11</b>
Course Prerequisites and Corequisites.....	11
Changing Technical Elective Courses .....	11
Internships and Cooperative Education .....	11
Petition for Coursework Overload.....	11
GPA Calculation of Repeated Courses .....	11
Student Clubs .....	12
<b>Course Descriptions .....</b>	<b>13</b>
Computer Engineering (EGCP) Courses .....	13
Computer Science (CPSC) Courses.....	16
Electrical Engineering (EGEE) Courses .....	20
General Engineering (EGGN) Course .....	23
Related Courses for Computer Engineering Majors.....	23
<b>Computer Engineering Progress Worksheet .....</b>	<b>26</b>
<b>Computer Engineering Study Plan.....</b>	<b>28</b>

## **INTRODUCTION**

Welcome to the Computer Engineering Program (CpE) in the College of Engineering and Computer Science at California State University, Fullerton (CSUF).

Over the past decade, there has been a rapid increase in demand for computer engineers in various fields ranging from the area of mobile devices (iPad, iPhone, etc.) to high-performance computing systems needed for e-prescription and electronic health record keeping. This trend only continues to grow.

CpE is committed to providing exciting academic programs. It strives to combine the best facilities along with a driven faculty and an innovative curriculum to prepare students for the engineering challenges of the 21<sup>st</sup> century.

The Integrated BS/MS program in Computer Engineering is designed to provide students with a strong understanding of the hardware design and practical applications of computer based systems. Courses in contemporary and highly evolving computer engineering areas provide students extensive hardware design and modeling experience, exposure to state-of-the-art Electronic Design Automation (EDA) tools and the ability to design and analyze today's modern computer systems. The program integrates pertinent science, mathematics, and engineering courses in order to develop an engineer capable of designing and analyzing all aspects of modern computer and embedded systems.

Academically promising students will have the exceptional opportunity to complete both bachelors and masters degrees in four years through the Integrated BS/MS Degree Program. This cohort program will prepare students for leadership roles in careers with industry, government and educational institutions.

**The Bachelor of Science degree in Computer Engineering at CSUF is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>.**

## **PROGRAM MISSION STATEMENT**

The undergraduate program in Computer Engineering is committed to providing students with a strong theoretical and practical understanding in both the hardware and software aspects of computer-based systems, along with the engineering analysis, design, and implementation skills necessary to solve problems using computer engineering principles and techniques. The program prepares students for productive, dynamic, and rewarding careers in computer engineering and for entry into graduate programs.

## **PROGRAM EDUCATIONAL OBJECTIVES**

The Computer Engineering program has established the following Program Educational Objectives:

- A. Technical Growth: Graduates will integrate into the local and global computer engineering workforce and contribute to the economy of California and the nation.
- B. Professional Skills: Graduates will demonstrate the professional skills necessary to be competent employees and assume/undertake leadership roles in their communities and/or profession. Qualified graduates will pursue advanced study if desired.
- C. Professional Attitude and Citizenship: Graduates will become productive citizens, who make sound engineering or managerial decisions, and have enthusiasm for the profession and professional growth.

## STUDENT OUTCOMES

Upon completion of the degree program, graduate of the Computer Engineering program must demonstrate:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## ADVISEMENT

CSUF offers academic advisement to all students. It gives you the opportunity to review your progress toward your degree and to discuss electives consistent with your career goals.

It is mandatory that you seek advisement at least once a year; otherwise, your registration will be put on hold. Appointments may be scheduled by calling the Computer Engineering Program office. Appointment sign-in sheets for advising are also available in the Computer Engineering Program office.

Be sure to follow the course requirements for your catalog year. Your catalog year is determined by the Admissions Office and is a part of your student records. Typically, this is the year you began college; although occasionally an advisor may approve a later year.

### *First-Time Freshmen*

The College of Engineering and Computer Science (ECS) sponsors orientation sessions for first-year students covering the registration procedures, university policies, general education, and major program requirements. Advisers are available to assist you in selecting your initial coursework. Orientations are scheduled during the Fall and Spring semesters. Please contact the Dean's office, College of Engineering and Computer Science, for the specific dates.

### *Credit by Examination*

If you do not have the material to prove the equivalency of a course, you may challenge that course by examination. To challenge a course by examination, pick up a CREDIT BY EXAMINATION form from the Program office and obtain:

- a) the approval of the adviser and the Program Coordinator
- b) register for the course and take the Challenge Exam before the third week of the semester from the instructor teaching that course.

Upon successful completion of the examination, the instructor will report the grade of CR. Students who fail the examination must continue the course for credit.

# ADMISSION REQUIREMENTS

## *General Requirements:*

At the time of admission into the program, students must:

- Be CSUF eligible for entering freshman;
- Have a minimum high school GPA (unweighted) of 3.0;
- And have successfully completed at least three AP courses (defined as receiving a score of 3, 4 or 5) towards the major and/or general education (total of 10 semester credits);
  - One of the three AP courses must be Mathematics/Calculus AB or Mathematics/Calculus BC (score of 4 or 5 is required).

## *Additional Information for International Students:*

International students must meet all the requirements listed above in the Admission Requirements. Verification of English proficiency and financial resources will be governed by the criteria established by the university.

All international students must submit their TOEFL score before they can be admitted to the program. The minimum score of 500 on the paper-based TOEFL exam or 61 on the internet-based TOEFL exam is required as they are admitted to the cohort program as freshmen.

# DEGREE REQUIREMENTS

The students in the program must complete all the requirements for the BS and the MS degree with a total of 150 semester units. The cohort degree program requires students to enroll during the summer sessions of the first and second year (total of 18 units).

The 150 units required for the 4-Year Integrated BS/MS Degree Program in Computer Engineering include 31 units of foundation courses in mathematics and science, 42 units of courses (24 unduplicated units) in General Education, 74 units of required core courses in the major, and 21 units of elective courses. Courses are designated as CPSC for computer science courses, EGCP for computer engineering courses, EGEE for electrical engineering courses, and EGGN for general engineering courses.

## *Minimum Academic Requirements*

Degree program participants should maintain a minimum cumulative GPA of 3.0 every semester. Participants failing to do so will be placed on probation for two semesters. Failure to raise the cumulative GPA to 3.0 after the probationary period will result in termination from the integrated BS/MS program. Students will be allowed to continue in the traditional 4-year BS program in Computer Engineering as long as they are eligible to continue in the program based on the criteria established for undergraduate programs at CSUF.

## *Required Courses (74 units)*

Core Courses	Description	Units
<b>Required core for the BS part of the BS/MS degree</b>		
CPSC 120	Introduction to Programming	3
CPSC 121	Programming Concepts	3
CPSC 131	Data Structures Concepts	3
CPSC 351	Operating Systems Concepts	3
EGCP 180	Digital Logic and Computer Structures	3
EGCP 280	Microcontrollers	3

EGCP 281	Designing with VHDL	2
EGCP 371	Modeling and Simulation of Signals and Systems	3
EGCP 381	Computer Design and Organization	4
EGCP 401	Engineering Economics & Professionalism	3
EGCP 441	Advanced Electronics for Computer Engineers	4
EGCP 446	Advanced Digital Design using Verilog HDL	3
EGCP 450	Embedded Processor Interfacing	4
EGCP 470	Multidisciplinary Projects in Computer Engg. – I	2
EGCP 471	Multidisciplinary Projects in Computer Engg. – II	2
EGEE 203	Electric Circuits	3
EGEE 203L	Electric Circuits Laboratory	1
EGEE 303	Electronics	3
EGEE 303L	Electronics Laboratory	1
EGEE 323	Engineering Probability and Statistics	3
<b>Required core for the Graduate Study Plan</b>		
EGCP 456	Introduction to Logic Design in Nanotechnology	3
EGCP 461	Low Power Digital IC Design	3
EGCP 520	Advanced Computer Architecture	3
EGCP 541	Mixed-Signal IC Design	3
EGCP 542	VLSI Testing and Design for Testability	3
EGCP 556	Advanced Nanoelectronics	3

### ***Technical Electives (21 units)***

The technical electives shall constitute a coherent body of study consistent with the student's professional and educational objectives. Students take 21 units of advisor approved elective courses. Students choose a maximum of two “Group A” electives and minimum of three “Group B” electives, from a suggested list of courses. The 300 level courses from “Group A” electives will be allowed as an elective only at the BS level. A recommended list of elective courses is given below. This list is not a comprehensive list of all possible elective courses. Courses not on this list may count as electives only with advisor approval.

<b>Group A – Electives (300/400 Level Courses)</b>		
300 level allowed only at the BS level		
Only one 400 level elective on the Graduate Study Plan		
<b>Wireless Communication</b>		
CPSC 433	Data Security and Encryption Techniques	3
CPSC 471	Computer Communications	3
EGEE 443	Electronic Communication Systems	3
EGEE 460	Introduction to Cellular Mobile Communications Systems	3
<b>Very Large Scale Integration (VLSI) and Optics</b>		
EGEE 410	Electro-Optical Systems	3
EGEE 455	Microelectronics and Nano Devices	3
EGEE 465	Introduction to VLSI Design	3
EGEE 480	Optical Engineering and Communications	3
<b>Microprocessors and Microcomputer Systems</b>		
CPSC 459	Micro-Computer Software Systems	3
<b>Control Systems and Systems Engineering</b>		
EGEE 416	Feedback Control Systems	3
EGEE 424	Computer Simulation of Continuous Systems	3
EGEE 425	Introduction to Systems Engineering	3
<b>Global Positioning Systems (GPS)</b>		
EGEE 483	Introduction to Global Positioning Systems	3
EGEE 483L	Global Positioning System Laboratory	2
<b>Software Engineering</b>		
CPSC 362*	Foundations of Software Engineering	3
CPSC 462	Software Design	3
CPSC 463	Software Testing	3
CPSC 464	Software Architecture	3
CPSC 466	Software Process	3
<b>Database System Design</b>		
CPSC 332	File Structures and Database Systems	3
CPSC 431	Database and Applications	3
CPSC 473	Web Programming and Data Management	3
CPSC 474	Distributed Computing using Web Service and .NET Remoting	3
<b>Multimedia and Digital Game Development</b>		
CPSC 484	Principles of Computer Graphics	3
CPSC 486	Game Programming	3
CPSC 489	Game Development Project	3
<b>Intelligent Systems</b>		
CPSC 335*	Algorithm Engineering	3
CPSC 481	Artificial Intelligence	3
CPSC 483	Data Mining and Pattern Recognition	3
EGEE 430	Fuzzy Logic and Control	3
<b>Hardware Security</b>		
EGCP 447	Introduction to Hardware Security and Trust	3
<b>Others</b>		
EGCP 463	Current Topics in Computer Engineering	3
EGCP 499	Independent Study	1-3
EGGN 495*	Professional Practice	1-3

\*Not allowed on Graduate Study Plan



<b>Group B – Electives</b>		
CPSC 531	Advanced Database Management	3
CPSC 54	Systems and Software Standards and Requirements	3
CPSC 542	Software Verification and Validation	3
CPSC 543	Software Maintenance	3
CPSC 544	Software Process Definition	3
CPSC 545	Software Design and Architecture	3
CPSC 546	Software Project Management	3
CPSC 547	Software Measurement	3
CPSC 548	Professional, Ethical and Legal Issues for Software Engineers	3
CPSC 551	Operating Systems Design	3
CPSC 558	Advanced Computer Networking	3
CPSC 566	Advanced Computer Graphics	3
CPSC 583	Expert Systems Design Theory	3
CPSC 585	Artificial Neural Networks	3
EGCP 543	Advanced Secure Hardware Design	3
EGEE 510	Optics & Electromagnetics in Communications	3
EGEE 518	Digital Signal Processing I	3
EGEE 519A	Hypercube Multiprocessing and Applications	3
EGEE 519B	Multiprocessing and Computer Networks	3
EGEE 522	Spread Spectrum Communications	3
EGEE 523A	VLSI Technology and Integrated Circuits	3
EGEE 523B	Very Large-Scale Integrated Circuits	3
EGEE 526	Digital Control Systems	3
EGEE 527	Fault Diagnosis and Fault-Tolerant Design	3
EGEE 529	Principles of Neural Systems	3
EGEE 537	Satellite Communications	3
EGEE 557	Microprogramming and Embedded Microprocessors	3
EGEE 558A	Microprocessors and System Applications I	3
EGEE 558B	Microprocessors and System Applications II	3
EGEE 559	Introduction to Robotics	3
EGEE 580	Analysis of Random Signals	3

### ***Upper Division Writing Requirements***

The following two courses are required to fulfill the upper-division English writing requirement:

- EGCP 441 Advanced Electronics for Computer Engineers: Satisfies 1 unit toward upper-division writing requirement
- EGCP 471 Multidisciplinary Projects in Computer Engineering - II: Satisfies 2 units toward upper-division writing requirement

Written work for these courses must meet professional standards. Both courses must be passed with a grade of "C" (2.0) or better to satisfy the writing requirement.

### ***Mathematics and Science Foundation Courses (21 Units)***

Course	Description	Units
MATH 150A	Analytic Geometry and Calculus	4
MATH 150B	Analytic Geometry and Calculus	4
MATH 250A	Intermediate Calculus	4
MATH 250B	Introduction to Linear Algebra and Differential Equations	4
MATH 270A	Mathematical Structures I	3
Physics 225	Fundamental Physics: Mechanics	3

Physics 226	Fundamental Physics: Electricity and Magnetism	3
Physics 227	Fundamental Physics: Waves, Optics, and Modern Physics	3
Physics 225L, 226L, 227L	Fundamental Physics: Laboratory	1, 1,1

***General Education Requirements (42 Units; 24 Units Unduplicated)***

**Area A: Core Competencies (6 Units)**

1. Oral Communication (3 Units)
  - HONR 101B, HCOM 100, 102
2. Written Communication (3 Units)
  - English 101
3. Critical Thinking
  - Not applicable for engineering majors

**Area B: Scientific Inquiry and Quantitative Reasoning (15 Units)**

1. Physical Science (6 Units)
  - PHYS 225 and 226
2. Life Science
  - Not applicable for engineering majors
3. Laboratory Experience (2 Units)
  - PHYS 225L and 226L
4. Mathematics/Quantitative Reasoning (7 Units)
  - MATH 150A and 270A
5. Implications & Explorations in Mathematics & Natural Sciences
  - Not applicable for engineering majors

**Area C: Arts and Humanities (12 Units)**

1. Introduction to Arts (3 Units)
  - Art 101, 201A, 201B, 311, 312, Dance 101, Music 100, 101
2. Introduction to the Humanities (3 Units)
  - Any lower division course in this category listed in the current class schedule
3. Explorations in the Arts and Humanities (3 Units)
  - Any upper-division course in this category listed in the current class schedule
4. Origins of the World Civilizations (3 Units)
  - History 110A or 110B, 210A, 210B

**Area D: Social Sciences (9 Units)**

1. Introduction to the Social Sciences (3 Units)
  - EGCP/EGCE/EGEE 401
2. World Civilizations and Cultures
  - Not applicable for engineering majors
3. American History, Institutions and Values (3 Units)
  - AFRO 190, AMST 201, CHIC 190, HIST 180, 190, HONR 201A
4. American Government (3 Units)
  - HONR 201B, POSC 100
5. Explorations in Social Sciences
  - Not applicable for engineering majors

**Area E: Lifelong Learning and Self Development**

- Not applicable for engineering majors

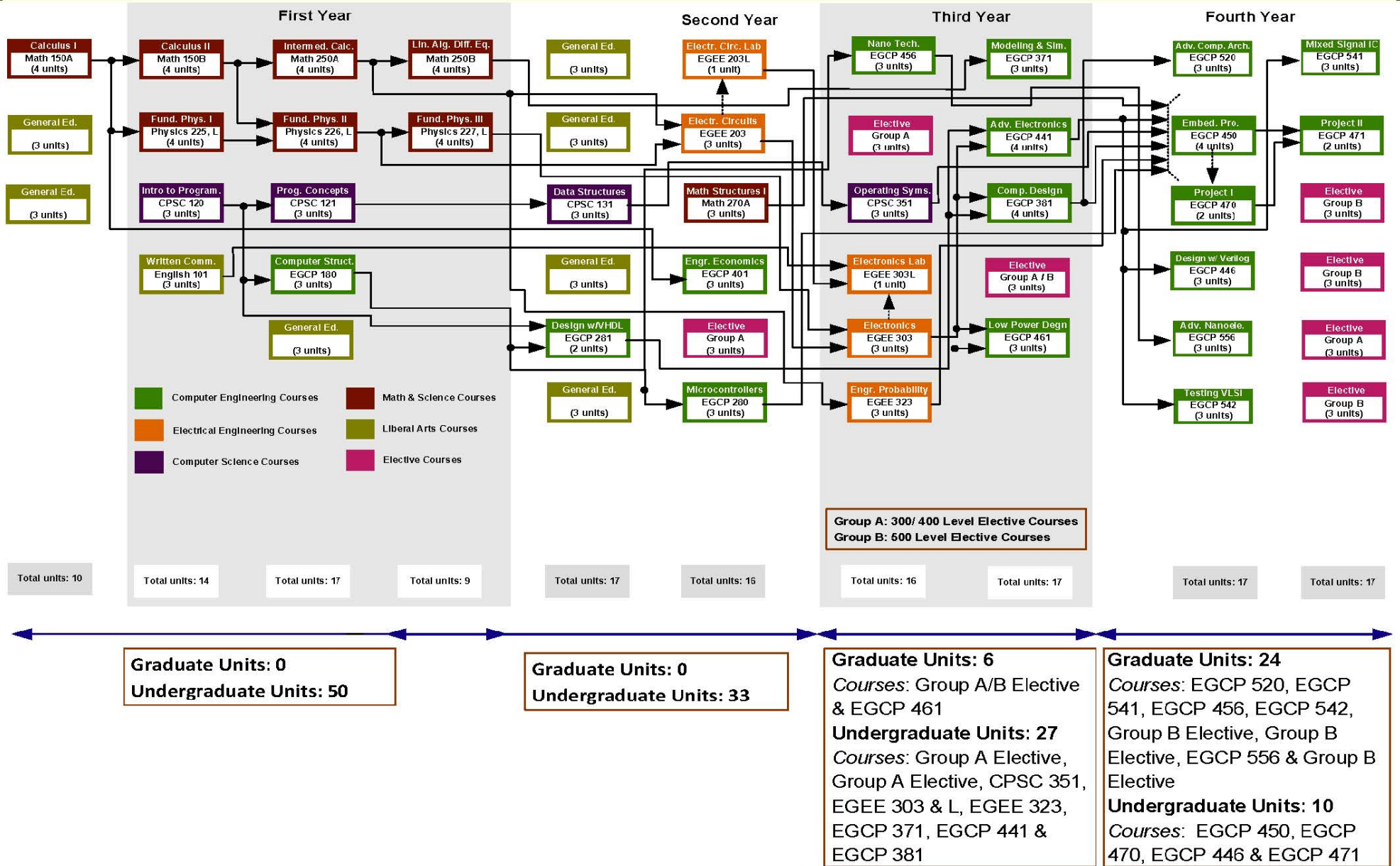
**Area Z: Cultural (3 Units)**

- Take at least one star (\*) course in Sections C.3 and D.5

***Requirement in Graduate Writing***

Competency in written communication in English must be demonstrated by a passing score on the California State University Examination in Writing Proficiency (EWP). The requirement must be satisfied before the student can be classified. Students who fail to pass the EWP test may complete ENGL 301 or ENGL 360 with a grade of “C” (2.0) or better as an alternative to the EWP requirement.

# Integrated BS/MS Degree in Computer Engineering, CSUF



## CLASSIFIED GRADUATE STANDING

Achievement of the Classified Graduate Standing status requires the following:

1. Approval of a formal Study Plan by the Computer Engineering Program Coordinator and Office of Graduate Studies;  
Students enrolled in the program must meet with an adviser prior to completing nine units toward the M.S. degree to develop a Study Plan. The study plan must be approved by the Program Coordinator and Office of Graduate Studies.
2. Satisfactory completion of no more than thirteen units on the Study Plan;
3. Fulfillment of university writing requirement.

Competency in written communication in English must be demonstrated by a passing score on the California State University Examination in Writing Proficiency (EWP). The requirement must be satisfied before the student can be classified. Students who fail to pass the EWP test may complete ENGL 301 or ENGL 360 with a grade of “C” (2.0) or better as an alternative to the EWP requirement.

## CULMINATING EXPERIENCE REQUIREMENTS

UPS 410.106, the culminating experience will be met through a comprehensive examination. However, students are given an option to use either:

Project (EGCP 597 - 3 units)  
OR  
Thesis (EGCP 598 - 6 units)

as their culminating experience. If a student chooses one of these options, the total credit hour requirement for the electives will be appropriately adjusted.

Students opting for graduate project option will be required to take two 500-level elective courses, while students opting for the thesis option will be required to take only one 500-level elective course. To enroll in EGCP 597 or EGCP 598, students must have Classified Graduate Standing. Students should file an approved proposal in the Computer Engineering program office no later than the last day of instruction of the preceding semester. For both project and thesis options, students are required to complete an oral defense, demo and a final report.

**Project (EGCP 597 – 3 units):** The experience includes a creative design effort with realistic socio economic constrains and development of skills such as, feasibility study, project planning, design formulation, time budgeting, oral, written and visual communication to document and disseminate the design adequately to others. The project requires students to think independently, research and brainstorm different project concepts before settling on a project that meets several criteria set forth by the Computer Engineering program. Students are provided with systematic faculty guidance during the project to ensure a well-rounded experience.

**Thesis (EGCP 598 – 6 units):** Student shall choose, in consultation with their faculty advisor, a thesis committee consisting of three faculty members. The thesis topic and proposal must be approved by the Faculty Advisor and the thesis committee prior to the student undertaking the research problem. The thesis should cover original research and be prepared according to the university guidelines. The thesis committee will judge the research competence of the student during the thesis defense. Thesis defense is announced in advance and open to the university community. Students are responsible for adhering to all due dates regarding the thesis defense, and submission of copies of the thesis.

## **OTHER INFORMATION**

The following are pertinent information and instructions that you may need during your course of study.

### ***Course Prerequisites and Corequisites***

It is your responsibility to make sure you satisfy the prerequisites and corequisites before signing up for a course. You will not be given credit if you take a course without satisfying the prerequisites. If you want to take a class for which you do not have the appropriate prerequisites, you need to fill out the “Prerequisite Waiver” petition form and submit it to the Computer Engineering Program office. If you feel you have the necessary background, you may take a challenge examination.

### ***Changing Technical Elective Courses***

To request a change, obtain the approval of the adviser and the program coordinator. Once the graduation check is completed, change of course(s) request will be denied unless you have serious and compelling reasons.

### ***Internships and Cooperative Education***

Learning takes place in many settings, not just the classroom. When you complete your educational career and are entering the professional job market for the first time, extensive professional experience can be highly beneficial. For this reason, CSUF and the Computer Engineering Program maintain an active internship program as a service to all students interested in obtaining employment while still in school.

Benefits of the internship program in Computer Engineering include:

- Paid work experience in the computer field.
- Job placement assistance from the Internship Office.
- Up to 3 units of technical elective credits.

We encourage you to use the internship program once you reach junior or senior status. To do so, follow these steps:

1. Visit the Center for Internships and Cooperative Education located in LH-209. Fill out and turn in the required forms along with your resume.
2. Wait for a position. This wait is three months on average, so be sure to plan in advance!
3. Once you secure a position, visit the Computer Engineering Program office and request enrollment in EGGN 495 – Professional Practice. This class may be repeated any number of times, for up to three units.

### ***Petition for Coursework Overload***

The maximum coursework for a semester is 18 units. Students may petition to take more than the maximum units. The adviser and the Program Coordinator must approve petition for course overload.

### ***GPA Calculation of Repeated Courses***

Normally, grades of all courses taken at CSUF are included in the calculation of the GPA. However, a student may petition to exclude the failed grades (F or D) of repeated courses. No more than 16 units may be petitioned.

### ***Student Clubs***

As a student member you can enhance your technical knowledge by becoming a member of one or more of the following clubs and by attending their seminars, conferences or symposiums, and subscribing to their technical magazines. Most are affiliated with local, regional, and national chapters, providing excellent opportunities for students to network with professionals in the field. Computer Engineering students are encouraged to become involved in one or more of the following student clubs:

- The IEEE Computer Society
- The Institute of Electrical and Electronics Engineers (IEEE)
- Association for Computer Machinery (ACM)
- Society of Mexican American Engineers & Scientists (MAES)
- National Society of Black Engineers (NSBE)
- Society of Hispanic Professional Engineers (SHPE)
- Society of Women Engineers (SWE)
- Tau Beta Pi (TBP – National Engineering Honor Society)
- Upsilon Pi Epsilon (UPE - International Honors Society for the Computing and Information Disciplines)

## **COURSE DESCRIPTIONS**

The 150 units required for the 4-Year Integrated BS/MS Degree Program in Computer Engineering include 31 units of foundation courses in mathematics and science, 42 units of courses (24 unduplicated units) in General Education, 74 units of required core courses in the major, and 21 units of elective courses. Courses are designated as CPSC for computer science courses, EGCP for computer engineering courses, EGEE for electrical engineering courses, and EGGN for general engineering courses.

### *Computer Engineering (EGCP) Courses*

#### **EGCP 180 Digital Logic and Computer Structures (3 units)**

Prerequisite: CPSC 120

Binary number system and arithmetic, computer codes, Boolean algebra, logic gates, K-map minimization, sequential circuits, memory devices, state diagram and table, computer architecture, memory, Arithmetic Logic Unit, and control unit. (2 hours lecture, 2 hours laboratory)

#### **EGCP 280 Microcontrollers (3 units)**

Prerequisite: EGCP 180

Microcontrollers, microcontroller programming model and instruction set, assembler directives, writing and debugging microcontroller assembly language routines, microcontroller memory system, microcontroller communication systems. (1 hour lecture, 4 hours laboratory)  
(Same as EGEE 280)

#### **EGCP 281 Designing with VHDL (2 units)**

Prerequisites: CPSC 120 or 121 and EGCP 180

Introduction to various modeling methods, timings, events, propagation delays and concurrency, the language constructs, data representations and formats, and physical attributes. (1 hour lecture, 2 hours laboratory) (Same as EGEE 281)

#### **EGCP 371 Modeling and Simulation of Signals and Systems (3 units)**

Prerequisite: Math 250B

Modeling and simulation of physical systems, mathematical description of systems, transfer functions, poles and zeros, frequency response, continuous and discrete-time convolution, continuous and discrete Fourier transforms, Laplace and Z transforms, Fast Fourier Transforms, simulation using Matlab.

#### **EGCP 381 Computer Design and Organization (4 units)**

Prerequisites: EGCP 281 and EGEE 303

Computer system, central processing unit (CPU) organization and design, instruction set and addressing modes, microprogrammed control unit design, cache memory, internal memory, virtual memory, input/output interfacing, parallel processors, superscalar processors. (2 hours lecture, 4 hours laboratory)

#### **EGCP 401 Engineering Economics & Professionalism (3 units)**

Prerequisites: Math 150A and Junior or senior standing in Engineering

Development, evaluation and presentation of design alternatives for engineering systems and projects using principles of engineering economy and cost benefit analysis. Study of engineering profession, professional ethics, and related topics. (Same as EGCE 401 & EGEE 401)



**EGCP 441 Advanced Electronics for Computer Engineers (4 units)**

Prerequisites: EGCP 281 and EGEE 303

High speed CMOS, biCMOS, CPLDs, FPGAs, A/D, D/A, transducers and optics; integration of these devices into complete systems. (2 hours lecture, 4 hours laboratory)

**EGCP 446 Advanced Digital Design using Verilog HDL (3 units)**

Prerequisite: EGCP 441

Fundamentals of Verilog programming, behavioral modeling using Verilog, structural modeling using Verilog, RTL design using Verilog, Shannon's decomposition, FPGA architecture, Digital design, synthesis and implementation using FPGA.

**EGCP 447 Introduction to Hardware Security and Trust (3 units)**

Prerequisite: EGCP 281

Hardware Trojan detection and isolation, physical and invasive attacks, side-channel attacks, physically unclonable functions, watermarking of Intellectual Property (IP) blocks, passive and active metering for prevention of piracy, access control.

**EGCP 450 Embedded Processor Interfacing (4 units)**

Prerequisites: EGCP 280, 381 and 441, EGEE 323, CPSC 351, Math 270A

Techniques of interfacing based on speed, timings, synchronization, noise, cross-talk, hazards and race conditions. Interfacing specifications of the processor data, address, and control buses. (2 hours lecture, 4 hours laboratory)

**EGCP 456 Introduction to Logic Design in Nanotechnology (3 units)**

Prerequisite: EGCP 180 or EGEE 245

Promising novel nanoelectronic technologies and logic primitives for such technologies, applicable basic logic design technique, design models for spatial dimensions, applicable world-level data structures, multilevel circuit design, testability and observability, tolerance and reliable computing. (Same as EGEE 456)

**EGCP 461 Low Power Digital IC Design (3 units)**

Prerequisites: EGCP 180 or EGEE 245; EGEE 303

Importance of low power design; analysis of power dissipation in digital integrated circuits; circuit-level low-power techniques, logic-level low-power techniques, and system-level low-power techniques. (Same as EGEE 461)

**EGCP 463 Current Topics in Computer Engineering (3 units)**

Prerequisites: junior/senior standing in computer engineering and consent of instructor

Topics of contemporary interest from the perspective of current research and development in computer engineering. Lectures by guest professionals.

**EGCP 470 Multidisciplinary Projects in Computer Engineering – I (2 units)**

Corequisite: EGCP 450

1st course in the 2-course senior design sequence. Students in teams will complete a hardware/software project, from conception through implementation and testing, under an instructor's supervision. Teams first explore technology issues related to the projects and then prepare complete design proposals.

**EGCP 471 Multidisciplinary Projects in Computer Engineering – II (2 units)**

Prerequisites: EGCP 450 and EGCP 470

2nd course in the 2-course senior design course in which students in teams will complete a hardware/software project under the supervision of the instructor. The development of design skill, based upon previous and current courses and laboratory experience, is emphasized. (4 hours laboratory)

**EGCP 499 Independent Study (1 – 3 units)**

Prerequisite: Application for independent study approved by the instructor and the Computer Engineering Program Coordinator

Independent study or research under the direction of a full-time faculty member. May be repeated for a maximum of 3 total units of credit.

**EGCP 520 Advanced Computer Architecture (3 units)**

Prerequisite: EGCP 381

Performance analysis and evaluation, limitations of scalar pipelines, superpipelined, superscalar and VLIW processing, parallelism in programs, memory and I/O systems, out-of-order execution, branch prediction, register and memory data flow techniques, Tomasulo's algorithm, COTS hardware accelerators, CUDA, GPU programming architecture.

**EGCP 541 Mixed-Signal IC Design (3 units)**

Prerequisite: EGCP 441

IC design techniques for: Op-amps, phase-locked loops (PLL), high-speed RF circuits, high-speed broadband circuits, clock/data recovery (CDR) circuits, analog and optical signal processing circuits, CMOS digital camera technologies.

**EGCP 542 VLSI Testing and Design for Testability (3 units)**

Prerequisite: EGCP 441

Fault model, equivalence and dominance, combinational and sequential circuit test generation, design for testability (DFT), test compression, memory testing and diagnosis, boundary scan, testing analog circuits, mixed-signal testing strategies, logic and mixed signal built-in self-test (BIST).

**EGCP 543 Advanced Secure Hardware Design (3 units)**

Prerequisites: EGCP 441 and 447

Secure hardware design and implementation at multiple levels of abstraction, cryptographic hardware primitives, cryptographic modules, trusted platforms, reverse engineering of cryptographic modules using passive attacks, active attacks and cryptanalytic techniques, countermeasures against reverse engineering.

**EGCP 556 Advanced Nanoelectronics (3 units)**

**Prerequisite: EGCP 456**

Novel nanoelectronic devices, CAD Analysis of nanoelectronic devices, Advanced MOSFETs—SOI, FinFETs, SiGe, carbon nanotubes and ribbons, nanowires, quantum devices: RTD, tunnel FET, qubits, nanomemory, DRAM, flash, M/F RAM, spin torque devices.

**EGCP 597 Project (3 units)**

Prerequisite: Consent of advisor. Classified graduate students only.

Project proposal must be approved prior to last day of class instruction of the preceding semester.

**EGCP 598 Thesis (6 units)**

Prerequisite: consent of advisor. Classified graduate students only.

Thesis proposal must be approved prior to last day of class instruction of the preceding semester.

**EGCP 599 Independent Graduate Research (1 - 3 units)**

Prerequisite: Application for independent study approved by the instructor and the Computer Engineering Program Coordinator. Independent study or research under the direction of a full-time faculty member. May be repeated for a maximum of 3 total units of credit.

*Computer Science (CPSC) Courses***CPSC 120 Introduction to Programming (3 units)**

Corequisite: Math 125

Introduction to the concepts underlying all computer programming: design and execution of programs; sequential nature of programs; use of assignment, control and input/output statements to accomplish desired tasks; use of functions and arrays. Structured programming methodologies. (1.5 hours lecture, 3 hours laboratory)

**CPSC 121 Programming Concepts (3 units)**

Prerequisite: CPSC 120 or passing score on Computer Science Placement Exam

Structure of algorithms; functions; strings and data types; pointers and linked structures; classes and objects; recursion; inheritance; polymorphism; exception handling; documentation. Object-oriented programming methodology. (2 hours lecture, 2 hours laboratory)

**CPSC 131 Data Structures Concepts (3 units)**

Prerequisite: CPSC 121 or sufficient score on the Computer Science Placement Exam

Review recursion. Data structures: lists, stacks, queues, linked structures, binary search trees and graphs. Algorithms: hashing, sorting and searching. Object-oriented implementation and applying data structures and algorithms.

**CPSC 332 File Structures and Database Systems (3 units)**

Prerequisite: CPSC 131

The fundamental theories and design of database systems, the Structural Query Language (SQL), and basic concepts and techniques on data organization in secondary storage. Topics include introduction to database systems, ER model, relational model, index structures, and hashing techniques.

**CPSC 335 Algorithm Engineering (3 units)**

Prerequisites: CPSC 131, Math 250B, and EGEE 323

Algorithm design using classical paradigms: exhaustive search, divide and conquer, reduction, dynamic programming and the greedy method. Asymptotic and experimental efficiency analysis. Problem hardness: lower bound, NP-completeness and decidability. Methods for circumventing hardness. Implementing algorithms to solve practical problems.

**CPSC 351 Operating Systems Concepts (3 units)**

Prerequisite: CPSC 131

Resource management, memory organization, input/output, control; process synchronization and other concepts as related to the objectives of multi-user operating systems.

**CPSC 362 Foundations of Software Engineering (3 units)**

Prerequisites: CPSC 131

Basic concepts, principles, methods, techniques and practices of software engineering. All aspects of software engineering fields will be covered briefly. Computer-Aided Software Engineering (CASE) tools are used.

**CPSC 386 Introduction to Game Design & Production (3 units)**

Prerequisite: CPSC 131

Current and future technologies and market trends in game design and production. Game technologies, basic building tools for games and the process of game design, development and production.

**CPSC 431 Database and Applications (3 units)**

Prerequisite: CPSC 332

Database design and application development techniques for a real-world system. Topics include system analysis, requirement specifications, conceptual modeling, logic design, physical design and web interface development. Develop projects using contemporary database management system and web-based application development platform.

**CPSC 433 Data Security and Encryption Techniques (3 units)**

Prerequisites: CPSC 351 and Math 250B

System security and encryption. Current issues in security, encryption and privacy of computer based systems.

**CPSC 459 Micro-Computer Software Systems (3 units)**

Prerequisite: CPSC 351

The design and implementation of software. Analysis of a micro-computer operating system and work on a team to implement a significant programming assignment.

**CPSC 462 Software Design (3 units)**

Prerequisite: CPSC 362

Concepts of software modeling, software process and some tools. Object-oriented analysis and design and Unified process. Some computer-aided software engineering (CASE) tools will be recommended to use for doing homework assignments.

**CPSC 463 Software Testing (3 units)**

Prerequisite: CPSC 362

Software testing techniques, reporting problems effectively and planning testing projects. Students apply what they learned throughout the course to a sample application that is either commercially available or under development.

**CPSC 464 Software Architecture (3 units)**

Prerequisite: CPSC 362

Basic principles and practices of software design and architecture. High-level design, software architecture, documenting software architecture, software and architecture evaluation, software product lines, and some considerations beyond software architecture.

**CPSC 466 Software Process (3 units)**

Prerequisite: CPSC 362

Practical guidance for improving the software development and maintenance process. How to establish, maintain and improve software processes. Exposure to some common process models, such as CMM, CMMI, PSP and TSP.

**CPSC 471 Computer Communications (3 units)**

Prerequisite: CPSC 351

Introduction to digital data communications. Terminology, networks and their components, common-carrier services, telecommunication facilities, terminals, error control, multiplexing and concentration techniques.

**CPSC 473 Web Programming and Data Management (3 units)**

Prerequisite: CPSC 332

Various techniques for developing Web-based database applications using software engineering methodology. Introduce concept and architecture of Web servers, Web database design techniques, client/server side programming, and Web applications tools and techniques.

**CPSC 474 Distributed Computing Using Web Service and .NET Remoting (3 units)**

Prerequisite: CPSC 473

Concepts of distributed computing and Web services, the applications of XML and Web services, distributed applications development techniques with Web services and .NET Remoting.

**CPSC 481 Artificial Intelligence (3 units)**

Prerequisite: CPSC 335

Use of computers to simulate human intelligence. Topics include production systems, pattern recognition, problem solving, searching game trees, knowledge representation and logical reasoning. Programming in AI environments.

**CPSC 483 Data Mining and Pattern Recognition (3 units)**

Prerequisite: CPSC 335

Classification techniques, discriminant functions, training algorithms, potential function theory, supervised and unsupervised learning, feature selection, clustering techniques, multidimensional rotations and rank ordering relations.

**CPSC 484 Principles of Computer Graphics (3 units)**

Prerequisites: CPSC 131, Math 150B, and Math 250B

Examination and analysis of computer graphics; software structures, display processor organization, graphical input/output devices, display files. Algorithmic techniques for clipping, windowing, character generation and viewpoint transformation.

**CPSC 486 Game Programming (3 units)**

Prerequisites: CPSC 386 and 484

Data structures and algorithms used for real-time rendering and computer game programming. Build upon existing mathematics and programming knowledge to create interactive graphics programs.

**CPSC 489 Game Development Project (3 units)**

Prerequisite: CPSC 486

Individually or in teams, student design, plan and build a computer game.

### **CPSC 531 Advanced Database Management (3 units)**

Prerequisite: CPSC 431

Implementation techniques for query analysis, data allocation, concurrency control, data structures, and distributed databases. New database models and recent developments in database technology. Student projects directed to specific design problems.

### **CPSC 541 Systems and Software Standards and Requirements (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

SESC framework and the IEEE Software Engineering Standards. Covers establishing the following standards: Software Life Cycle Processes, Work Product Standards, Process Standards, Requirement Analysis and Management and System Integration. Framework of CMMI introduced, and a number of practical lessons discussed.

### **CPSC 542 Software Verification and Validation (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

How to ensure that a high quality software product is developed. Theory and practice of software verification and validation (V&V), such as Software integrity levels, Minimum V&V tasks for each software integrity level, walkthroughs, inspections and Cleanroom. Software testing topics: white- and black-box testing, boundary value analysis, equivalence class partitioning, unit testing, functional testing and how to create test plans.

### **CPSC 543 Software Maintenance (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

Theory and practice of maintaining large-scale software and how to construct maintainable software. Maintenance framework, along with maintenance process, process management and maintenance measures. Topics include fundamentals of software change, implications of software change, maintenance process models, program understanding, reusability for maintenance, reverse engineering, maintenance testing, software configuration management and tools in maintenance.

### **CPSC 544 Advanced Software Process (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

Advanced guidance for defining and improving the software development process. Concepts of software maturity framework, principles of process improvement and software process assessment. Current topics such as CMMI and SCAMPI.

### **CPSC 545 Software Design and Architecture (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

Advanced software design and architecture principles focusing a software engineering approach to the development process. Topics include architecture business cycle, quality attributes, attribute-driven design method, architectural styles, design patterns, software product lines and component-based design.

### **CPSC 546 Modern Software Management (3 units)**

Prerequisite: CPSC 362 or equivalent work experience

Modern project management methodologies and techniques. Software development process. Planning, estimating, organizing, directing, monitoring, controlling software projects and managing risks. Other related software management issues, such as infrastructure, quality software development, project and product metrics, and external factors.

**CPSC 558 Advanced Computer Networking (3 units)**

Prerequisite: CPSC 471

System-oriented view of computer network design, protocol implementation, networking, high-speed networking, network management, computer network performance issues.

**CPSC 566 Advanced Computer Graphics (3 units)**

Prerequisite: CPSC 484

Three-dimensional: reflection models, shading techniques, rendering process, parametric representation, ray tracing, radiosity, texture, anti-aliasing, animation, color science.

**CPSC 583 Expert Systems Design Theory (3 units)**

Prerequisite: CPSC 481

Knowledge representation and search strategies for expert systems; logic programming; expert system tools; project.

**CPSC 585 Artificial Neural Networks (3 units)**

Prerequisite: CPSC 481

Principles of neural networks; neural networks paradigms, software implementations, applications, comparison with statistical methods, use of fuzzy logic; project.

*Electrical Engineering (EGEE) Courses***EGEE 203 Electric Circuits (3 units)**

Prerequisites: Physics 226 and Math 250A. Corequisite: CPSC 120

Units; Ohm's and Kirchhoff's laws; mesh and nodal analysis, superposition; Thevenin and Norton theorems; RL and RC transients; phasors and steady state sinusoidal analysis; response as a function of frequency; current, voltage, and power relationships; polyphase circuits.

**EGEE 203L Electric Circuits Laboratory (1 unit)**

Prerequisite or Corequisite: EGEE 203

Simple resistive RL and RC circuits, electrical measurement techniques, verification of basic circuit laws through hard-wired breadboarding and CAD circuit simulation. (3 hours laboratory)

**EGEE 303 Electronics (3 units)**

Prerequisites: Physics 227 and EGEE 203

Characteristics and elementary applications of semiconductor diodes, field-effect transistors and bipolar-junction transistors, and operational amplifiers; mid-frequency small-signal analysis and design of transistors.

**EGEE 303L Electronic Laboratory (1 unit)**

Prerequisites: EGEE 203L and English101. Corequisite: EGEE 303

Semiconductor diodes, transistors and elementary electronic circuits through hard-wired breadboarding, CAD electronic simulation and analysis. (3 hours laboratory)

**EGEE 323 Engineering Probability and Statistics (3 units)**

Prerequisite: Math 250A or 270B

Set theory: axiomatic foundation of probability; random variables; probability distribution and density functions; joint, conditional and marginal distributions; expected values; distribution of functions of random variables; central limit theorem; estimation.

**EGEE 410 Electro-Optical Systems (3 units)**

Prerequisites: Physics 226, Math 250B, and EGEE 203

Introduction to electro-optics; optical radiation characteristics and sources; geometrical and physical optics; lasers and electro-optical modulation; quantum and thermal optical radiation detectors; detector performance analysis; electro-optical systems modeling and analysis; application examples.

**EGEE 416 Feedback Control Systems (3 units)**

Prerequisite: EGCP 371

Feedback control system characteristics; stability in the frequency and time domains; analysis and design of continuous-time systems using root-locus, Bode and Nyquist plots, Nichols chart and applications.

**EGEE 424 Computer Simulation of Continuous Systems (3 units)**

Prerequisites: CPSC 120 and EGCP 371

Using digital computer for simulation of physical systems modeled by ordinary differential equations; problem formulation, in-depth analysis of two integration methods, and the use of a general purpose system simulation program such as CSSL.

**EGEE 443 Electronic Communication Systems (3 units)**

Prerequisites: EGCP 441 and EGEE 323 or equivalent

Principles of amplitude, angular and pulse modulation, representative communication systems, the effects of noise on system performance.

**EGEE 455 Microelectronics and Nano Devices (3 units)**

Prerequisites: EGEE 303, Math 250B, and Physics 226

Quantum mechanical principles, crystal structure, energy band, carrier transport, carrier generation and recombination, p-n junction, bipolar transistor, MOSFET, MEFET and related devices, basic microwave and optoelectronic technology, crystal growth and fabrication, introduction to nano structure, nano devices and technology.

**EGEE 460 Introduction to Cellular Mobile Communications Systems (3 units)**

Prerequisite: EGEE 443 or equivalent

Introduction to wireless mobile telecommunications, description and analysis of cellular radio systems, co-channel interference reduction, channel capacity and digital cellular systems.

**EGEE 465 Introduction to VLSI Design (3 units)**

Prerequisites: EGCP 180 and 303

Computer-aided design of VLSI circuits. MOS device structure, design rules, layout examples, CMOS standard cells. Speed power trade off, scaling, device and circuit simulation. VLSI design software tools. Routing method system design, Design Project. Chip fabrication through MOSIS service, testing.

**EGEE 480 Optical Engineering and Communications (3 units)**

Prerequisites: EGEE 203, Math 250B, and Physics 227

Optics review, lightwave fundamentals, integrated optic waveguides, first design of fiber optic system, analog and digital modulation, digital fiber optic system design, baseband coding, digital video transmission in optical fiber, optical emitters and receivers, coherent optical communication, measurements in fiber optic telecommunication.



**EGEE 483 Introduction to Global Positioning Systems (GPS) (3 units)**

Corequisite: EGCP 371

Description of Global Positioning Systems (GPS) and Differential Global Positioning Systems (DGPS), GPS navigation, errors. Satellite signals and co-ordinate transform math. Modeling for position and velocity. Application to navigation.

**EGEE 510 Optics and Electromagnetics in Communications (3 units)**

Prerequisite: EGEE 480 or equivalent or consent of instructor

Plane-wave propagation and reflection from multiple layers; two- and three-dimensional boundary value problems; waveguides and resonant cavities; radiation from apertures and antennas; electromagnetic properties of materials, gases and plasmas; significant coverage of engineering applications.

**EGEE 518 Digital Signal Processing (3 units)**

Prerequisite: EGEE 420 or equivalent or consent of instructor

Discrete Fourier transform; fast Fourier transform; Chirp Z-transform; discrete time random signals; floating-point arithmetic; quantization; finite word length effect in digital filters; spectral analysis and power spectrum estimation.

**EGEE 522 Spread Spectrum Communications (3 units)**

Prerequisites: EGEE 443 and 580 or equivalent or consent of instructor

Introduction to Spread Spectrum (SS) Systems. Performance analysis of coherent digital signaling schemes. Synchronization. Direct sequence, frequency hopping, time hopping and Hybrid Spread Spectrum Modulations. Binary shift register sequences. Code tracking loops. Performance of SS systems in a jamming environment, with forward error correction.

**EGEE 523A VLSI and Nano Technology and Devices (3 units)**

Prerequisite: EGEE 455 or equivalent or consent of instructor

Silicon crystal, PN junction physics, oxide and interface physics, wafer fabrication technology; oxidation, diffusion, ion-implantation, epitaxy, photolithography, thin films process. Layout design principle for integrated circuits. Nano-electronic devices and technology.

**EGEE 523B CMOS VLSI Design (3 units)**

Prerequisites: EGEE 465 and EGEE 448 or equivalent or consent of instructor

Surface physics of MOS system, MOS device physics. Short channel effect; hot carrier effect, subthreshold conduction. CMOS fabrication process. Layout design rules. Scaling design and analysis of CMOS circuits. Standard cell method. CAD design and SPICE simulation.

**EGEE 526 Digital Control Systems (3 units)**

Prerequisite: EGEE 416 or equivalent or consent of instructor

Analysis, design and implementation of digital control systems; Z-transform methods; frequency domain and state-space approach for discrete-time systems.

**EGEE 537 Satellite Communications (3 units)**

Prerequisite: EGEE 443 or equivalent or consent of instructor

Satellite systems, link analysis, propagation effects, SNR/CNR calculations, modulation schemes, TDMA, FDMA, CDMA techniques.

**EGEE 557 Microprogramming and Embedded Microprocessors (3 units)**

Prerequisites: EGEE 412 and EGEE 448 or equivalent or consent of instructor

Introduction to microprogramming concepts and applications to the control unit of a computer, microprogrammable control, arithmetic-logic unit, implementation of an embedded process on FPGA and interfacing with external memories.

**EGEE 558A Microprocessors and System Applications I (3 units)**

Prerequisites: EGEE 404 and 404L or equivalent or consent of instructor

Microprocessors and micro-computers, their related software systems, system design with microprocessors, applications in peripheral controllers, communication devices and multiprocessing systems.

**EGEE 558B Microprocessors and Systems Applications II (3 units)**

Prerequisite: EGEE 558A or equivalent or consent of instructor

Advanced microprocessor architecture and their applications to microcomputer networking; RISC VS CISC architectures, communication protocol, distributed-operating system, and local area networks.

**EGEE 559 Introduction to Robotics (3 units)**

Prerequisite: EGEE 416 or equivalent or consent of instructor

Science of robotics from an electrical engineering standpoint, including modeling, task planning, control, sensing and robot intelligence.

**EGEE 580 Analysis of Random Signals (3 units)**

Prerequisites: EGEE 323 and 409 or equivalent or consent of instructor

Random processes pertinent to communications, controls and other physical applications, Markov sequences and processes, the orthogonality principle.

*General Engineering (EGGN) Course*

**EGGN 495 Professional Practice (1 – 3 units)**

Prerequisite: Junior or senior standing in engineering

Professional engineering work in industry or government. Written report required. May be repeated for credit any number of times, for up to three units.

*Related Courses for Computer Engineering Majors*

**MATH 150A & Math 150B Calculus (4, 4 units)**

Prerequisites: passing score ELM (Entry Level Mathematics Exam) or exemption; four years of high school mathematics including college algebra trigonometry, and Math 125 or equivalent or a passing score on the MQE (Mathematics Qualifying Exam) for MATH 150A. MATH150A is the only prerequisite for MATH 150B.

Analytic geometry, functions, limits, differentiation, the definite integral, techniques of integration, applications.

**MATH 250A Multivariate Calculus (4 units)**

Prerequisites: MATH 150A, B or equivalent

A continuation of MATH 150. Infinite series, Taylor's theorem, functions of several variables, partial differentiation, multiple integration.

**MATH 250B Introduction to Linear Algebra and Differential Equations (4 units)**

Prerequisite: MATH 250A

An introduction to the solutions of ordinary differential equations and their relationship to linear algebra. Topics include matrix algebra, systems of linear equations, vector space, linear independence, linear transformations and eigenvalues.

**MATH 270A Mathematical Structures I (3 units)**

Prerequisite: Four years high school mathematics

First of two semesters of fundamental discrete mathematical concepts and techniques needed in computer-related disciplines. Logic, truth tables, elementary set theory, proof techniques, and combinatorics.

**PHYS 225 Fundamental Physics: Mechanics (3 units)**

Prerequisite: MATH 150A. Concurrent enrollment in PHYS 225L required

Classical Newtonian mechanics; linear and circular motion; energy; linear/angular momentum; systems of particles; rigid body motion; wave motion and sound. (3 hours lecture)

**PHYS 226 Fundamental Physics: Electricity and Magnetism (3 units)**

Prerequisite: MATH 150B and PHYS 225 or equivalent. Concurrent enrollment in PHYS 226L required

Electrostatics, electric potential, capacitance, dielectrics, electrical circuits, resistance, EMF, electromagnetic induction, magnetism and magnetic materials, and introduction to Maxwell's equations. (3 hours lecture)

**PHYS 227 Fundamental Physics: Waves, Optics, and Modern Physics (3 units)**

Prerequisite: PHYS 226 or equivalent. Corequisite: enrollment in PHYS 227L laboratory except for Biochemistry, Chemistry and Mechanical Engineering majors who may enroll for 1 unit credit (optics component). All others must enroll for 3 units of credit.

Geometrical and physical optics, wave phenomena; quantum physics, including the photoelectric effect, line spectra and the Bohr atom; the wave nature of matter, Schroedinger's equation and solutions; the Uncertainty Principle, special theory of relativity.

**PHYS 225L, 226L, 227L Fundamental Physics Laboratory (1, 1, 1 unit)**

Concurrent enrollment in the corresponding PHYS 225, 226, 227 lecture required (3 hours laboratory). (Instructional fee required)

## **Computer Engineering Undergraduate (BS) Progress Worksheet**

The Computer Engineering BS Progress Worksheet will assist you to track your progress in the BS component of the Integrated BS/MS degree program in Computer Engineering. Use this worksheet to keep a record of the courses you have completed and for which you have transfer credits. Keep them up-to-date by entering the grades of the courses you have completed.

**Integrated BS/MS in Computer Engineering (150 Units total)  
BS Progress Worksheet**

Course	Title	CSUF			Transfer	
		Semester	Grade	Units	Institution	Course #
<b>Required Core for the BS part of the BS/MS degree (56 Units)</b>						
CPSC 120	Introduction to Programming					
CPSC 121	Programming Concepts					
CPSC 131	Data Structures					
CPSC 351	Operating Systems					
EGCP 180	Digital Logic & Comp.					
EGCP 280	Microcontrollers					
EGCP 281	Designing with VHDL					
EGCP 371	Mod. & Sim. Of Signals					
EGCP 381	Comp. Design & Org.					
EGCP 401	Engineering Econ & Prof					
EGCP 441	Advanced Electronics					
EGCP 446	Adv. Digital Design using Verilog HDL					
EGCP 450	Emb. Proc. Interfacing					
EGEE 203	Electric Circuits					
EGEE 203L	Electric Circuits Lab					
EGEE 303	Electronics					
EGEE 303L	Electronics Lab					
EGEE 323	Probability & Statistics					
<b>Senior Design Project Courses</b>						
EGCP 470	Multidisc. Projects I					
EGCP 471	Multidisc. Projects II					
<b>Upper Division Writing (3 Units; included in the Core)</b>						
EGCP 441	Advanced Electronics					
EGCP 471	Multidisc. Projects II					
<b>Math &amp; Science Course (31 Units)</b>						
Math 150A	Analytic Geom & Calc					
Math 150B	Analytic Geom & Calc					
Math 250A	Calculus					
Math 250B	Calculus					
Math 270A	Mathematical Struct. I					
Phys 225	Fund Phys, Mech					
Phys 225L	Fund Phys, Mech Lab					
Phys 226	Fund Phys, E&M					
Phys 226L	Fund Phys, E&M Lab					
Phys 227	Fund Phys, Modern					
Phys 227L	Fund Phys, Mod Lab					
<b>Technical Electives (9 Units; 12 units if CPSC 120 is waived)</b>						

## **Computer Engineering Graduate (MS) Study Plan**

The Computer Engineering Graduate Study Plan will assist you to track your progress in the MS component of the Integrated BS/MS degree program in Computer Engineering. Use this Study Plan to keep a record of the courses you have completed. Keep them up-to-date by entering the grades of the courses you have completed.



**Study Plan**

**Master of Science in Computer Engineering**

Name \_\_\_\_\_ Student ID No. \_\_\_\_\_ Date \_\_\_\_\_  
 Address \_\_\_\_\_ Home Phone: \_\_\_\_\_  
 \_\_\_\_\_ Z \_\_\_\_\_ Work Phone: \_\_\_\_\_  
 Campus Email \_\_\_\_\_

The following pre-classification requirements have been met:

1.  BA  BS  Other from \_\_\_\_\_ Month \_\_\_\_\_  
 Undergraduate Major: \_\_\_\_\_
2.  Major in computer engineering or a related discipline from ABET accredited school with  
 GPA of 2.5 in cumulative or last 60 units OR  
 If Bachelor's degree is not in computer engineering, satisfactory completion of additional
3. Writing Requirement has been met by \_\_\_\_\_

**ALL STATE AND UNIVERSITY REQUIREMENTS ARE TO BE MET INCLUDING FIVE-YEAR LIMIT**

<i>Study Plan Requirements</i>	<i>Units</i>	<i>Grade</i>	<i>Sem/Yr</i>	<i>Ext.</i>	<i>Comments</i>
<b>REQUIRED CORE COURSES (18 units)</b>					
EGCP 456 Intro to Logic Design in Nanotechnology	3				
EGCP 461 Low Power Digital IC Design	3				
EGCP 520 Advanced Computer Architecture	3				
EGCP 541 Mixed Signal IC Design	3				
EGCP 542 VLSI Testing & Design for Testability	3				
EGCP 556 Advanced Nanoelectronics	3				
<b>ELECTIVES ( 6-12 units) (Maximum 3 units 400-level)</b>					
<b>CAPSTONE RESEARCH PROJECT (0-6 units)</b>					
EGCP 597 (3 units)					
EGCP 598 (6 units)					
Comprehensive Exam (0 units)					
<b>TOTAL UNITS REQUIRED</b>	<b>30</b>	<b>(Minimum 21 units 500-level)</b>			

CLASSIFIED STANDING recommended by committee (prerequisites met and Study Plan approved):

Members: \_\_\_\_\_  
 Faculty \_\_\_\_\_ Department \_\_\_\_\_  
 Adviser \_\_\_\_\_ Date \_\_\_\_\_ Adviser \_\_\_\_\_ Date \_\_\_\_\_  
 Reviewed in Graduate Office \_\_\_\_\_ Date \_\_\_\_\_  
 CLASSIFIED GRADUATE STANDING \_\_\_\_\_ Date \_\_\_\_\_  
 Associate Vice President,