CSUF | Electrical and Computer Engineering
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

BLENDED BACHELOR AND MASTER OF SCIENCE IN COMPUTER ENGINEERING

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Electrical & Computer Engineering Department

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COMPUTER ENGINEERING PROGRAM
BLENDED BACHELOR AND MASTER OF SCIENCE HANDBOOK
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INTRODUCTION

The Blended Computer Engineering Bachelor of Science-to-Master of Science provides 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 with 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. The B.S.-M.S. is a unique and attractive program that provides an accelerated route to completing both bachelor's and master's degrees in four years, thereby saving both time and resources.

In addition to the requirements for the major, students must meet all other university requirements for the bachelor's and master's degrees. Please consult the Graduation Requirements for the Bachelor's Degree section in the catalog for complete information. For university requirements regarding the master's degree, please consult the Graduate Regulations section in this catalog for complete information.

The Bachelor of Science degree in Computer Engineering (CpE) at CSUF is accredited by the Engineering Accreditation Commission of ABET.

PROGRAM MISSION STATEMENT

The BS-MS program in Computer Engineering provides students with a strong theoretical and practical foundation in both hardware and software aspects of computer-based systems. It emphasizes engineering analysis, design, and implementation skills essential for solving real-world problems using computer engineering principles. The program prepares students for dynamic, rewarding careers in computer engineering as well as for continued study in graduate programs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

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

A. Technical Growth: Graduates will be successful in modern engineering practice, integrate into the local and global workforce, and contribute to the economy of California and the nation.
B. Professional Skills: Graduates will continue to demonstrate the professional skills necessary to be competent employees, assume leadership roles, and enjoy career success and satisfaction.
C. Professional Attitude and Citizenship: Graduates will become productive citizens with high ethical and professional standards, make sound engineering or managerial decisions, and have enthusiasm for the profession and professional growth.

STUDENT OUTCOMES

Upon completion of the degree program, graduates 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, providing the opportunity to review progress toward your degree and discuss elective choices aligned with your career goals.

BS-MS students in the Computer Engineering (CpE) program are required to attend academic advising at least once per academic year. To ensure compliance, advising holds are placed on students' accounts: those with CWIDs ending in an odd number during the Fall semester, and those with CWIDs ending in an even number during the Spring semester.

For information on scheduling an appointment, visit the Electrical and Computer Engineering (ECE) website.

Be sure to follow the course requirements for your catalog year—the year typically corresponding to when you began college, as determined by the Admissions Office. In some cases, an advisor may approve a later catalog year.

First-Time Freshmen

The College of Engineering and Computer Science (ECS) sponsors orientation sessions for first-year students that cover registration procedures, university policies, general education, and major program requirements. Academic advisers are available to help students select their initial coursework. Orientation sessions are offered during both the Fall and Spring semesters. For specific dates, please contact the ECS Dean's Office.

Credit by Examination

If you are unable to provide materials proving course equivalency, you may challenge a course by examination. To do so:

1. Obtain a "Credit by Examination" form from the ECE Office.
2. Secure approval from both your advisor and the Department Chair.

3. Register for the course and take the Challenge Exam before the third week of the semester with the course instructor.

If you pass, the instructor will assign a grade of CR (Credit). If you fail, you must continue in the course to earn credit through regular completion.

ADMISSION REQUIREMENTS

- Entering freshmen must be CSUF-eligible.
- Must have a minimum high school GPA (unweighted) of 3.0.

Admission Requirements 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. Please consult the Office of Admission's International Graduate Eligibility Requirements website for current exam requirements.

GRADUATE STANDING - CLASSIFIED

Classified standing requires approval of a formal study plan by the computer engineering graduate adviser and Office of Graduate Studies. Students enrolled in the program must meet with an adviser prior to completing 13 units toward the MS degree to develop a study plan.

PLACEMENT EXAMINATION

Students with a working knowledge of a high-level programming language such as C++ are encouraged to take the Computer Science placement examination to qualify for a CPSC 120A and CPSC 120L waivers.

BS DEGREE REQUIREMENTS

Students in the program must complete all requirements for both the BS and MS degrees, totaling 138 semester units. The department recommends that students enroll in summer sessions during their first year, completing a total of 11 units (see flowchart).

The 138 units required for the 4-Year Blended BS-MS Degree Program in Computer Engineering include:

- 31 units of foundation courses in mathematics and science
- 45 units of General Education (GE) courses (24 unduplicated units)
- 74 units of required core courses in the major
- 9 units of elective courses

Courses are designated as follows: CPSC for computer science, EGEC for electrical and computer engineering, and EGGN for general engineering.

The blended Computer Engineering BS-MS program allows students to apply 12 units toward both the BS and MS degrees.

The following courses satisfy 9 units of required MS coursework and 9 units of BS electives: EGEC 447, EGEC 463, and EGEC 520.

The following course satisfies 3 units of required BS coursework and 3 units of MS electives: EGEC 451.

Minimum Academic Requirements

For the BS degree, all courses must be passed with a grade of "C-" or better. For the MS degree, all courses must be completed with a grade of "C" or better, and students must maintain an overall GPA of 3.0 or higher. If students do not meet these requirements, they may continue in the traditional 4-year BS program in Computer Engineering, provided they meet the eligibility requirements established for the undergraduate Computer Engineering program at CSUF. The program also satisfies the upper-division writing requirement; written work must meet professional standards, and students must pass the requirement with a grade of "C" (2.0) or better.

BS Degree Requirements (56 units)

All courses must be passed with a "C-" or better. See Note for exceptions.

- CPSC 120A* - Introduction to Programming Lecture (2)
- CPSC 120L* - Introduction to Programming Lab (1)
- CPSC 121A - Object Oriented Programming Lecture (2)
- CPSC 121L - Object-Oriented Programming Lab (1)
- CPSC 131 - Data Structures (3)
- EGEC 180 - Digital Logic and Computer Structures (3)
- EGEC 203 - Electric Circuits (3)
- EGEC 203L - Electric Circuits Laboratory (1)
- EGEC 280 - Microcontrollers (3)
- EGEC 281 - Designing with VHDL (2)
- EGEC 303 - Electronics (3)
- EGEC 303L - Electronics Laboratory (1)
- EGEC 323 - Engineering Probability and Statistics (3)
- EGEC 371 - Modeling and Simulation of Signals and Systems (3)
- EGEC 381 - Computer Design and Organization (4)
- EGEC 401 - Engineering Economics and Professionalism (3)
- EGEC 441† - Advanced Electronics for Computer Engineers (4)
- EGEC 446 - Advanced Digital Design using Verilog HDL (3)
- EGEC 450 - Embedded Processor Interfacing (4)
- EGEC 451 - Real-Time Operating Systems for Embedded Systems (3)
- EGEC 470 - Multidisciplinary Projects in Computer Engineering - I (2)
- EGEC 471† - Multidisciplinary Projects in Computer Engineering - II (2)

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* CPSC 120A and CPSC 120L are the introductory programming courses required for the major. They serve as prerequisites for CPSC 121A and CPSC 121L. These courses may be waived if the student has completed an equivalent programming course or passes the placement exam administered by the Computer Science Department. If CPSC 120A and CPSC 120L are waived, the student must take an additional course—approved by their academic advisor—to fulfill the 120-unit degree requirement.

† Satisfies the upper-division writing requirement. Written work must meet professional standards. Must pass both with a "C" (2.0) or better.

MS Degree Requirements (18 units)

All courses must be passed with a "C" or better and a 3.0 overall GPA.

Required (12 units)

- EGEC 447 - Introduction to Cyber-Physical Systems Security (3)
- EGEC 463 - Current Topics in Computer Engineering (3)
- EGEC 520 - Advanced Computer Architecture (3)
- EGEC 540 - Computer Arithmetic Structures (3)

Culminating Experience (6 units)

- EGEC 598 - Thesis (1-6) (must take 6 units in 3-unit intervals)
  or
- EGEC - 543 Advanced Cyber-Physical Systems Security (3) *and*
- EGEC 597 - Project (3)
  or
- EGEC 543 - Advanced Cyber-Physical Systems Security (3) *and*
- EGEC 548 - Real-Time Audio and Language Processing (3) *and*
- Comprehensive Exam (0)

BS and MS Electives (9 units)

Courses not on the list may count as electives only with adviser approval. Master's students must select 500-level courses.

- CPSC 531 - Advanced Database Management (3)
- CPSC 535 - Advanced Algorithms (3)
- CPSC 541 - Systems and Software Standards and Requirements (3)
- CPSC 542 - Software Verification and Validation (3)
- CPSC 543 - Software Maintenance (3)
- CPSC 544 - Advanced Software Process (3)
- CPSC 545 - Software Design and Architecture (3)
- CPSC 546 - Modern Software 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 552 - Cyber Forensics (3)
- CPSC 558 - Advanced Computer Networking (3)
- CPSC 566 - Advanced Computer Graphics (3)
- CPSC 583 - Knowledge Representation and Reasoning (3)
- CPSC 585 - Neural Networks, Deep Learning, and Reinforcement Learning (3)
- EGEC 441 - Advanced Electronics for Computer Engineers (4)
- EGEC 446 - Advanced Digital Design using Verilog HDL (3)
- EGEC 447‡ - Introduction to Cyber-Physical Systems Security (3)
- EGEC 450‡ - Embedded Processor Interfacing (4)

‡ Not eligible as an elective for an MS degree

- EGEC 451 - Real-Time Operating Systems for Embedded Systems (3)
- EGEC 456 - Introduction to Logic Design in Nanotechnology (3)
- EGEC 461 - Low Power Digital IC Design (3)
- EGEC 463‡ - Current Topics in Computer Engineering (3)
- EGEC 543§ - Advanced Cyber-Physical Systems Security (3)
- EGEC 548§ - Real-Time Audio and Language Processing (3)
- EGEC 510 - Optics and Electromagnetics in Communications (3)
- EGEC 518 - Digital Signal Processing I (3)
- EGEC 520 - Advanced Computer Architecture (3)
- EGEC 522 - Spread Spectrum Communications (3)
- EGEC 523A - VLSI and Nano Technology and Devices (3)
- EGEC 523B - CMOS VLSI Design (3)
- EGEC 526 - Digital Control Systems (3)
- EGEC 529 - Principles of Neural Systems (3)
- EGEC 537 - Satellite Communications (3)
- EGEC 557 - Microprogramming and Embedded Microprocessors (3)
- EGEC 558B - Microprocessors and Systems Applications II (3)
- EGEC 559 - Introduction to Robotics (3)
- EGEC 580 - Analysis of Random Signals (3)

Requirements in Related Fields (31 units)

All mathematics and science courses must be passed with a "C-" or better to count as prerequisite courses for engineering courses or as credit towards the degree.

Mathematics (19 units)

- MATH 150A - Calculus I (4)
- MATH 150B - Calculus II (4)
- MATH 250A - Calculus III (4)
- MATH 250B - Introduction to Linear Algebra and Differential Equations (4)
- MATH 170A - Mathematical Structures I (3)

Science (12 units)

- PHYS 225 - Fundamental Physics: Mechanics (3)
- PHYS 225L - Fundamental Physics: Laboratory (1)
- PHYS 226 - Fundamental Physics: Electricity and Magnetism (3)
- PHYS 226L - Fundamental Physics: Laboratory (1)
- PHYS 227 - Fundamental Physics: Waves, Optics, and Modern Physics (1-3)
- PHYS 227L - Fundamental Physics: Laboratory (1)

General Education

All students at Cal State Fullerton are expected to complete prescribed units of General Education that are made up of courses outside of their chosen disciplines. Students seeking a degree in Engineering have been provided exceptions from some of the General Education requirements.

§ Not eligible as MS elective if taken for culminating experience

For this reason, it is important that students take the approved G.E. courses for Engineering majors that are found in their Titan Degree Audit (TDA). Additionally, they should confirm the G.E. courses that are required within their specific programs with their respective advisers.

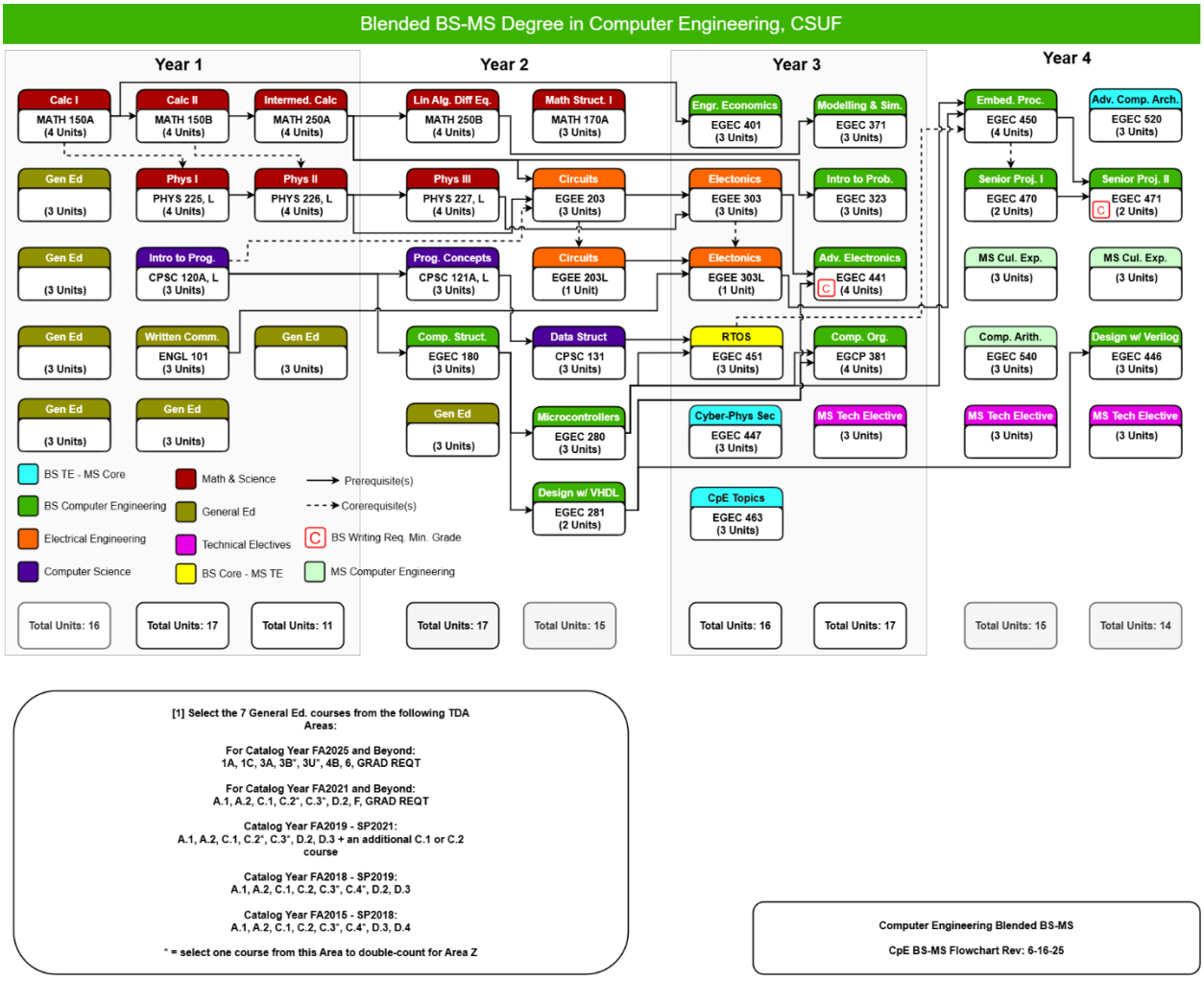
Graduation Requirement (3 units)

- HONR 201B - Honors Seminar: American Institutions and Values since 1877 (3)
- POSC 100 - American Government (3)

PROGRAM SCHEDULE PREPARATION

Recommended Schedule

To complete your coursework on schedule, it is essential to plan ahead by creating a semester-by-semester timetable. The 4-year curriculum flowchart for the Blended Bachelor and Master of Science in Computer Engineering, provided below, outlines a recommended timeline for completing the program in four years. This flowchart is carefully designed to ensure that all prerequisite requirements are satisfied in the proper sequence.



[1] Select the 7 General Ed. courses from the following TDA Areas:

For Catalog Year FA2025 and Beyond:
1A, 1C, 3A, 3B*, 3U*, 4B, 6, GRAD REQT

For Catalog Year FA2021 and Beyond:
A.1, A.2, C.1, C.2*, C.3*, D.2, F, GRAD REQT

Catalog Year FA2019 - SP2021:
A.1, A.2, C.1, C.2*, C.3*, D.2, D.3 + an additional C.1 or C.2 course

Catalog Year FA2018 - SP2019:
A.1, A.2, C.1, C.2, C.3*, C.4*, D.2, D.3

Catalog Year FA2015 - SP2018:
A.1, A.2, C.1, C.2, C.3*, C.4*, D.3, D.4

*** = select one course from this Area to double-count for Area Z**

Computer Engineering Blended BS-MS

CpE BS-MS Flowchart Rev: 6-16-25

OTHER INFORMATION

The following provides important information and instructions that may be helpful throughout your course of study.

Course Prerequisites and Corequisites

It is your responsibility to ensure that you have met all prerequisites and corequisites before enrolling in a course. You will not receive credit for a course taken without meeting its prerequisites. If you wish to enroll in a course without having completed the required prerequisites, you must submit a "Prerequisite Waiver" petition to the ECE Office. If you believe you possess the necessary background, you may also opt to take a challenge examination.

Changing Technical Elective Courses

To request a change, you must obtain approval from both your advisor and the department Chair. Once the graduation check has been completed, course change requests will be denied unless supported by serious and compelling reasons.

Internships and Cooperative Education

Learning occurs in many settings beyond the classroom. As you prepare to complete your education and enter the professional job market, gaining hands-on experience can be extremely valuable. To support this, CSUF and the ECE offer an active internship program for students seeking employment while still in school.

Benefits of the internship program include:

- Paid work experience in the computing field
- Job placement assistance through the Internship Office
- Up to 3 units of technical elective credit

We strongly encourage students to participate in the internship program once they reach junior or senior standing. For more information, please visit the ECS Academic Internship website.

Petition for Coursework Overload

The maximum course load for a semester is 18 units. Students who wish to exceed this limit must submit a petition for a course overload. Approval from both the advisor and the department Chair is required for the petition to be granted.

GPA Calculation for Repeated Courses

Normally, all courses taken at CSUF are included in the calculation of a student's GPA. However, students may petition to exclude grades of D or F from repeated courses. A maximum of 16 units may be excluded through this process.

Academic Notice and Disqualification

A student whose overall GPA and/or semester GPA falls below 2.0 will be placed on academic notice and have a registration hold placed on their account until they meet with the Program Academic Advisor and complete the online RESET Canvas course administered by the College of ECS. These steps must be completed before enrolling in the following semester. In most cases, repeating the course and petitioning to exclude the original grade from the GPA calculation will

remove the academic notice. Continued academic notice may result in disqualification from the program.

Student Clubs

As a student, you can enhance your technical knowledge and professional development by joining one or more of the following clubs. These organizations offer valuable opportunities to attend seminars, conferences, and symposiums, as well as to subscribe to technical publications. Most are affiliated with local, regional, and national chapters, providing excellent networking opportunities with professionals in the field. Computer Engineering students are strongly encouraged to get involved in one or more of the following student organizations:

- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Navigation (IoN)
- Association for Computing Machinery (ACM)
- Society of Mexican American Engineers and 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 Honor Society for the Computing and Information Disciplines)

COURSE DESCRIPTIONS

Electrical and Computer Engineering (EGEC) Courses

EGEC 180 - Digital Logic and Computer Structures (3)

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)

Prerequisites: CPSC 120

EGEC 203 - Electric Circuits (3)

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.

Prerequisites: PHYS 226, MATH 250A

Corequisite: CPSC 120 or EGME 205

EGEC 203L - Electric Circuits Laboratory (1)

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)

Prerequisite or Corequisite: EGEC 203

EGEC 280 - Microcontrollers (3)

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)

Prerequisite: EGEC 180 or EGEC 245

EGEC 281 - Designing with VHDL (2)

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)

Prerequisites: CPSC 120 or CPSC 121; EGEC 180 or EGEC 245

EGEC 303 - Electronics (3)

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.

Prerequisites: PHYS 227, EGEC 203

EGEC 303L - Electronics Laboratory (1)

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

Prerequisites: EGEC 203L, ENGL 101

Corequisite: EGEC 303

EGEC 323 - Engineering Probability and Statistics (3)

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.

Prerequisite: MATH 250A or MATH 170B

EGEC 371 - Modeling and Simulation of Signals and Systems (3)

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.

Prerequisite: MATH 250B

EGEC 381 - Computer Design and Organization (4)

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)

Prerequisite: EGEC 280, EGEC 281

EGEC 401 - Engineering Economics and Professionalism (3)

Development, evaluation, and presentation of design alternatives for engineering systems and projects using principles of engineering economy and cost-benefit analysis. Engineering profession, professional ethics, and related topics. (Not available for use on graduate study plans.) (EGEC 401, EGCE 401, and EGME 401 are the same course)

Prerequisites: MATH 150A; Engineering or Computer Science major; junior or senior standing

EGEC 410 - Electro-Optical Systems (3)

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.

Prerequisite: EGEC 311 or graduate standing

EGEC 416 - Feedback Control Systems (3)

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.

Prerequisite: EGEC 409; or graduate standing

EGEC 441 - Advanced Electronics for Computer Engineers (4)

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)

Prerequisite: EGEC 281, EGEC 303 both with a "C-" (1.7) or better.

EGEC 443 - Electronic Communication Systems (3)

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

Prerequisites: EGEC 310, EGEC 323

EGEC 446 - Advanced Digital Design using Verilog HDL (3)

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.

Prerequisite: EGEC 441

EGEC 447 - Introduction to Cyber-Physical Systems Security (3)

Hardware Trojan detection; physical and invasive attacks; side-channel attacks; intellectual property piracy; circuit obfuscation; passive and active metering; physical unclonable functions; cryptographic algorithms; introduction to cyber-physical systems and IoT security; security threats and vulnerabilities in cyber-physical systems.

Prerequisites: CPSC 223P, CPSC 240; or EGEC 281; or graduate standing

EGEC 450 - Embedded Processor Interfacing (4)

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

Prerequisites: EGEC 280, EGEC 303L

Corequisites: EGEC 451

EGEC 451 - Real-Time Operating Systems for Embedded Systems (3)

Fundamentals of Real-Time Operating Systems (RTOS) for embedded systems, including thread communication and synchronization, real-time scheduling, memory and process management, file systems and management, and commercially available RTOS. (2 hours lecture, 2 hours laboratory)

Prerequisites: CPSC 131, EGEC 280; or graduate standing

EGEC 455 - Microelectronics and Nano Devices (3)

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.

Prerequisites: EGEC 303, EGEC 311; or graduate standing

EGEC 456 - Introduction to Logic Design in Nanotechnology (3)

Promising novel nano-electronic technologies and logic primitives for such technologies, applicable basic logic design techniques, design models for spatial dimensions, applicable word-level data structures, multilevel circuit design, testability and observability, tolerance, and reliable computing.

Prerequisite: EGEC 180 or EGEC 245, both with a “C-” (1.7) or better; or Computer Engineering graduate standing

EGEC 460 - Introduction to Cellular Mobile Communications Systems (3)

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

Prerequisite: EGEC 323 or graduate standing

EGEC 461 - Low Power Digital IC Design (3)

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.

Prerequisites: EGEC 180 or EGEC 245; EGEC 303; all with a “C-” (1.7) or better

EGEC 463 - Current Topics in Computer Engineering (3)

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

Prerequisites: Engineering or Computer Science major; junior or senior standing

EGEC 465 - Introduction to VLSI Design (3)

Computer-aided design of VLSI circuits. MOS device structure, design rules, layout examples, and 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 the MOSIS service, testing.

Prerequisite: EGEC 245, EGEC 303, or graduate standing

EGEC 470 - Multidisciplinary Projects in Computer Engineering - I (2)

The first course in the two-course senior design sequence. Student teams develop 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.

Corequisite: EGEC 450

EGEC 471 - Multidisciplinary Projects in Computer Engineering - II (2)

Second course in the two-course senior design course in which student teams develop a hardware/software project under the supervision of the instructor. Develop design skills based upon previous and current courses and laboratory experience. (4 hours laboratory)

Prerequisite: EGEC 450, EGEC 470 both with a "C-" (1.7) or better

EGEC 480 - Optical Engineering and Communications (3)

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, optical emitters and receivers, coherent optical communication, measurements in fiber optic telecommunication.

Prerequisite: EGEC 311, PHYS 227; or graduate standing

EGEC 483 - Introduction to Global Positioning Systems (GPS) (3)

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.

Corequisite: EGEC 409 or EGEC 371

EGEC 497 - Senior Project (1-3)

Directed independent design project. May be taken for credit for a maximum of six units. Requires consent of adviser and instructor.

Department Consent Required

EGEC 499 - Independent Study (1-3)

Specialized topics in engineering selected in consultation with and completed under the supervision of the instructor. May be repeated for a maximum of 6 units. Requires approval of the study plan by the advisor.

Department Consent Required

EGEC 503 - Information Theory and Coding (3)

Information measures, probabilistic studies of the transmission and encoding of information, Shannon's fundamental theorems and coding for noisy channels.

Prerequisite: EGEC 323 or graduate standing

EGEC 504A - Linear Network Synthesis (3)

Synthesis of passive element driving-point and transfer-functions with emphasis on RC networks. Basic operational amplifier RC circuits and their performance limitations, introduction to second-order RC active filters. Parameter sensitivity analysis.

Prerequisite: EGEC 310 or graduate standing

EGEC 510 - Optics and Electromagnetics in Communications (3)

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.

Prerequisite: EGEC 480 or graduate standing

EGEC 518 - Digital Signal Processing I (3)

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.

Prerequisite: EGEC 420 or graduate standing

EGEC 520 - Advanced Computer Architecture (3)

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.

Prerequisite: EGEC 381 or graduate standing

EGEC 522 - Spread Spectrum Communications (3)

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. SS systems performance in a jamming environment, with forward error correction.

Prerequisites: EGEC 443, EGEC 580

EGEC 523A - VLSI and Nano Technology and Devices (3)

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

Prerequisite: EGEC 455 or graduate standing

EGEC 523B - CMOS VLSI Design (3)

Surface physics of MOS system and 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.

Prerequisites: EGEC 465, EGEC 448 or graduate standing

EGEC 526 - Digital Control Systems (3)

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

Prerequisite: EGEC 416 or graduate standing

EGEC 529 - Principles of Neural Systems (3)

Principles of neural systems and their hardware implementation. Basic properties, discrete and continuous bidirectional associative memories. Temporal associative memories. Neural nets classifiers, perceptrons, supervised and unsupervised learning. Forward and backward propagation. Electrical models of neural networks using op-amp., analog VLSI.

Prerequisites: EGEC 310, EGEC 409 or graduate standing

EGEC 531 - Digital Communication and Phase Locked Loop (3)

Theory of digital communications. Baseband modulation and demodulation/detection. Bandpass modulation/demodulation. Theory of noise and linear system. FM feedback principles. Theory and design of phase locked loops and their application in communication and control.

Prerequisite: EGEC 443 or graduate standing

EGEC 536 - Modern Power Systems (3)

Modern electrical power system containing interconnected generation, transmission and distribution subsystems. Mathematical foundations for analysis, such as per unit systems and symmetrical components. Power flow analysis, simulation, fault analysis, optimal power flow, microgrids and integration of renewable energy.

Prerequisites: EGEC 203, EGEC 215, EGEC 309, EGEC 313; or graduate standing

EGEC 537 - Satellite Communications (3)

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

Prerequisite: EGEC 443 or graduate standing

EGEC 540 - Computer Arithmetic Structures (3)

Suitability of signed binary number systems for high-speed arithmetic, normalized and denormalized binary floating-point representation formats, high-speed algorithms, implementations and design tradeoffs for fast arithmetic operations - addition, subtraction, multiplication and division, floating point arithmetic.

Prerequisite: EGEC 381; or Computer Engineering graduate standing

EGEC 541 - Mixed-Signal IC Design (3)

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.

Prerequisite: EGEC 441 or graduate standing

EGEC 542 - VLSI Testing and Design for Testability (3)

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).

Prerequisite: EGEC 441 or graduate standing

EGEC 543 - Advanced Cyber-Physical Systems Security (3)

Secure cyber-physical design and implementation; cryptographic hardware primitives; cryptographic modules; trusted platforms; reverse engineering of cryptographic modules using passive/active attacks; and cryptanalytic techniques, countermeasures against reverse engineering, threats to cyber-physical systems in various domains, such as network and IoT.

Prerequisite: EGEC 447

EGEC 548 - Real-Time Audio and Language Processing (3)

Introduction to designing, developing, and implementing audio and language processing algorithms, in real time, on dedicated processors.

Prerequisite: CPSC 121 and EGEC 371

EGEC 556 - Advanced Nanoelectronics (3)

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.

Prerequisite: EGEC 456 or graduate standing

EGEC 557 - Microprogramming and Embedded Microprocessors (3)

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.

Prerequisite: EGEC 448 or graduate standing

EGEC 558B - Microprocessors and Systems Applications II (3)

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

Prerequisite: EGEC 404 or graduate standing

EGEC 559 - Introduction to Robotics (3)

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

Prerequisite: EGEC 416 or graduate standing

EGEC 565 - Rapid Prototyping for Internet of Things (3)

Introduction to Internet of Things (IoT), IoT network architecture and design, application protocols for IoT, data and analytics for IoT, integration of embedded devices in web-based, distributed applications, and prototyping IoT devices.

Prerequisite: CPSC 121; or graduate standing

EGEC 570 - Introduction to Digital VLSI Logic Design and Computer Organization (3)

Introduction to digital VLSI design (MOSFETs, logic design, timing issues), FPGA design with HDL, computer architecture (CPU structure and function, instruction set).

Prerequisites: EGEC 180, EGEC 245; or Computer Engineering or Electrical Engineering graduate standing

EGEC 580 - Analysis of Random Signals (3)

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

Prerequisite: EGEC 323, EGEC 409 or graduate standing

EGEC 582 - Linear Estimation Theory (3)

Mathematical models of continuous-time and discrete-time stochastic processes; the Kalman filter, smoothing and suboptimal filtering computational studies.

Prerequisites: EGEC 580, EGEC 581

EGEC 597 - Project (3)

Project proposal must be approved prior to last day of class instruction of the preceding semester. Requires classified graduate status; consent of graduate program adviser and program coordinator.

Department Consent Required

EGEC 598 - Thesis (1-6)

Unless approved by the department chair, EGEC 598 cannot be taken if EGEC 597 has been completed. May be repeated for a maximum of 6 units. Requires consent of adviser. Classified graduate students only.

Department Consent Required

EGEC 599 - Independent Graduate Research (1-3)

Unless approved by department chair, EGEC 599 cannot be taken if EGEC 597 has been completed. May be repeated for a maximum of six units. Requires consent of adviser.

Department Consent Required

Computer Science (CPSC) Courses

CPSC 120A - Introduction to Programming (2)

Introduction to the concepts underlying computer programming to accomplish desired tasks, including: designing and executing programs; sequential nature of programs; using variables and assignment; control flow; input/output; designing and using functions; structured and object-oriented methodologies.

Corequisite: CPSC 120L, MATH 125 or MATH 116

CPSC 120L - Introduction to Programming Laboratory (1)

Introduction to the concepts underlying computer programming to accomplish desired tasks, including: designing and executing programs; sequential nature of programs; using variables and assignment; control flow; input/output; designing and using functions; Structured and object-oriented methodologies.

Corequisite: CPSC 120A, MATH 125 or MATH 116

CPSC 121A - Object-Oriented Programming (2)

Object-oriented programming paradigm, including classes, objects, member variables and functions, exceptions, inheritance, templates, encapsulation, decoupling and class design best practices. Advanced program design, including iterators, operator overloading, recursion and dynamic memory allocation.

Prerequisite: CPSC 120; or CPSC 120A and CPSC 120L; or passing score on Computer Science Placement Exam

Corerquisite: CPSC 121L

CPSC 121L - Object-Oriented Programming Laboratory (1)

Application of object-oriented programming concepts including classes, objects, member variables and functions, exceptions, inheritance, templates, encapsulation, decoupling, and class design best practices. Activities also include advanced program design including iterators, operator overloading, recursion, and dynamic memory allocation.

Prerequisite: CPSC 120; or CPSC 120A and CPSC 120L; or passing score on Computer Science Placement Exam

Corerequisite: CPSC 121A

CPSC 131 - Data Structures (3)

Classical data structures: vector, linked list, stack, queue, binary search tree, and graph representations. Worst-case analysis, amortized analysis, and big-O notation. Object-oriented and recursive implementation of data structures. Self-resizing vectors and self-balancing trees. Empirical performance measurement.

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

CPSC 531 - Advanced Database Management (3)

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 are directed to specific design problems. CPSC 431 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 535 - Advanced Algorithms (3)

Design and analysis of sophisticated algorithms and data structures. Lower, tight and pseudo-polynomial bounds. Randomization, approximation and special-purpose data structures. Algorithmic frameworks, such as maximum flow and linear programming. CPSC 335 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 541 - Systems and Software Standards and Requirements (3)

SESC framework and the IEEE Software Engineering Standards. Establishing the following standards: Software Life Cycle Processes, Work Product Standards, Process Standards, Requirement Analysis and Management and System Integration. Introduces CMMI framework; discuss number of practical lessons. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 542 - Software Verification and Validation (3)

Theory and practice of software verification and validation (V&V), including software integrity levels, minimum V&V tasks, walkthroughs, inspections and clean room. Topics include: white-box and black-box testing, boundary value analysis, equivalence class partitioning, unit testing, functional testing and test plans. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 543 - Software Maintenance (3)

Theory and practice of maintaining large-scale software. Maintenance framework, process, measures, and process management. Topics include fundamentals of software change and its implications, maintenance process models, reusability for maintenance, reverse engineering, maintenance testing, software configuration management and tools in maintenance. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 544 - Advanced Software Process (3)

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 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 545 - Software Design and Architecture (3)

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 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 546 - Modern Software Management (3)

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 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 547 - Software Measurement (3)

Current software measurement practices. Topics include: establishing an effective software metrics program; measuring software product, project and process; applying Statistical Process Control and other statistical techniques. High maturity concepts defined in CMMI model will be discussed. Stresses a practitioner-based approach. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 548 - Professional, Ethical and Legal Issues for Software Engineers (3)

Professional, legal and ethical issues pertaining to software engineering. Topics include professional codes of ethics, intellectual property laws, computer privacy and human-computer interaction. Relevant regulatory documents and their applications. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 551 - Operating Systems Design (3)

Professional, legal and ethical issues pertaining to software engineering. Topics include professional codes of ethics, intellectual property laws, computer privacy and human-computer interaction. Relevant regulatory documents and their applications. CPSC 362 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 552 - Cyber Forensics (3)

Introduction to principles and practices of cyber forensics. Topics include: developing an investigative capability; legal and IT requirements; forensic tools; incident response; live forensic investigations; seizure of digital information; operating system boot processes; and investigation of network traffic. CPSC 456 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 558 - Advanced Computer Networking (3)

System-oriented view of computer network design, protocol implementation, networking, high-speed networking, network management, computer network performance issues. CPSC 471 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 566 - Advanced Computer Graphics (3)

Three-dimensional: reflection models, shading techniques, rendering process, parametric representation, ray tracing, radiosity, texture, anti-aliasing, animation, color science. CPSC 484 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 583 - Knowledge Representation and Reasoning (3)

A field of artificial intelligence representing information about the world in a form that a computer system can use to solve complex tasks. Representing knowledge symbolically for automated reasoning; inference algorithms; logic programming; Semantic Web; reasoning under uncertainty; Requires project. CPSC 481 recommended.

Prerequisite: Computer Science or Computer Engineering graduate standing

CPSC 585 - Neural Networks, Deep Learning, and Reinforcement Learning (3)

Principles of artificial neural networks, designing network architectures, implementations and applications. Principles of reinforcement learning, frameworks, designing solutions, implementations and applications. Principles of deep learning and applications.

Prerequisite: Computer Science or Computer Engineering graduate standing

Related Courses for Computer Engineering Majors

MATH 150A - Calculus I (4)

Properties of functions. The limit, derivative and definite integral concepts; applications of the derivative, techniques and applications of integration. Six units of credit are given for both MATH 130 and MATH 150A, or for both MATH 135 and MATH 150A. Biology, geology and earth science majors who pass ALEKS must take MATH 130. CBE majors who pass ALEKS must take MATH 135.

Prerequisite: Passing score on ALEKS; or passing score or exemption on MQE; or MATH 125 with “C” (2.0) or better; or MATH 115, MATH 116, both with a “C” (2.0) or better; or MATH 115A, MATH 115B, MATH 116, all with a “C” (2.0) or better

MATH 150B - Calculus II (4)

Techniques of integration, improper integrals and applications of integration. Introduction to differential equations. Parametric equations, sequences and series.

Prerequisite: MATH 150A

MATH 250A - Calculus III (4)

Calculus of functions of several variables. Partial derivatives and multiple integrals with applications. Parametric curves, vector-valued functions, vector fields, line integrals, Green's Theorem, Stokes' theorem, the Divergence Theorem, vectors and the geometry of 3-space.

Prerequisite: MATH 106 or MATH 150B

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

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

Prerequisite: MATH 250A

MATH 170A - Mathematical Structures I (3)

First of two semesters of fundamental discrete mathematical concepts and techniques needed in computer-related disciplines. Logic, truth tables, elementary set theory, proof techniques, combinatorics, Boolean algebra, recursion and graph theory. Must have completed four years of high school mathematics.

PHYS 225 - Fundamental Physics: Mechanics (3)

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

Corequisites: MATH 150A, PHYS 225L

PHYS 225L - Fundamental Physics: Laboratory (1)

Laboratory for PHYS 225. Instructional fee required. (3 hours laboratory)

Corequisite: PHYS 225

PHYS 226 - Fundamental Physics: Electricity and Magnetism (3)

Electrostatics, electric potential, capacitance, dielectrics, electrical circuits, resistance, emf, electromagnetic induction, magnetism and magnetic materials, and introduction to Maxwell's equations.

Prerequisite: PHYS 225 with a "C" (2.0) or better

Corequisites: MATH 150B, PHYS 226L

PHYS 226L - Fundamental Physics: Laboratory (1)

Laboratory for PHYS 226. Instructional fee required. (3 hours laboratory)

Corequisite: PHYS 226

PHYS 227 - Fundamental Physics: Waves, Optics, and Modern Physics (1-3)

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.

Prerequisite: PHYS 226 with a C (2.0) or better

Corequisite: PHYS 227L, except for Biochemistry, Chemistry and Mechanical Engineering majors, who may enroll for one unit (optics component); all others must enroll for three units

PHYS 227L - Fundamental Physics: Laboratory (1)

Laboratory for PHYS 227. Instructional fee required. (3 hours laboratory)

Corequisite: PHYS 227

Disclaimer

This handbook is intended as a quick reference for students pursuing the Blended Bachelor and Master of Science in Computer Engineering. In the event of any discrepancies between the contents of this handbook and official College or University documents (such as the University Catalog), the most recent version of the relevant College and/or University documents shall take precedence.