specialized professional training at the advanced level and to provide necessary breadth to the student’s overall program of studies. This provides the basis for lifelong learning.

2. Experienced in-depth training in state-of-the-art specialty areas in electrical engineering. This is implemented through our senior electives. Students are required to take two sequences of at least two courses each at the senior level.

3. Benefited from imaginative and highly supportive laboratory experiences where appropriate throughout the program. The laboratory experience will be closely integrated with coursework and will make use of up-to-date instrumentation and computing facilities. Students should experience both hardware-oriented and simulation-oriented exercises.

4. Experienced design-oriented challenges that exercise and integrate skills and knowledge acquired in several courses. These may include design of components or subsystems with performance specifications. Graduates should be able to demonstrate an ability to design and conduct experiments as well as analyze the results.

5. Learned to function well in teams. Also, students must develop communication skills, written and oral, both through team and classroom experiences. Skills including written reports, webpage preparation, and public presentations are required.

6. Completed a well-rounded and balanced education through required studies in selected areas of fine arts, humanities, and social sciences. This provides for the ability to understand the impact of engineering solutions in a global and societal context. A course in engineering ethics is also required of all undergraduates.

Undergraduate Program

Bachelor of Science—Electrical Engineering

A minimum of 189 units is required for graduation. A complete list of requirements for the major can be found on page 52. Schedules should be planned to meet both General Education and major requirements.

The department academic advisor can suggest a recommended study plan for electrical engineering freshmen and sophomores. Each student is assigned a departmental faculty advisor who must be consulted in planning the junior and senior year programs.

The required 32 units (8 courses) of departmental electives are taken primarily in the senior year, and they permit students to develop depth in specialty areas of their choice. The 32 units of departmental electives must include at least 2 sequences, one of which must be an approved EE Senior Capstone Design/Project course sequence. A student’s elective course program must be approved by a departmental faculty advisor. The advisor will check the program to ensure satisfaction of the departmental requirements. A wide variety of elective programs will be considered acceptable.

Three matters should be noted: (1) students who fail to attain a grade-point average of at least 2.0 in the major may be denied the privilege of continuing in the major, (2) a large majority of electrical and computer engineering courses have prerequisites which must be completed successfully. Successful completion of prerequisite courses means receiving a grade of C- or better in prerequisite courses except for Mathematics 3A-B, Mathematics 4A-B and Mathematics 6A and 6B which require a grade of C or better to apply these courses as prerequisites, (3) courses required for the pre-major or major, inside or outside of the Department of Electrical Engineering, cannot be taken for the passed/not passed grading option. They must be taken for letter grades.

Bachelor of Science—Computer Engineering

This major is offered jointly by the Department of Computer Science and the Department of Electrical and Computer Engineering. For information about this major, see page 25.

Electrical & Computer Engineering Courses

Many of the ECE courses are restricted to ECE majors only. Instructor and quarter offered are subject to change.

LOWER DIVISION

1A. Computer Engineering Seminar

Prerequisite: Open to computer engineering majors only. Seminar: 1 hour

Introductory seminar to expose students to a broad range of topics in Computer Engineering.

1B. Ten Puzzling Problems in Computer Engineering

Prerequisite: (1) YORK 1P

Gain familiarity with, and motivation to study, the field of computer engineering, through puzzle-like problems that represent a range of challenges facing computer engineers in their daily problem-solving efforts and at the frontiers of research.

2A. Circuits, Devices, and Systems

Prerequisites: Mathematics 3A-B, and Mathematics 3C or 4A or Math 4B or 4AI with a minimum grade of C; and, Physics 1 or 4BI with a minimum grade of C (may be taken concurrently); Mathematics 5A or 4B with a minimum grade of C (may be taken concurrently); Physics 3 or 23 (may be taken concurrently); open to electrical engineering, computer engineering, and pre-computer engineering majors only. Lecture, 3 hours; laboratory, 4 hours.

Introduction to basic circuit analysis. KCL, KVL, nodal analysis, superposition, independent and dependent sources; diodes and I-V characteristics; basic op-amp circuits; first-order transient analysis; AC analysis and phasors. Introduction to the use of test instruments.

2B. Circuits, Devices, and Systems

Prerequisites: ECE 2A with a grade of C- or better; open to electrical engineering, computer engineering, and pre-computer engineering majors only. Lecture, 3 hours; laboratory, 4 hours.

Second order circuits. Laplace transform and solution of steady state and transient circuit problems in the s-domain: Bode plots; Fourier series and transforms; filters. Transistor as a switch; load lines; simple logic gates; latches and flip-flops.

2C. Circuits, Devices, and Systems

Prerequisites: ECE 2B with a grade of C- or better (may be taken concurrently); open to electrical engineering, computer engineering, and pre-computer engineering majors only. Lecture, 3 hours; laboratory, 4 hours.

Two-port network parameters; small-signal models of nonlinear devices; transistor amplifier circuits; frequency response of amplifiers; non-ideal op-amps; modulation, bandwidth, signals; Fourier analysis.

3. Introduction to Electrical Engineering

Prerequisites: Open to EE majors only. Lecture, 3 hours; laboratory, 2 hours

Introduction to fundamental design problems in Electrical Engineering through programming in Python. Includes basics of software engineering, algorithm design, data structures, with design problems derived from signals systems. Specific areas will include 1-D and 2-D signal processing, basic transformations and applications.

4. Design Project for Freshmen

Prerequisites: Mathematics 3A-B and Mathematics 3C or 4A and Physics 1 with minimum grades of C; Engineering 3 with a minimum grade of C-. Lecture, 3 hours; laboratory, 3 hours.

This first course on design gives an intuitive introduction to engineering design. Learn how to take an idea of a system and convert it to a working model. Use hardware and software for building a system.

5. Introduction to Electrical & Computer Engineering

Prerequisite: Open only to Electrical Engineering and Computer Engineering majors. Lecture: 2 hours; laboratory: 3 hours

Aims at exposing freshmen students to the different sub-fields within Electrical and Computer Engineering. Composed of lectures by different faculty members and a weekly laboratory based on projects that are executed using the Arduino environment.

10A. Foundations of Analog and Digital Circuits & Systems

Prerequisite: Mathematics 2A-B or 3A-B or Mathematics 3AH-3BH, and Mathematics 3C or 4A or 4AI with a minimum grade of C; and, Math 4B or 4BI with a minimum grade of C (may be taken concurrently); Physics 3 or 23 (may be taken concurrently); open only to electrical engineering and computer engineering majors. Lecture: 3 hours; laboratory: 3 hours

Introduction to basic circuit analysis. KCL, KVL, nodal analysis, superposition, independent and dependent sources; diodes and I-V characteristics; basic op-amp circuits; first-order transient analysis; AC analysis and phasors. Introduction to the use of test instruments.

10AL. Foundations of Analog and Digital Circuits and Systems Lab

Not open for credit for those who have received a C- or higher in ECE 2A.

The objective of the course is to establish the foundations of analog and digital circuits. The course will introduce the student to the power of abstraction, resistive networks, network analysis, nonlinear analysis and the digital abstraction.
10B. Foundations of Analog and Digital Circuits and Systems

Prerequisite: ECE 10A with C- or better grade. Lecture: 3 hours
Not open for credit for those who have received a C- or higher in ECE 2B.

The objective of the course is to introduce the MOSFET both as a simple digital switch and as controlled current source for analog design. The course will cover basic digital design, small signal analysis, charge storage elements and operational amplifiers. (W)

10BL. Foundations of Analog and Digital Circuits and Systems Lab

Prerequisite: ECE 10B (may be taken concurrently) with a C- or better grade. Laboratory: 4 hours
Not open for credit for those who have received a C- or higher in ECE 2B.
The goal of 10BL is to provide the student with a hands-on application of the concepts discussed in ECE 10B. The lab will utilize the microcontroller to introduce students to the understanding of datasheets for both digital and analog circuits, single-stage amplifier design and basic instrumentation.

10C. Foundations of Analog and Digital Circuits and Systems

Prerequisite: ECE 10B with C- or better grade. Lecture: 3 hours
Not open for credit for those who have received a C- or higher in ECE 2C.
The objective of this course is to introduce the student to the basics of transient analysis. The course will cover energy and power dissipation in digital circuits, first-order and second-order linear time invariant circuits, sinuosidal steady state, impedance representation, feedback and resonance. (S)

10CL. Foundations of Analog and Digital Circuits and Systems Lab

Prerequisite: ECE 10C (may be taken concurrently) with a C- or better grade. Laboratory: 4 hours
Not open for credit for those who have received a C- or higher in ECE 2C.
The goal of 10CL is to provide the student with a hands-on application of the concepts discussed in ECE 10C. The lab will utilize the microcontroller to introduce students to the understanding of propagation delay in digital circuits and the resulting power dissipation, first order linear networks, second order linear networks, sinuosoidal steady-state, impedance analysis and op-amp circuits.

15A. Fundamentals of Logic Design

Prerequisite: Open to electrical engineering, computer engineering, and pre-computer engineering majors only.
Not open for credit to students who have completed ECE 15. Lecture: 3 hours; discussion: 1 hour.

Boolean algebra, logic propositions, minterm and maxterm expansions, Karnaugh maps, Quine-McCluskey methods, mulli-level circuits, combinational circuit design and simulation, multiplexers, decoders, programmable logic devices.

92. Projects in Electrical and Computer Engineering

Prerequisite: Consent of instructor; for Electrical Engineering and Computer Engineering majors only.
Projects in electrical and computer engineering for advanced undergraduate students.

94AA-2Z. Group Studies in Electrical and Computer Engineering

Prerequisite: consent of instructor.
Group studies intended for small number of advanced students who share an interest in a topic not included in the regular departmental curriculum.

96. Undergraduate Research

Prerequisite: Consent of instructor. Must have a 3.00 GPA. May be repeated for up to 12 units.
135. Optical Fiber Communication

Prerequisite: ECE 132 and 134 with a minimum grade of C- in both; Lecture, 3 hours; discussion, 1 hour.

Optical fiber as a transmission medium, dispersion and nonlinear effects in fiber transmission, fiber and semiconductor optical amplifiers and lasers, optical modulators, photo detectors, optical connectors, wavelength division multiplexing components, optical filters, basic transmission system analysis and design.

137A. Circuits and Electronics I

Prerequisite: ECE 10A-B and ECE 10AL-BC-CL or ECE 2A-B-C, 130A, and 132 all with a minimum grade of C- in all; open to EE majors only. Lecture, 3 hours; laboratory, 3 hours.

Analysis and design of single stage and multistage transistor circuits including biasing, gain, impedances and maximum signal levels.

137B. Circuits and Electronics II

Prerequisite: ECE 10C and 10CL or ECE 2C and 137A with a minimum grade of C- in both; open to EE majors only. Lecture, 3 hours; laboratory, 3 hours.

Analysis and design of single stage and multistage transistor circuits at low and high frequencies. Transient response. Analysis and design of feedback circuits. Stability criteria.

139. Probability and Statistics

Prerequisite: Open to Electrical Engineering, Computer Engineering and pre-Computer Engineering majors only. Lecture, 3 hours; discussion, 2 hours.

Fundamentals of probability, conditional probability, Bayes rule, random variables, expectation and high-order moments, Markov, hypothesis testing.

141A. Introduction To Nanoelectromechanical- and Microelectromechanical Systems (MEMS/MEMS)

Prerequisite: ME 16 & 17, ME 152A, ME 151A (may be concurrent); or ECE 130A and 137A with a minimum grade of C- in both. Lecture: 3 hours; laboratory: 6 hours.

Introduction to nano- and microtechnology. Scaling laws and nanoscale physics are stressed. Individual subjects at the nanoscale including materials, mechanics, photonics, electronics, and fluidics will be described, with an emphasis on differences of behavior at the nanoscale and real-world examples.

141B. MEMS: Processing and Device Characterization

Prerequisite: ME 141A, ME 163 (may be concurrent); or ECE 141A.

Lectures and laboratory on semiconductor-based processing for MEMS. Description of key equipment and characterization tools used for MEMS and design, fabrication, characterization and testing of MEMS Emphasis on current MEMS devices including accelerometers, comb drives, micro-reactors and capacitor-actuators. (W)

141C. Introduction to Microfluidics and BioMEMS

Prerequisite: ME 141A or ECE 141A; open to ME and EE majors only.

Introduces physical phenomena associated with micro/nanoscale fluid mechanics, microfluids, and bioMEMS. Biological methods and numerical simulation tools are used for analysis of microfluids.

142. Introduction to Power Electronics

Prerequisite: ECE 132, ECE 134, and ECE 137A with a minimum grade of C- in all; open to EE majors only. Lecture, 3 hours; laboratory, 2 hours.

An introduction to modern switched-mode power electronics and associated devices. Covers modern converter/inverter topologies for the control and conversion of electrical power with high efficiency with applications in power supplies, renewable energy systems, lighting, electric/hybrid vehicles, and electric motor drivers.

144. Electromagnetic Fields and Waves

Prerequisite: ECE 134 with a minimum grade of C-; Lecture, 3 hours; laboratory, 3 hours.

Waves on transmission lines, Maxwell’s equations, skin effect, propagation and reflection of electromagnetic waves, microwave integrated circuit principles, metal and dielectric waveguides, resonant cavities, antennas. Microwave and optical device examples and experience with modern microwave and CAD software.

145A. Communication Electronics II

Prerequisite: ECE 137A-B with a minimum grade of C- in both. Lecture, 3 hours; laboratory, 6 hours.


145B. Communication Electronics II

Prerequisite: ECE 145A with a minimum grade of C-; EE majors only. Lecture, 3 hours; laboratory, 6 hours.

RF models for CMOS and BJT. Discrete vs. IC implementation. On-chip passive components. LNAs, PAs, T/R switches. Mixers. VCOs. Poly-phase filters. Radar range and digital signal modulators. Introduction to receiver architectures. I/Q modulation. Image-reject architectures.

145C. Communication Electronics III

Prerequisite: ECE 145B with a minimum grade of C-; EE majors only. Lecture, 4 hours.


146A. Digital Communication Fundamentals

Prerequisite: ECE 130A-B with a minimum grade of C-; open to EE Majors only. Lecture: 3 hours; Laboratory: 6 hours.

Signal and channel models, with emphasis on wireless systems; digital modulation; demodulation basics; statistical modeling of noise, including review of probability theory applied to random variables.

146B. Communication Systems Design

Prerequisite: ECE 130A-B and 146A with minimum grades of C-; open to EE Majors only. Lecture: 3 hours; Laboratory: 6 hours.

Optimal demodulation, including signal space geometry; communication performance characterization; advanced wireless communication techniques, including spread spectrum and multichannel systems; emerging frontiers in communications.

147A. Feedback Control Systems - Theory and Design

Prerequisite: ECE 130A-B with a minimum grade of C- in each; open to EE and computer engineering majors only. Lecture, 3 hours; laboratory, 6 hours.

Analysis and design of linear control systems. Basic feedback configurations and feedback synthesis in time and frequency domains. Analysis and synthesis of closed loop systems. Computer aided analysis and design.

147B. Digital Control Systems - Theory and Design

Prerequisite: ECE 147A with a minimum grade of C-; open to EE and computer engineering majors only. Lecture, 3 hours; laboratory, 6 hours.

Analysis of sampled data feedback systems; state space description of linear systems; observability, controllability, pole assignment, state feedback, observers. Design of digital control systems. (W)

147C. Control System Design Project

Prerequisite: ECE 147A or ME 155B or ME 173 with a minimum grade of C-; Lecture, 3 hours; laboratory, 6 hours.

Students are required to design, implement, and document a significant control systems project. The project is implemented in hardware or in high-fidelity numerical simulators. Lectures and laboratories cover special topics related to the practical implementation of control systems.

148. Applications of Signal Analysis and Processing

Prerequisite: ECE 130A and 130B with a minimum grade of C- in both. Lecture: 3 hours; Discussion: 2 hours

Recommended Preparation: concurrent enrollment in ECE 130C.

A sequence of engineering applications of signal analysis and processing techniques, in communications, image processing, analog and digital filter design, signal detection and parameter estimation, holography and tomography, Fourier optics, and microwave and acoustic sensing.

150. Mobile Embedded Systems

Prerequisite: Proficiency in JAVA programming, and a C- in ECE 152.

Architectures of modern smartphones and their key hardware components including mobile application processors, communications chips, display, touchscreen, graphics, camera, battery, GPS and various sensors; the OS and software development platform of smartphones; smartphone applications; low power design techniques.

151. Distributed Systems

Prerequisite: Computer Science 170 with a minimum grade of C-.

Not open for credit to students who have completed Computer Science 171. Lecture, 3 hours; discussion, 1 hour.

Distributed systems architecture, distributed programming techniques, message passing, remote procedure call, distributed communication and membership, naming, asynchronous, causality, consistency, fault-tolerance and recovery, resource management, scheduling, monitoring, testing and debugging.

152A. Digital Design Principles

Prerequisite: ECE 15A and 2A or ECE 10A & ECE 10AL with a minimum grade of C- in each course, or Computer Science 30 or 64 with a minimum grade of C- in each course; open to electrical engineering, computer engineering, and computer science majors only. Lecture: 3 hours; Laboratory: 6 hours.

Design of synchronous digital systems: timing diagrams, propagation delay, latches and flip-flops, shift registers and counters, Melay/Moore finite state machines, Verilog, 2-phase clocking, timing analysis, CMOS implementation, S-RAM, RAM-based designs, ASM charts, state minimization.

153A. Hardware/Software Interface

Prerequisite: Upper division standing in Computer Engineering, Computer Science or Electrical Engineering.

Same course as Computer Science 153A. Issues in interfacing computing systems and software to practical terminal interfaces. Rapid response, real-time events and management of tasks, threads, and scheduling required for efficient design of embedded software and systems is discussed. Techniques for highly constrained systems.

153B. Sensor and Peripheral Interface Design

Prerequisite: ECE 152A with a minimum grade of C-.

Lecture: 3 hours; Laboratory: 3 hours

Hardware description languages, field-
programmable logic and ASIC design techniques. Mixed-signal techniques: A/D and D/A converter interfaces; video and audio signal acquisition, processing and generation, communication and network interfaces.

154A. Introduction to Computer Architecture (4) PARRHAM
Prerequisite: ECE 152A with a minimum grade of C-; open to EE and CMPEN majors only. Lecture: 3 hours; Discussion: 1 hour
Not open for credit to students who have completed Computer Science 154. ECE 154A is the formerly numbered ECE 154. Students who have taken ECE 154 and have received a grade of C- or lower may take ECE 154A for a better grade.

154B. Advanced Computer Architecture (4) STRUKOV
Prerequisite: ECE 154A with a C- grade or better. Open to EE and CMPEN majors only. Lecture: 3 hours; Laboratory: 4 hours
Not open for credit to those who have taken Computer Science 154. ISA variations; Pipeline data and control hazards; Fast ALU design; Instruction-level parallelism, multithreading, VLIW; Vector and array processing, multi/many-core chips: Cache and virtual memory; Disk arrays; Shared- and distributed-memory systems, supercomputers; Reconfigurable and application-specific circuits.

155A. Introduction to Computer Networks (4) MOSER
Prerequisite: Upper-division standing in Electrical Engineering, Computer Engineering and Computer Science; and CMPSC 24 with a minimum grade of C-.

155B. Network Computing (4) MOSER
Prerequisite: ECE 155A or CMPSC 176A with a minimum grade of C-; and CMPSC 32 with a minimum grade of C-; and experience in Java programming or consent of instructor. Lecture: 3 hours; Discussion 1 hour
Not open for credit to students who have completed Computer Science 176, 176A, or ECE 155.

156A. Digital Design with VHDL and Synthesis (4) WANG
Prerequisite: ECE 152A with a minimum grade of C-. Lecture, 3 hours; Laboratory, 3 hours.
Introduction to VHDL basics. VHDL simulation concepts. VHDL concurrent statements with examples and applications. VHDL subprograms, packages, libraries and design units. Writing VHDL for synthesis. Writing VHDL for finite state machines. Design case study.

156B. Computer-Aided Design of VLSI Circuits (4) WANG
Prerequisite: ECE 156A with a minimum grade of C-. Lecture, 3 hours; Laboratory, 3 hours.
Introduction to computer-aided simulation and synthesis tools for VLSI. VLSI system design flow, role of CAD tools, layout synthesis, circuit simulation, logic simulation, logic synthesis, behavior synthesis and test synthesis.

158. Digital Signal Processing (4) GIBSON
Prerequisites: ECE 130A-B with a minimum grade of C- in both; open to EE majors only.
Lecture, 3 hours; laboratory, 3 hours. Discrete signals and systems, convolution, z-transforms, discrete Fourier transforms, digital filters.

160. Multimedia Systems (4) MELLiar-smith
Prerequisite: Upper-division standing; open to electrical engineering, computer engineering, computer science, and creative studies majors only. Lecture: 3 hours; Laboratory: 3 hours.
Not open for credit to students who have completed CMPSC 182.

162A. The Quantum Description of Electronic Materials (4) STAFF
Prerequisites: ECE 130A-B and 134 with a minimum grade of C- in all; open to EE, seniors in the BS/MS program and Materials graduate students only.
Same course as Materials 162A. Lecture, 4 hours.

162B. Fundamentals of the Solid State (4) COLDREN
Prerequisite: ECE 162A with a minimum grade of C-; open to EE, senior students in the BS/MS programs and Materials graduate students only.
Same course as Materials 162B. Lecture, 3 hours; discussion, 1 hour.

162C. Optoelectronic Materials and Devices (4) COLDREN
Prerequisites: ECE 162A-B with a minimum grade of C-; open to electrical engineering and materials majors only. Lecture, 3 hours; discussion, 1 hour.

178. Introduction to Digital Image and Video Processing (4) MANJUNATH
Prerequisites: open to EE, computer engineering, and computer science majors with upper-division standing. Lecture, 3 hours; discussion, 1 hour.
Basic concepts in image and video processing. Topics include image formation and sampling, image transforms, image enhancement, and image and video compression including JPEG and MPEG coding standards.

179P. Introduction to Robotics: Planning and Kinematics (4) BYL
Prerequisites: ENGR 3; and either ME 17 or ECE 130C (may be taken concurrently). Not open for credit to student who have completed Mechanical Engineering 170A or ECE 181A.
Same course as ME 179P.
Motion planning and kinematics topics with an emphasis on geometric reasoning, programming, and matrix computations. Motion planning: configuration spaces, sensor-based planning, decomposition and sampling methods, and advanced planning algorithms. Kinematics: reference frames, rotations and displacements, kinematic motion models.

181. Introduction to Computer Vision (4) MANJUNATH
Prerequisite: Upper-division standing in Electrical Engineering, Computer Engineering, Computer Science, Chemical Engineering or Mechanical Engineering. Lecture: 3 hours; Discussion: 1 hour.
Same course as Computer Science 181B.
Repeat Comments: Not open for credit to students who have completed ECE/CMPSC 181B with a grade of C or better. ECE/CMPSC 181B is a legal repeat of ECE/CMPSC 181B.
Overview of computer vision problems and techniques for analyzing the content of images and video. Topics include image formation, edge detection, image segmentation, pattern recognition, texture analysis, optical flow, stereo vision, shape representation and recovery techniques, issues in object recognition, and case studies of practical vision systems.

183. Nonlinear Phenomena (4) STAFF
Prerequisites: Physics 105A or Physics 103; or ME 163 or upper-division standing in ECE.
Same course as Physics 106 and ME 169.
Not open for credit to students who have completed ECE 163C. Lecture, 3 hours; discussion, 1 hour.
An introduction to nonlinear phenomena. Flows and bifurcations in one and two dimensions, chaos, fractals, strange attractors. Applications to physics, engineering, chemistry, and biology.

188A. Senior Electrical Engineering Project (3) STAFF
Prerequisite: Consent of instructor. Lecture: 3 hours; Laboratory: 3 hours.
Student groups design a significant project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through a practical design experience. The project is evaluated through written reports, oral presentations, and demonstrations of performance.

188B. Senior Electrical Engineering Project (3) STAFF
Prerequisite: ECE 188A with a minimum grade of C-. Lecture: 3 hours; Laboratory: 3 hours.
Student groups design a significant project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through a practical design experience. The project is evaluated through written reports, oral presentations, and demonstrations of performance.
evaluated through written reports, oral presentations, and demonstrations of performance.

188C. Senior Electrical Engineering Project
(3) STAFF
Prerequisite: ECE 188B with a minimum grade of C-
Lecture: 3 hours; Laboratory: 3 hour
Student groups design a significant project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through a practical design experience. The project is evaluated through written reports, oral presentations, and demonstrations of performance.

189A. Senior Computer Systems Project
(4) STAFF
Prerequisite: ECE 153B; senior standing in Computer Engineering, Computer Science or EE.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to students who have completed Computer Science 189A-B.
Student groups design a significant computer-based project. Groups work independently with interaction among groups via interface specifications and informal meetings.

189B. Senior Computer Systems Project
(4) STAFF
Prerequisite: ECE 189A; senior standing in Computer Engineering, Computer Science or EE.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to students who have completed Computer Science 189A-B.
Student groups design a significant computer-based project. Groups work independently with interaction among groups via interface specifications and informal meetings.

189C. Senior Computer Systems Project
(4) ISUKAPALLI
Prerequisite: ECE 189B; senior standing in Computer Engineering, Computer Science or EE.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to students who have completed Computer Science 189A-B.
Student groups design a significant computer-based project. The focus in this course will be on the integration of both hardware and software components. Students continue to work in groups. Apart from project reports and presentations, the evaluation will be based on successful demonstration of both hardware and software aspects of the project.

192. Projects in Electrical and Computer Engineering
(4) STAFF
Prerequisite: consent of instructor. Discussion, 2 hours; laboratory, 6 hours.
Projects in electrical and computer engineering for advanced undergraduate students.

193. Internship in Industry
(1-8) STAFF
Prerequisite: consent of department.
Must have a 3.0 grade-point average. May not be used as departmental electives. May be repeated to a maximum of 12 units. Field, 1-8 hours.
Special projects for selected students. Offered in conjunction with engineering practice in selected industrial and research firms, under direct faculty supervision.

194AA-ZZ. Special Topics in Electrical and Computer Engineering
(1-5) STAFF
Prerequisite: consent of instructor. Variable hours.

196. Undergraduate Research
(2-4) STAFF
Prerequisite: upper-division standing; consent of instructor.
Must have a minimum 3.0 grade-point average for the preceding three quarters. May be repeated for up to 12 units. Not more than 4 units may be applied to departmental electives.
Research opportunities for undergraduate students. Students will be expected to give regular oral presentations, actively participate in a weekly seminar, and prepare at least one written report on their research.

199. Independent Studies in Electrical and Computer Engineering
(1-5) STAFF
Prerequisite: upper division standing; completion of two upper-division courses in electrical and computer engineering; consent of instructor.
Must have a minimum 3.0 grade-point average for the preceding three quarters. Students are limited to five units per quarter and 30 units total in all 98/99/198/199/199DC/199RA courses combined. Directed individual study, normally experimental.

GRADUATE COURSES

Graduate courses for this major can be found in the UCSB General Catalog.

Engineering Sciences

Engineering Sciences, Office of Associate Dean for Undergraduate Studies, Harold Frank Hall, Room 1006; Telephone (805) 893-2809
Web site: www.engineering.ucsb.edu/undergraduate/majors-programs/engineering-sciences

Chair & Associate Dean: Glenn E. Beltz

Faculty
Glenn E. Beltz, Ph.D., Harvard, Professor
Jeffrey M. Moehlis, Ph.D., University of California, Berkeley, Professor
Linda R. Petzold, Ph.D., University of Illinois at Urbana-Champaign, Professor
Tyler G. Susko, Lecturer Potential SOE
Robert York, Ph.D., Cornell University, Professor

The Engineering Sciences program at UCSB serves as a focal point for the cross-disciplinary educational environment that prevails in each of our five degree-granting undergraduate programs (chemical engineering, computer engineering, computer science, electrical engineering, and mechanical engineering). The courses offered in this “department” are designed to cultivate well-educated, innovative engineers and scientists with excellent management and entrepreneurial skills and attitudes oriented to new technologies.

One of the missions of the Engineering Sciences program is to provide coursework commonly needed across other educational programs in the College of Engineering. For example, courses in computer programming, computation, ethics, engineering writing, engineering economics, science communication to the public, and even an aeronautics-inspired art course are offered.

Engineering Sciences Courses

LOWER DIVISION

3. Introduction to Programming for Engineers
(3) MOEHLIS, PETZOLD
Prerequisites: Open to chemical engineering, electrical engineering, and mechanical engineering majors only.
General philosophy of programming and problem solving. Students will be introduced to the programming language MATLAB. Specific areas of study will include algorithms, basic decision structures, arrays, matrices, and graphing. (F, S, M).

99. Introduction to Research
(1-3) STAFF
Prerequisite: Consent of instructor.
May be repeated for credit to a maximum of 6 units. Students are limited to 5 units per quarter and 30 units total in all 98/99/198/199/199AA-ZZ courses combined. Directed study to be arranged with individual faculty members. Course offers exceptional students an opportunity to participate in a research group.

UPPER DIVISION

101. Ethics in Engineering
(3) STAFF
Prerequisite: senior standing in engineering.
The nature of moral value, normative judgment, and moral reasoning. Theories of moral value. The engineer’s role in society. Ethics in professional practice. Safety, risk, responsibility. Morality and career choice. Code of ethics. Case studies will facilitate the comprehension of the concepts introduced. (F,W,S,M)

103. Advanced Engineering Writing
(4) STAFF
Prerequisites: Writing 50 or 50E; upper-division standing.
Practice in the forms of communication—