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 194 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. 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-C and Mathematics 5A and 5B 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: Open to pre-computer engineering and computer engineering majors only. Not open for credit for those who have taken ECE 1.

Gaining 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 with a minimum grade of C; and, Math 4B or 5A with a minimum grade of C (may be taken concurrently); Physics 3 or 23 (may be taken concurrently); open to electrical engineering and computer engineering majors. 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. 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.

4. Design Project for Freshmen

Prerequisite: Open only to Electrical 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

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

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. (F)

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

Prerequisite: ECE 10A (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 2A.

The goal of 10AL is to provide the student with a hands-on application of the concepts discussed in ECE 10A. The lab will introduce the use of microcontrollers as a data acquisition system, network analysis, resistors, nonlinear analysis and digital abstraction.

10B. Foundations of Analog and Digital Circuits and Systems

Prerequisite: ECE 10A with a 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)
120A. Integrated Circuit Design and Fabrication

(4) BOWERS

Prerequisite: ECE 132 with a minimum grade of C-.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to those who have taken ECE 124B.
Theory, fabrication, and characterization of solid state devices including P-N junctions, capacitors, bipolar and MOS devices. Devices are fabricated using modern VLSI processing techniques including lithography, oxidation, diffusion, and evaporation. Physics and performance of processing steps are discussed and analyzed.

120B. Integrated Circuit Design and Fabrication

(4) BOWERS

Prerequisite: ECE 2ABC and either ECE 124B or ECE 120A with a minimum grade of C- or better in each of the courses.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to those who have taken ECE 124C.
Design, simulation, fabrication, and characterization of NMOS integrated circuits. Circuit design and layout is performed using commercial layout software. Circuits are fabricated using modern VLSI processing techniques. Circuit and discrete device electrical performance are analyzed.

121A. The Practice of Science

(3) HU, AWSCHALOM

Prerequisite: Consent of instructor.
Same course as Physics 121A.
Provides experience in pursuing careers within science and engineering through discussions with researchers, lectures on ethics, funding, intellectual property, and commercial innovation. Students prepare a focused research proposal that is pursued in the second quarter of the course.

121B. The Practice of Science

(3) HU, AWSCHALOM

Prerequisite: ECE 121A or Physics 121A; consent of instructor.
Same course as Physics 121B.
Provides experience in pursuing careers within science and engineering through discussions with researchers, lectures on ethics, funding, intellectual property, and commercial innovation. Students prepare a focused research proposal that is pursued in the second quarter of the course.

122A. VLSI Principles

(4) BANERJEE

Prerequisite: ECE 152A with a minimum grade of C-.
Lecture: 3 hours; Laboratory: 3 hours
Not open for credit to those who have taken ECE 124A or ECE 123.
Introduction to CMOS digital VLSI design: CMOS devices and manufacturing technology; transistor level design of static and dynamic logic gates and components and interconnections; circuit characterization; delay, noise margins, and power dissipation; combinational and sequential circuits; arithmetic operations and memories.

122B. VLSI Architecture and Design

(4) BOWERS

Prerequisite: ECE 124A or ECE 123 or ECE 122A with a minimum grade of C-.
Lecture: 3 hours; Laboratory: 2 hours
Not open for credit to those who have taken ECE 124D.
Practical issues in VLSI circuit design, pad/ pin limitations, clocking and interfacing standards, electrical packaging for high-speed and high-performance devices, power dissipation, clock and power distribution, architectural and circuit design constraints, interconnection limits and transmission line effects.

123. High-Performance Digital Circuit Design

(4) THEOGARAJAN

Prerequisite: ECE 2A-B-C with a minimum grade of C- in each of those courses; open to both electrical engineering and computer engineering majors only.
Not open for credit to those who have taken ECE 124A or ECE 122A.
Introduction to high-performance digital circuit design techniques. Basics of digital physics including deep submicron effects; device sizing and logical effort; Circuit design styles; clocking & timing issues; memory & datapath design; low-power design; VLSI design flow; and associated EDA tools.

125. High Speed Digital Integrated Circuit Design

(4) BANERJEE

Prerequisite: ECE 124A or ECE 127A with a minimum grade of C in each; Lecture, 4 hours.
Advanced digital VLSI design: CMOS scaling, nanoscale issues including variability, thermal management, interconnects, reliability, non-clocked, clocked and self-timed logic, clock domain elements; high-speed components, PLLs and DLLs; clock and power distribution; memory systems; signaling and I/O design; low-power design.

130A. Signal Analysis and Processing

(4) MADHOW

Prerequisite: Mathematics 4B or 5A with a minimum grade of C and ECE 2B with a minimum grade of C-; open to EE and computer engineering majors only.
Lecture: 3 hours; Discussion: 2 hours

130B. Signal Analysis and Processing

(4) CHANDRASEKARAN

Prerequisite: ECE 130A with a grade of C- or better; open to EE and computer engineering majors only.
Lecture, 3 hours; discussion, 2 hours
Analysis of discrete time linear systems in the time and frequency domains. 2 transforms. Discrete Fourier transforms. Sampling and aliasing.

130C. Signal Analysis and Processing

(4) CHANDRASEKARAN

Prerequisites: ECE 130A-B with a minimum grade of C- in both; Lecture, 3 hours; discussion, 2 hours.
Basic techniques for the analysis of linear models in electrical engineering: Gaussian elimination, vector spaces and linear equations, orthogonality, determinants, eigenvalues and eigenvectors, systems of linear differential equations, positive definite matrices, singular value decomposition.

132. Introduction to Solid-State Electronic Devices

(4) MISHRA

Prerequisite: Physics 4 or 24 with a minimum grade of C-; Mathematics 4B or 5A with a minimum grade of C; and, ECE 2A-B (may be taken concurrently) with a minimum grade of C- in each; open to EE and computer engineering majors only.
Lecture: 3 hours; Discussion: 2 hours
Electrons and holes in semiconductors; doping (P and N); state occupation statistics, transport properties of electrons and holes; P-N junction diodes; I-V, C-V, and switching properties of P-N junctions; introduction of bipolar transistors, MOSFET’s and JFET’s.

134. Introduction to Fields and Waves

(4) DAGLI, JAFFER

Prerequisite: Physics 3 or 23 with a minimum grade of C-; Mathematics 4B or 5A and Mathematics 5B or 6A with a minimum grade of C in each; and Mathematics 5C or 6B with a minimum grade of C-; open to EE and computer engineering majors only.
Lecture: 3 hours; Discussion: 2 hours
Introduction to applied electromagnetics and wave phenomena in high frequency electron circuits and systems. Waveon transmission-lines, elements of electrostatics and magnetostatics and applications, plane waves, examples and applications to RF, microwave, and optical systems.

135. Optical Fiber Communication

(4) DAGLI

Prerequisites: ECE 132 and 134 with a minimum grade of C in each. 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 receivers, wavelength division multiplexing components, optical filters, basic transmission system analysis and design.

137A. Circuits and Electronics I
Prerequisite: ECE 2A-B-C, 130A, and 132 with a minimum grade of C- in all; open to EE majors only. Lecture, 3 hours; laboratory, 3 hours.

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

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

140A. Communication Electronics I
Prerequisite: ECE 137A with a minimum grade of C- in all; open to EE majors only. Lecture, 3 hours; laboratory, 3 hours.

140B. Communication Electronics II
Prerequisite: ECE 137A with a minimum grade of C- in both; open to EE majors only. Lecture, 3 hours; laboratory, 6 hours.

141A. Introduction To Nanoelectromechanical and Microelectromechanical Systems(NEMS/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. 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 microphones, gyroes, accelerometers, filters, micro-reactors and capacitor-actuators. (W)

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.

143. Electromagnetic Fields and Waves
Prerequisite: ECE 134 with a minimum grade of C-. Lecture: 3 hours; laboratory, 3 hours.

145A. Communication Electronics
Prerequisite: ECE 147A or ECE 155B or ECE 173 with a minimum grade of C-. Lecture: 3 hours; laboratory, 3 hours.

ELECTRICAL AND COMPUTER ENGINEERING • 35

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. 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 calls, group communication and membership, naming, asynchrony, causality, consistency, fault-tolerance and recovery, resource management, scheduling, monitoring, testing and debugging.

152A. Digital Design Principles
Prerequisite: ECE 15A and 2A, or Computer Science 30 or 64 with a minimum grade of C- in each; 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, Mealy/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 I/O 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. Integrated circuit design methods. Mixed-signal design, 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) PARMAMB
Prerequisite: ECE 152A with a minimum grade of C-; open to EE and CMPEN majors only. Lecture: 3 hours; Discussion: 1 hour.

154B. Advanced Computer Architecture
(4) STRUKOV
Prerequisite: ECE 154A with a minimum grade of C- or lower may take ECE 154A for a better grade.
Instruction-set architecture (ISA) and computer performance; Machine instructions, assembly addressing modes; Memory map, arrays, pointers; Procedure calls; Number formats; Simple ALUs; Data path, control, microprogram; Buses, I/O programming, interrupts; Pipelined data paths and control schemes.

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-.
Topics in this course include network architectures, protocols, wired and wireless networks, transmission media, multiplexing, switching, framing, error detection and correction, flow control, routing, congestion control, TCP/IP, DNS, email, Network Security, socket programming in C/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.
Topics in this course include client/server computing, threads, Java applets, Java sockets, Java RMI, Java servlets, Java Server Pages, Java Database Connectivity, Enterprise Java Beans, Hypertext Markup Language, eXtensible Markup Language, Web Services, programming networked applications in Java.

156A. Digital Design with VHDL and Synthesis
(4) WANG
Prerequisite: ECE 152A with a minimum grade of C-.
Introduction to VHDL basic elements. VHDL simulation concepts. VHDL concurrent statements with examples and applications. VHDL subprograms, packages, libraries and design units. Writing VHDL for synthesis. 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-.
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
Prerequisite: 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) MELLAR-SMITH
Prerequisite: Upper-division standing; open to electrical engineering, computer engineering, computer science, and creative studies majors only.
Lecture: 3 hours; Laboratory: 3 hours
Introduction to multimedia and applications, including WWW, image/video databases and video streaming. Covers media content analysis, media data organization and indexing (image/video databases), and media data distribution and interaction (video-on-demand and interactive TV).

162A. The Quantum Description of Electronic Materials
(4) STAFF
Prerequisite: ECE 130A-B and 134 with a minimum grade of C- in all; open to EE and materials majors 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 and materials majors only.
Same course as Materials 162B. Lecture, 3 hours; discussion, 1 hour.

162C. Optoelectronic Materials and Devices
(4) COLDREN
Prerequisite: ECE 162A-B with a minimum grade of C-; open to electrical engineering and materials majors only.

171. Introduction to Robotics: Planning and Kinematics
(4) BYL
Prerequisite: ENGR 3; and either ME 17 or ECE 130C (may be taken concurrently). Not open for credit to students 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.

178. Introduction to Robotics: Planning and Kinematics
(4) BYL
Prerequisite: ENGR 3; and either ME 17 or ECE 130C (may be taken concurrently). Not open for credit to students 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.
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.

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
Prerequisites: 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 four 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
Prerequisites: 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 98/99/198/199/199AA-ZZ courses combined.
Directed individual study, normally experimental.

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

Engineering Sciences Courses

LOWER DIVISION
3. Introduction to Programming for Engineers
(3) MOEHLS, 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.

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. (W,S,M)

103. Advanced Engineering Writing
(4) STAFF
Prerequisites: Writing 50 or 50E; upper-division standing.
Practice in the forms of communication—contractual reports, proposals, conference papers, oral presentations, business plans—that engineers and entrepreneurial engineers will encounter in professional careers. Focus is on research methods, developing a clear and persuasive writing style, and electronic document preparation.

160. Science for the Public
(1-4) STAFF
Prerequisite: consent of instructor.
Same course as Physics 150K. Open to graduate students in science and engineering disciplines and to undergraduate science and engineering majors. Provides experience in communicating science and technology to nonspecialists. The major components of the course include field work in mentoring, a biweekly seminar, presentations to precollege students and to adult nonscientists, and end-of-semester research papers.

Engineering Sciences
Engineering Sciences, Office of Associate Dean for Undergraduate Studies, Harold Frank Hall, Room 1006; Telephone (805) 993-2809; Web site: http://engrsci.ucsb.edu
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

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.