Electrical Engineering and Computer Sciences

Overview

The Department of Electrical Engineering and Computer Sciences (EECS) offers one of the strongest research and instructional programs in this field anywhere in the world. Our key strength is our array of cross-disciplinary, team-driven projects. The integration of Electrical Engineering (EE) and Computer Science (CS) forms the core, with strong interactions that extend into the biological sciences, mechanical and civil engineering, the physical sciences, chemistry, mathematics, and operations research. Our programs have been consistently ranked in the top three nationwide and worldwide by various organizations.

Each year, top students from all parts of the world are attracted to Berkeley's EECS program by the excellence of the faculty, the breadth of the educational opportunities in EECS and across the campus, our proximity to the vibrant California tech sector, and the Berkeley environment. The department's close ties to the industry, coupled with its commitment to engineering research and education, ensure that students receive a rigorous, relevant, and broad education.

Faculty members at Berkeley are committed to research and discovery at the highest level, informed and creative teaching, and the creative desire to excel. The distinction of the EECS faculty has been recognized in a long list of prestigious honors and awards, including two National Medals of Science, six ACM Turing Awards, four IEEE Medals of Honor, 44 members of the National Academy of Engineering, eighteen members of the National Academy of Sciences, and 26 fellows of the American Academy of Arts and Sciences.

Unlike many institutions of similar stature, regular faculty teach the vast majority of our courses, and the most exceptional teachers are often also the most exceptional researchers. The department's list of active teaching faculty includes seven winners of the prestigious Berkeley Campus Distinguished Teaching Award.

The mission of the EECS Department has three parts:

1. Educating future leaders in academia, government, industry, and entrepreneurial pursuit, through a rigorous curriculum of theory and application that develops the ability to solve problems, individually and in teams
2. Creating knowledge of fundamental principles and innovative technologies, through research within the core areas of EECS, and in collaboration with other disciplines, that is distinguished by its impact on academia, industry, and society
3. Serving the communities to which we belong, at local, national, and international levels, with a deep awareness of our ethical responsibilities to our profession and to society

Our strategy to accomplish this mission is simple: recruit and retain the very best faculty, students, and staff, and then empower them to direct and drive the creation and dissemination of knowledge. We know that we have succeeded in this mission when our students succeed, becoming leaders and serving society.

Electrical Engineering began on the Berkeley campus more than a century ago, with the hiring of its first electrical engineer, Clarence Cory, into the College of Mechanics. The early days focused on electric power production and distribution, and Cory's laboratory, in fact, provided the first light and power for the entire campus.

The evolution since then has been dramatic, accelerating rapidly in the latter half of the twentieth century. The development of our world-class computer science faculty followed naturally from the synergies between electronics, systems theory, and computing. In the twenty-first century, EECS has become a broader field, defined more by its intellectual approach to engineering problems than by particular technical solutions. Broadly, EECS harnesses physical processes to perform logical functions, and hence easily extends beyond its core technological base in electronics to, for example, biological systems.

We have current strengths in biosystems and computational biology, nanotechnology, artificial intelligence, concurrent and distributed systems, embedded systems, novel devices (such as organic semiconductors), robotics, advanced networking, computer security and trusted computing, energy, and sensor networks, which complement beautifully our more traditional strengths in physical electronics, integrated circuits, operating systems and networking, graphics and human-computer interaction, communications systems, computer architecture, control theory, signal processing, the theory of computing, programming languages, scientific computing, electronic design automation, power systems, and database management systems. Many of our current research projects are focused on enormous societal challenges and opportunities such as energy efficiency, network intelligence, transportation systems, security, and health care.

Our graduate programs emphasize research, preparing students for leadership positions in industrial labs, government, or academia. Our laboratory and computing facilities are among the best anywhere and have conceived many transformative inventions. Our research programs are well funded, and nearly all of our PhD students receive full financial support.

Undergraduate Programs

Computer Science (https://guide.berkeley.edu/undergraduate/degree-programs/computer-science/): BA (major program offered through the College of Letters and Science), Minor
Electrical Engineering and Computer Sciences (https://guide.berkeley.edu/undergraduate/degree-programs/electrical-engineering-computer-sciences/): BS, Minor
Electronic Intelligent Systems (https://guide.berkeley.edu/undergraduate/degree-programs/electronic-intelligent-systems/): Minor
Electrical Engineering and Computer Sciences/Materials Science and Engineering (https://guide.berkeley.edu/undergraduate/degree-programs/electrical-engineering-computer-sciences-materials/): BS (Joint Major)
Electrical Engineering and Computer Sciences/Nuclear Engineering (https://guide.berkeley.edu/undergraduate/degree-programs/electrical-engineering-computer-sciences-nuclear-joint-major/): BS (Joint Major)

Graduate Programs

Computer Science (https://guide.berkeley.edu/graduate/degree-programs/computer-science/): MS, MEng, PhD
Electrical Engineering and Computer Sciences (https://guide.berkeley.edu/graduate/degree-programs/electrical-engineering-computer-sciences/): MEng, MS, PhD

Select a subject to view courses

Electrical Engineering and Computer Sciences

EECS 16A Foundations of Signals, Dynamical Systems, and Information Processing 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course offers an introduction to signals, systems, optimization, controls, and machine learning, all grounded in linear algebraic techniques. After a brief review of linear algebra, students will delve into topics such as signal processing, linear systems, feedback control, optimization methods, and foundational machine learning algorithms. Emphasizing practical applications, the course prepares EECS majors for advanced study by connecting mathematical concepts to real-world engineering problems.

Rules & Requirements

Prerequisites: MATH 54

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Alon, Arcak, Ayazifar, Maharbiz, Niknejad, Ranade, Sahai, Subramanian, Tomlin, Tennant

Formerly known as: Electrical Engineering 16A

EECS 16B Introduction to Circuits & Devices 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course teaches the fundamentals needed to predict the behavior of real-world electronic phenomena and applications via mathematical models and circuit analytical methods that simplify initially complex problems, rendering them solvable and understandable. Among the specific topics to be covered are time and frequency domain representation, complex arithmetic, phasor analysis of systems governed by differential equations, Kirchhoff's laws, physical examples of electronic elements and devices, RLC circuits, op amp-based signal processors, feedback methods, and circuit models for domains beyond the electronic. Class contact time includes lectures, discussions, and a laboratory component designed to help solidify learned concepts.

Rules & Requirements

Prerequisites: MATH 54

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Alon, Ayazifar, Lustig, Maharbiz, Subramanian, Tomlin, Wu

Formerly known as: Electrical Engineering 16B

EECS 47D Completion of work in Electrical Engineering 16A 1 - 3 Units

Terms offered: Fall 2021

This course allows students who have had a linear algebra and/or basic circuit theory course to complete the work in EE16A and be ready for EE16B or EE47E. The course focuses on the fundamentals of designing modern information devices and systems that interface with the real world and provides a comprehensive foundation for core EECS topics in signal processing, learning, control, and circuit design. Modeling is emphasized in a way that deepens mathematical maturity, and in both labs and homework, students will engage computationally, physically, and visually with the concepts being introduced in addition to traditional paper/pencil exercises.

Rules & Requirements

Prerequisites: MATH 51; MATH 52; COMPSCI 61A (encouraged to be taken concurrently); college level courses in linear algebra and/or circuit theory; and consent of the instructor

Hours & Format

Fall and/or spring: 15 weeks - 2-8 hours of self-paced per week

Summer: 8 weeks - 4-13 hours of self-paced per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Alon, Arcak, Ayazifar, Maharbiz, Niknejad, Ranade, Sahai, Subramanian, Tomlin

EECS 47E Completion of work in Electrical Engineering 16B 1 - 3 Units

Terms offered: Not yet offered

This course allows students who have had a linear algebra and/or basic circuit theory course to complete the work in EE16B. The course focuses on the fundamentals of designing modern information devices and systems that interface with the real world and provides a comprehensive foundation for core EECS topics in signal processing (DFT), learning (SVD/PCA), feedback control, and circuit design. Modeling is emphasized in a way that deepens mathematical maturity, and in both labs and homework, students will engage computationally, physically, and visually with the concepts being introduced in addition to traditional paper/pencil exercises.

Rules & Requirements

Prerequisites: MATH 51; MATH 52; COMPSCI 61A; EECS 16A or EECS 47D or MATH 54; college level courses in linear algebra and/or circuit theory; and consent of the instructor

Hours & Format

Fall and/or spring: 15 weeks - 3-8 hours of self-paced per week

Summer: 8 weeks - 6-16 hours of self-paced per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Alon, Arcak, Ayazifar, Maharbiz, Niknejad, Ranade, Sahai, Subramanian, Tomlin

EECS 47F Completion of work in Computer Science 70 1 - 3 Units

Terms offered: Prior to 2007

This course allows students who have had a discrete math and/or probability course to complete the work in CS70. Logic, infinity, and induction; applications include undecidability and stable marriage problem. Modular arithmetic and GCDs; applications include primality testing and cryptography. Polynomials; examples include error correcting codes and interpolation. Probability including sample spaces, independence, random variables, law of large numbers; examples include load balancing, existence arguments, Bayesian inference.

Rules & Requirements

Prerequisites: Sophomore mathematical maturity, programming experience equivalent to that gained in COMPSCI 61A, a prior college level course on discrete math and/or probability, and consent of the instructor

Hours & Format

Fall and/or spring: 15 weeks - 3-8 hours of self-paced per week

Summer: 8 weeks - 6-16 hours of self-paced per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Ranade, Rao, Sahai, Seshia, Vazirani, Walrand

EECS C106A Introduction to Robotics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023, Fall 2021, Fall 2020, Fall 2019

This course is an introduction to the field of robotics. It covers the fundamentals of kinematics, dynamics, control of robot manipulators, robotic vision, sensing, forward & inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, & control. We will present techniques for geometric motion planning & obstacle avoidance. Open problems in trajectory generation with dynamic constraints will also be discussed. The course also presents the use of the same analytical techniques as manipulation for the analysis of images & computer vision. Low level vision, structure from motion, & an introduction to vision & learning will be covered. The course concludes with current applications of robotics.

Rules & Requirements

Prerequisites: Familiarity with linear algebra at the level of EECS 16A/ EECS 16B or MATH 54. Experience coding in python at the level of COMPSCI 61A. Preferred: experience developing software at the level of COMPSCI 61B and experience using Linux

Credit Restrictions: Students will receive no credit for Electrical Engineering and Computer Science C106A/Bioengineering C106A after completing EE C106A/BioE C125, Electrical Engineering 206A, or Electrical Engineering and Computer Science 206A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Sastry

Also listed as: BIO ENG C106A/MEC ENG C106A

EECS C106B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023, Spring 2021, Spring 2020, Spring 2019

The course is a sequel to EECS/BIOE/MEC106A/EECSC206A, which covers the mathematical fundamentals of robotics including kinematics, dynamics and control as well as an introduction to path planning, obstacle avoidance, and computer vision. This course will present several areas of robotics and active vision, at a deeper level and informed by current research. Concepts will include the review at an advanced level of robot control, the kinematics, dynamics and control of multi-fingered hands, grasping and manipulation of objects, mobile robots: including non-holonomic motion planning and control, path planning, Simultaneous Localization And Mapping (SLAM), and active vision. Additional research topics covered at the instructor's discretion.

Rules & Requirements

Prerequisites: EECS C106A / BIO ENG C106A / MEC ENG C106A / EECS C206A or an equivalent course. A strong programming background, knowledge of Python and Matlab, and some coursework in feedback controls (such as EL ENG C128 / MEC ENG C134) are also useful. Students who have not taken the prerequisite course should have a strong programming background, knowledge of Python and Matlab, and exposure to linear algebra, Lagrangian dynamics, and feedback controls at the intermediate level. EECS C106A

Credit Restrictions: Students will receive no credit for Electrical Engineering and Computer Science C106B/Bioengineering C106B after completing Electrical Engineering C106B/Bioengineering C125B, Electrical Engineering 206B, or Electrical Engineering and Computer Science 206B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Sastry

Also listed as: BIO ENG C106B/MEC ENG C106B

EECS 107 Introduction to AR/VR and Applications in Metaverse 4 Units

Terms offered: Prior to 2007

This course develops a fundamental understanding of computer vision (CV) and computer graphics (CG) that underpin the emerging AR/VR and Metaverse applications. The syllabus includes 3D perception, near-eye optics, depth cameras, 3D localization, and immersive 3D user experience. The companion lab helps students to acquire basic AR/VR coding skills in Unity and develop Metaverse applications. The course builds a strong foundation for students to take more advanced course: CS 294-137.

Rules & Requirements

Prerequisites: Familiarity with Linear Algebra at the level of EECS 16A/B or MATH 54. Experience on coding proficiency and data structures at the level of CS61 A/B

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Yang

EECS 126 Probability and Random Processes 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course covers the fundamentals of probability and random processes useful in fields such as networks, communication, signal processing, and control. Sample space, events, probability law. Conditional probability. Independence. Random variables. Distribution, density functions. Random vectors. Law of large numbers. Central limit theorem. Estimation and detection. Markov chains.

Rules & Requirements

Prerequisites: COMPSCI 70 preferred but not required; Familiarity with linear algebra

Credit Restrictions: Students will receive no credit for EECS 126 after completing EE 126.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Ramchandran

EECS 127 Optimization Models in Engineering 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course offers an introduction to optimization models and their applications, ranging from machine learning and statistics to decision-making and control, with emphasis on numerically tractable problems, such as linear or constrained least-squares optimization.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B, or consent of instructor

Credit Restrictions: Students will receive no credit for EECS 127 after taking EECS 227AT or Electrical Engineering 127/227AT.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: El Ghaoui

Formerly known as: Electrical Engineering 127

EECS 149 Introduction to Embedded and Cyber Physical Systems 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course introduces students to the basics of modeling, analysis, and design of embedded, cyber-physical systems. Students learn how to integrate computation with physical processes to meet a desired specification. Topics include models of computation, control, analysis and verification, interfacing with the physical world, real-time behaviors, mapping to platforms, and distributed embedded systems. The course has a strong laboratory component, with emphasis on a semester-long sequence of projects.

Objectives & Outcomes

Course Objectives: To develop the skills to realize embedded systems that are safe, reliable, and efficient in their use of resources.
To learn how to model and design the joint dynamics of software, networks, and physical processes.
To learn to think critically about technologies that are available for achieving such joint dynamics.

Rules & Requirements

Prerequisites: COMPSCI 61C and COMPSCI 70; EECS 16A and EECS 16B, or permission of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Seshia, Lee, Dutta

EECS 151 Introduction to Digital Design and Integrated Circuits 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
An introduction to digital and system design. The material provides a top-down view of the principles, components, and methodologies for large scale digital system design. The underlying CMOS devices and manufacturing technologies are introduced, but quickly abstracted to higher-levels to focus the class on design of larger digital modules for both FPGAs (field programmable gate arrays) and ASICs (application specific integrated circuits). The class includes extensive use of industrial grade design automation and verification tools for assignments, labs and projects.
The class has two lab options: ASIC Lab (EECS 151LA) and FPGA Lab (EECS 151LB). Students must enroll in at least one of the labs concurrently with the class.
Objectives & Outcomes

Course Objectives: The Verilog hardware description language is introduced and used. Basic digital system design concepts, Boolean operations/combinational logic, sequential elements and finite-state-machines, are described. Design of larger building blocks such as arithmetic units, interconnection networks, input/output units, as well as memory design (SRAM, Caches, FIFOs) and integration are also covered. Parallelism, pipelining and other micro-architectural optimizations are introduced. A number of physical design issues visible at the architecture level are covered as well, such as interconnects, power, and reliability.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Credit Restrictions: Students must enroll concurrently in at least one the lab flavors EECS151LA or EECS151LB. Students wishing to take a second lab flavor next term can sign-up only for that Lab section and receive a Letter grade. The pre-requisite for “Lab-only” enrollment that term will be EECS151 from previous terms.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Stojanovic, Wawrzynek

EECS 151LA Application Specific Integrated Circuits Laboratory 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This lab lays the foundation of modern digital design by first presenting the scripting and hardware description language base for specification of digital systems and interactions with tool flows. The labs are centered on a large design with the focus on rapid design space exploration. The lab exercises culminate with a project design, e.g., implementation of a three-stage RISC-V processor with a register file and caches. The design is mapped to simulation and layout specification.
Objectives & Outcomes

Course Objectives: Software testing of digital designs is covered leading to a set of exercises that cover the design flow. Digital synthesis, floor-planning, placement and routing are covered, as well as tools to evaluate timing and power consumption. Chip-level assembly is covered, including instantiation of custom blocks: I/O pads, memories, PLLs, etc.

Rules & Requirements

Prerequisites: COMPSCI 61C, EECS 16A, EECS 16B, and EL ENG 105

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructors: Stojanovic, Wawrzynek

EECS 151LB Field-Programmable Gate Array Laboratory 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This lab covers the design of modern digital systems with Field-Programmable Gate Array (FPGA) platforms. A series of lab exercises provide the background and practice of digital design using a modern FPGA design tool flow. Digital synthesis, partitioning, placement, routing, and simulation tools for FPGAs are covered in detail. The labs exercises culminate with a large design project, e.g., an implementation of a full three-stage RISC-V processor system, with caches, graphics acceleration, and external peripheral components. The design is mapped and demonstrated on an FPGA hardware platform.
Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, and COMPSCI 61C; EL ENG 105 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructors: Stojanovic, Wawrzynek

EECS 183 Natural Language Processing 4 Units

Terms offered: Fall 2025
This course provides a hands-on introduction to language technologies, covering methods for processing speech and text. This includes: statistical models, early neural models, and transformer-based LLMs; model architectures, training, evaluation, and social impacts; core tasks and methods like machine translation, parsing, and prompting; analysis and representation of speech and speech recognition models. Weekly assignments provide practical experience in building systems and understanding their strengths and limitations.

Rules & Requirements

Prerequisites: COMPSCI C182, COMPSCI 188, or COMPSCI 189

Credit Restrictions: Students will receive no credit for EECS 183 after completing COMPSCI 288. A deficient grade in EECS 183 may be removed by taking COMPSCI 288.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Suhr, Anumanchipalli

EECS C191A Introduction to Quantum Computing I 4 Units

Terms offered: Fall 2025
This is the first semester of a multidisciplinary two-semester sequence in Quantum Computing. This semester provides an introduction to fundamental conceptual aspects of quantum mechanics in the language of qubits and quantum gates, and a first introduction to quantum computation. Topics in part one include basic concepts and results in quantum information, quantum algorithms, and an introduction to quantum error correction.

Rules & Requirements

Prerequisites: Linear Algebra: Either EECS 16A, Physics 89, Math 54, or equivalent. Some background in either quantum mechanics (Physics 137A, Chemistry 120A, or equivalent) or discrete mathematics (CS 70, Math 55, or equivalent) is expected

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191A/PHYSICS C191A

EECS C191B Introduction to Quantum Computing II 4 Units

Terms offered: Not yet offered
This is the second semester of a multidisciplinary two-semester sequence in Quantum Computing. This second semester covers fundamentals of control of qubits, methods of quantum error mitigation, quantum benchmarking, quantum supremacy and tests of quantumness, advanced quantum error correction including fault-tolerant quantum computing and error thresholds, theory/practice of near-term fault fault tolerance, discussions of different physical platforms for quantum computing, and alternative paradigms for quantum computing.

Rules & Requirements

Prerequisites: C191A or equivalent (with permission of instructor)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191B/PHYSICS C191B

EECS C206A Introduction to Robotics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course is an introduction to the field of robotics. It covers the fundamentals of kinematics, dynamics, control of robot manipulators, robotic vision, sensing, forward & inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, & control. We will present techniques for geometric motion planning & obstacle avoidance. Open problems in trajectory generation with dynamic constraints will also be discussed. The course also presents the use of the same analytical techniques as manipulation for the analysis of images & computer vision. Low level vision, structure from motion, & an introduction to vision & learning will be covered. The course concludes with current applications of robotics.

Rules & Requirements

Prerequisites: Familiarity with linear algebra at level of EECS 16A/ EECS 16B or MATH 54. Experience doing coding in python at the level of COMPSCI 61A. Preferred: experience developing software at level of COMPSCI 61B and experience using Linux. EECS 120 is not required, but some knowledge of linear systems may be helpful for the control of robots

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Sastry, Sreenath

Formerly known as: Electrical Engin and Computer Sci 206A

Also listed as: MEC ENG C206A

EECS C206B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course is a sequel to EECS C106A/206A, which covers kinematics, dynamics and control of a single robot. This course will cover dynamics and control of groups of robotic
manipulators coordinating with each other and interacting with the environment. Concepts will include
an introduction to grasping and the constrained manipulation, contacts and force control for interaction
with the environment. We will also cover active perception guided manipulation, as well as the
manipulation of non-rigid objects. Throughout, we will emphasize design and human-robot
interactions, and applications to applications in manufacturing, service robotics, tele-surgery, and
locomotion.

Rules & Requirements

Prerequisites: Students are expected to have taken EECS C106A / BioE C106A / ME C106A / ME C206A/ EECS C206A or an equivalent course. A strong programming background, knowledge of Python and Matlab, and some coursework in feedback controls (such as EE C128 / ME C134) are also useful. Students who have not taken EECS C106A / BioE C106A / ME C106A / ME C206A/ EECS C206A should have a strong programming background, knowledge of Python and Matlab, and exposure to linear algebra, and Lagrangian dynamics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Bajcsy, Sastry

Formerly known as: Electrical Engin and Computer Sci 206B

Also listed as: MEC ENG C206B

EECS 208 Computational Principles for High-dimensional Data Analysis 4 Units

Terms offered: Fall 2023, Fall 2022, Fall 2021
Introduction to fundamental geometric and statistical concepts and principles of low-dimensional models for high-dimensional signal and data analysis, spanning basic theory, efficient algorithms, and diverse real-world applications. Systematic study of both sampling complexity and computational complexity for sparse, low-rank, and low-dimensional models – including important cases such as matrix completion, robust principal component analysis, dictionary learning, and deep networks.
Rules & Requirements

Prerequisites: The following courses are recommended undergraduate linear algebra (Math 110), statistics (Stat 134), and probability (EE126). Back-ground in signal processing (ELENG 123), optimization (ELENG C227T), machine learning (CS189/289), and computer vision (COMPSCI C280) may allow you to appreciate better certain aspects of the course material, but not necessary all at once. The course is open to senior undergraduates, with consent from the instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: Ma

EECS 219A Numerical Simulation and Modeling 4 Units

Terms offered: Spring 2025, Spring 2024
Numerical simulation and modeling are enabling technologies that pervade science and engineering. This course provides a detailed introduction to the fundamental principles of these technologies and their translation to engineering practice. The course emphasizes hands-on programming in MATLAB and application to several domains, including circuits, nanotechnology, and biology.
Rules & Requirements

Prerequisites: Consent of instructor; a course in linear algebra and on circuits is very useful

Credit Restrictions: Students will receive no credit for EL ENG 219A after completing EL ENG 219.

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: Roychowdhury

Formerly known as: Electrical Engineering 219A

EECS 219C Formal Methods: Specification, Verification, and Synthesis 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Introduction to the theory and practice of formal methods for the design and analysis of systems, with a focus on algorithmic techniques. Covers selected topics in computational logic and automata theory including modeling and specification formalisms, temporal logics, satisfiability solving, model checking, synthesis, learning, and theorem proving. Applications to software and hardware design, cyber-physical systems, robotics, computer security, and other areas will be explored as time permits.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor; COMPSCI 170 is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: Seshia

Formerly known as: Electrical Engineering 219C

EECS 225A Statistical Signal Processing 3 Units

Terms offered: Fall 2025, Spring 2025, Spring 2023
This course connects classical statistical signal processing (Hilbert space filtering theory by Wiener and Kolmogorov, state space model, signal representation, detection and estimation, adaptive filtering) with modern statistical and machine learning theory and applications. It focuses on concrete algorithms and combines principled theoretical thinking with real applications.
Rules & Requirements

Prerequisites: EL ENG 120 and EECS 126

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Jiao, Waller

Formerly known as: Electrical Engineering 225A

EECS 225B Digital Image Processing 3 Units

Terms offered: Fall 2023, Fall 2022, Fall 2020
This course deals with computational methods as applied to digital imagery. It focuses on image sensing and acquisition, image sampling and quantization; spatial transformation, linear and nonlinear filtering; introduction to convolutional neural networks, and GANs; applications of deep learning methods to image processing problems; image enhancement, histogram equalization, image restoration, Weiner filtering, tomography, image reconstruction from projections and partial Fourier information, Radon transform, multiresolution analysis, continuous and discrete wavelet transform and computation, subband coding, image and video compression, sparse signal approximation, dictionary techniques, image and video compression standards, and more.

Rules & Requirements

Prerequisites: Basic knowledge of signals and systems, convolution, and Fourier Transform

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: Zakhor

Formerly known as: Electrical Engineering 225B

EECS 227AT Optimization Models in Engineering 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course offers an introduction to optimization models and their applications, ranging from machine learning and statistics to decision-making and control, with emphasis on numerically tractable problems, such as linear or constrained least-squares optimization.

Rules & Requirements

Prerequisites: MATH 54 or consent of instructor

Credit Restrictions: Students will receive no credit for EECS 227AT after taking EECS 127 or Electrical Engineering 127/227AT.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: El Ghaoui

Formerly known as: Electrical Engineering 227AT

EECS C249B Cyber Physical System Design Prinicples and Applications 4 Units

Terms offered: Spring 2020, Spring 2019, Spring 2016
Principles of embedded system design. Focus on design methodologies and foundations. Platform-based design and communication-based design and their relationship with design time, re-use, and performance. Models of computation and their use in design capture, manipulation, verification, and synthesis. Mapping into architecture and systems platforms. Performance estimation. Scheduling and real-time requirements. Synchronous languages and time-triggered protocols to simplify the design process.

Rules & Requirements

Prerequisites: Suggested but not required: CS170, EECS149/249A

Credit Restrictions: Students will receive no credit for EECS C249B after completing EL ENG 249, or EECS 249B. A deficient grade in EECS C249B may be removed by taking EECS 249B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructor: Sangiovanni-Vincentelli

Formerly known as: Electrical Engineering C249B/Civil and Environmental Engineering C289

Also listed as: CIV ENG C289

EECS 251A Introduction to Digital Design and Integrated Circuits 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
An introduction to digital circuit and system design. The material provides a top-down view of the principles, components, and methodologies for large scale digital system design. The underlying CMOS devices and manufacturing technologies are introduced, but quickly abstracted to higher levels to focus the class on design of larger digital modules for both FPGAs (field programmable gate arrays) and ASICs (application specific integrated circuits). The class includes extensive use of industrial grade design automation and verification tools for assignments, labs, and projects.

Objectives & Outcomes

Course Objectives: The Verilog hardware description language is introduced and used. Basic digital system design concepts, Boolean operations/combinational logic, sequential elements and finite-state-machines, are described. Design of larger building blocks such as arithmetic units, interconnection networks, input/output units, as well as memory design (SRAM, Caches, FIFOs) and integration are also covered. Parallelism, pipelining and other micro-architectural optimizations are introduced. A number of physical design issues visible at the architecture level are covered as well, such as interconnects, power, and reliability.

Student Learning Outcomes: Although the syllabus is the same as EECS151, the assignments and exams for EECS251A will have harder problems that test deeper understanding expected from a graduate level course.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B; COMPSCI 61C; and recommended: EL ENG 105. Students must enroll concurrently in at least one the laboratory flavors EECS 251LA or EECS 251LB. Students wishing to take a second laboratory flavor next term can sign-up only for that laboratory section and receive a letter grade. The prerequisite for “Lab-only” enrollment that term will be EECS 251A from previous terms

Credit Restrictions: Students must enroll concurrently in at least one the laboratory flavors Electrical Engineering and Computer Science 251LA or Electrical Engineering and Computer Science 251LB. Students wishing to take a second laboratory flavor next term can sign-up only for that laboratory section and receive a letter grade. The pre-requisite for “Lab-only” enrollment that term will be Electrical Engineering and Computer Science 251A from previous terms.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Stojanovic, Wawrzynek

Formerly known as: Electrical Engineering 241A

EECS 251B Advanced Digital Integrated Circuits and Systems 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course aims to convey a knowledge of advanced concepts of digital circuit and system-on-a-chip design in state-of-the-art technologies. Emphasis is on the circuit and system design and optimization for both energy efficiency and high performance for use in a broad range of applications, from edge computing to datacenters. Special attention will be devoted to the most important challenges facing digital circuit designers in the coming decade. The course is accompanied with practical laboratory exercises that introduce students to modern tool flows.

Rules & Requirements

Prerequisites: Introduction to Digital Design and Integrated Circuits, EECS151 (taken with either EECS151LA or EECS151LB lab) or EECS251A (taken with either EECS251LA or EECS251LB lab)

Credit Restrictions: Students will receive no credit for EECS 251B after completing COMPSCI 250, or EL ENG 241B.

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Nikoli#, Shao, Wawrzynek, Asanovi#, Stojanovi#, Seshia

EECS 251LA Introduction to Digital Design and Integrated Circuits Lab 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This lab lays the foundation of modern digital design by first presenting the scripting and hardware description language base for specification of digital systems and interactions with tool flows. The labs are centered on a large design with the focus on rapid design space exploration. The lab exercises culminate with a project design, e.g. implementation of a 3-stage RISC-V processor with a register file and caches. The design is mapped to simulation and layout specification.

Objectives & Outcomes

Course Objectives: Software testing of digital designs is covered leading to a set of exercises that cover the design flow. Digital synthesis, floor-planning, placement and routing are covered, as well as tools to evaluate timing and power consumption. Chip-level assembly is covered, including instantiation of custom blocks: I/O pads, memories, PLLs, etc.

Student Learning Outcomes: Although the syllabus is the same as EECS151LA, the assignments and exams for EECS251LA will have harder problems in labs and in the project that test deeper understanding expected from a graduate level course.

Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, and COMPSCI 61C; and EL ENG 105 is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Stojanovic, Wawrzynek

EECS 251LB Introduction to Digital Design and Integrated Circuits Lab 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This lab covers the design of modern digital systems with Field-Programmable Gate Array (FPGA) platforms. A series of lab exercises provide the background and practice of digital design using a modern FPGA design tool flow. Digital synthesis, partitioning, placement, routing, and simulation tools for FPGAs are covered in detail. The labs exercises culminate with a large design project, e.g., an implementation of a full 3-stage RISC-V processor system, with caches, graphics acceleration, and external peripheral components. The design is mapped and demonstrated on an FPGA hardware platform.

Objectives & Outcomes

Student Learning Outcomes: Although the syllabus is the same as EECS151LB, the assignments and exams for EECS251LB will have harder problems in labs and in the project that test deeper understanding expected from a graduate level course.

Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, and COMPSCI 61C; and EL ENG 105 is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Stojanovic, Wawrzynek

EECS 283A Natural Language Processing 4 Units

Terms offered: Fall 2025

This course provides a hands-on introduction to language technologies, covering methods for processing speech and text. This includes: statistical models, early neural models, and transformer-based LLMs; model architectures, training, evaluation, and social impacts; core tasks and methods like machine translation, parsing, and prompting; analysis and representation of speech and speech recognition models. Weekly assignments provide practical experience in building systems and understanding their strengths and limitations.

Rules & Requirements

Prerequisites: COMPSCI C182, COMPSCI 188, or COMPSCI 189

Credit Restrictions: Students will receive no credit for EECS 283A after completing COMPSCI 288. A deficient grade in EECS 283A may be removed by taking COMPSCI 288.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engin and Computer Sci/Graduate

Grading: Letter grade.

Instructors: Suhr, Anumanchipalli

Computer Science

COMPSCI C8 Foundations of Data Science 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025, Fall 2024, Spring 2023, Fall 2022, Spring 2022, Fall 2021, Summer 2021 8 Week Session, Fall 2020

Foundations of data science from three perspectives: inferential thinking, computational thinking, and real-world relevance. Given data arising from some real-world phenomenon, how does one analyze that data so as to understand that phenomenon? The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks. It delves into social and legal issues surrounding data analysis, including issues of privacy and data ownership.

Rules & Requirements

Prerequisites: This course may be taken on its own, but students are encouraged to take it concurrently with a data science connector course (numbered 88 in a range of departments)

Credit Restrictions: Students will receive no credit for DATA C8\COMPSCI C8\INFO C8\STAT C8 after completing COMPSCI 8, or DATA 8. A deficient grade in DATA C8\COMPSCI C8\INFO C8\STAT C8 may be removed by taking COMPSCI 8, COMPSCI 8, or DATA 8.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Computer Science C8/Statistics C8/Information C8

Also listed as: DATA C8/INFO C8/STAT C8

COMPSCI 10 The Beauty and Joy of Computing 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
An introductory course for students with minimal prior exposure to computer science. Prepares students for future computer science courses and empowers them to utilize programming to solve problems in their field of study. Presents an overview of the history, great principles, and transformative applications of computer science, as well as a comprehensive introduction to programming. Topics include abstraction, recursion, algorithmic complexity, higher-order functions, concurrency, social implications of computing (privacy, education, algorithmic bias), and engaging research areas (data science, AI, HCI). Students will program in Snap! (a friendly graphical language) and Python, and will design and implement two projects of their choice.

Rules & Requirements

Credit Restrictions: Students will receive no credit for 10 after having taken W10, 61A, 61B, or 61C.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture, 1 hour of discussion, and 4 hours of laboratory per week

Summer: 8 weeks - 4 hours of lecture, 2 hours of discussion, and 8 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Garcia, Hug

COMPSCI W10 The Beauty and Joy of Computing 4 Units

Terms offered: Fall 2012
This course meets the programming prerequisite for 61A. An introduction to the beauty and joy of computing. The history, social implications, great principles, and future of computing. Beautiful applications that have changed the world. How computing empowers discovery and progress in other fields. Relevance of computing to the student and society will be emphasized. Students will learn the joy of programming a computer using a friendly, graphical language, and will complete a substantial team programming project related to their interests.

Rules & Requirements

Credit Restrictions: Students will receive no credit for W10 after taking 10, 61A, 61B or 61C. A deficient grade in 10 may be removed by taking W10.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of web-based lecture and 5 hours of web-based discussion per week

Summer: 8 weeks - 4 hours of web-based lecture and 10 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Garcia, Hug

COMPSCI 36 CS Scholars Seminar: The Educational Climate in CS & CS61A technical discussions 2 Units

Terms offered: Fall 2019, Fall 2018, Spring 2018
Computer Science 36 is a seminar for CS Scholars who are concurrently taking CS61A: The Structure and Interpretation of Computer Programs. CS Scholars is a cohort-model program to provide support in exploring and potentially declaring a CS major for students with little to no computational background prior to coming to the university. CS 36 provides an introduction to the CS curriculum at UC Berkeley, and the overall CS landscape in both industry and academia—through the lens of accessibility and its relevance to diversity. Additionally, CS36 provides technical instruction to review concepts in CS61A, in order to support CS Scholars' individual learning and success in the CS61A course.
Objectives & Outcomes

Student Learning Outcomes: Students will know where to find several support services including tutoring, advising, counseling, and career advice.
Students will perform as well as possible in the CS61A prerequisite for the CS major. They will also have customized program plans for completing the major within four years.

Rules & Requirements

Prerequisites: Prerequisite satisfied Concurrently: Participating in the CS Scholars program, and concurrently taking COMPSCI 61A

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Alternative to final exam.

Instructor: Hunn

COMPSCI 39 Freshman/Sophomore Seminar 1.5 - 2 Units

Terms offered: Spring 2025, Fall 2023, Spring 2022
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester. Enrollment limits are set by the faculty, but the suggested limit is 25.
Rules & Requirements

Prerequisites: Priority given to freshmen and sophomores

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-3 hours of seminar per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final Exam To be decided by the instructor when the class is offered.

COMPSCI 47A Completion of Work in Computer Science 61A 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
Implementation of generic operations. Streams and iterators. Implementation techniques for supporting functional, object-oriented, and constraint-based programming in the Scheme programming language. Together with 9D, 47A constitutes an abbreviated, self-paced version of 61A for students who have already taken a course equivalent to 61B.
Rules & Requirements

Prerequisites: COMPSCI 61B, COMPSCI 9D, and consent of instructor

Credit Restrictions: Students will receive no credit for 47A after taking 61A.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of self-paced per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Garcia

COMPSCI 47B Completion of Work in Computer Science 61B 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
Iterators. Hashing, applied to strings and multi-dimensional structures. Heaps. Storage management. Design and implementation of a program containing hundreds of lines of code. Students who have completed a portion of the subject matter of COMPSCI 61B may, with consent of instructor, complete COMPSCI 61B in this self-paced course. Please note that students in the College of Engineering are required to receive additional permission from the College as well as the EECS department for the course to count in place of COMPSCI 61B.

Rules & Requirements

Prerequisites: A course in data structures, COMPSCI 9G, and consent of instructor

Credit Restrictions: Students will receive no credit for 47B after taking 61B.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of self-paced per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Garcia

COMPSCI 47C Completion of Work in Computer Science 61C 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
MIPS instruction set simulation. The assembly and linking process. Caches and virtual memory. Pipelined computer organization. Students with sufficient partial credit in 61C may, with consent of instructor, complete the credit in this self-paced course.

Rules & Requirements

Prerequisites: Experience with assembly language including writing an interrupt handler, COMPSCI 9C, and consent of instructor

Credit Restrictions: Students will receive no credit for COMPSCI 47C after completing COMPSCI 61C, or COMPSCI 61CL.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of self-paced per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Garcia

COMPSCI 61A The Structure and Interpretation of Computer Programs 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
An introduction to programming and computer science focused on abstraction techniques as means to manage program complexity. Techniques include procedural abstraction; control abstraction using recursion, higher-order functions, generators, and streams; data abstraction using interfaces, objects, classes, and generic operators; and language abstraction using interpreters and macros. The course exposes students to programming paradigms, including functional, object-oriented, and declarative approaches. It includes an introduction to asymptotic analysis of algorithms. There are several significant programming projects.

Rules & Requirements

Prerequisites: MATH 51 (may be taken concurrently); or MATH 10A; or MATH 16A; and programming experience equivalent to that gained from a score of 3 or above on the Advanced Placement Computer Science exam

Credit Restrictions: Students will receive no credit for COMPSCI 61A after completing COMPSCI 47A, COMPSCI 61AS, or COMPSCI W61A. A deficient grade in COMPSCI 61A may be removed by taking COMPSCI 61AS, or COMPSCI W61A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1.5 hours of discussion, and 1.5 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 3 hours of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Garcia, Hilfinger

COMPSCI 61B Data Structures 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Fundamental dynamic data structures, including linear lists, queues, trees, and other linked structures; arrays strings, and hash tables. Storage management. Elementary principles of software engineering. Abstract data types. Algorithms for sorting and searching. Introduction to the Java programming language.

Rules & Requirements

Prerequisites: COMPSCI 61A, COMPSCI 88, or ENGIN 7

Credit Restrictions: Students will receive no credit for COMPSCI 61B after completing COMPSCI 61BL, or COMPSCI 47B. A deficient grade in COMPSCI 61B may be removed by taking COMPSCI 61BL.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Hilfinger, Shewchuk

COMPSCI 61BL Data Structures and Programming Methodology 4 Units

Terms offered: Summer 2025 8 Week Session, Summer 2024 8 Week Session, Summer 2023 8 Week Session
The same material as in 61B, but in a laboratory-based format.

Rules & Requirements

Prerequisites: COMPSCI 61A, COMPSCI 88, or ENGIN 7

Credit Restrictions: Students will receive no credit for COMPSCI 61BL after completing COMPSCI 47B, or COMPSCI 61B. A deficient grade in COMPSCI 61BL may be removed by taking COMPSCI 61B.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 6 hours of laboratory per week

Summer: 8 weeks - 2 hours of lecture and 12 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Hilfinger

COMPSCI 61C Great Ideas of Computer Architecture (Machine Structures) 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
The internal organization and operation of digital computers. Machine architecture, support for high-level languages (logic, arithmetic, instruction sequencing) and operating systems (I/O, interrupts, memory management, process switching). Elements of computer logic design. Tradeoffs involved in fundamental architectural design decisions.

Rules & Requirements

Prerequisites: COMPSCI 61A, along with either COMPSCI 61B or COMPSCI 61BL, or programming experience equivalent to that gained in COMPSCI 9C, COMPSCI 9F, or COMPSCI 9G

Credit Restrictions: Students will receive no credit for COMPSCI 61C after completing COMPSCI 61CL.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Garcia, Katz, Stojanovic

COMPSCI 70 Discrete Mathematics and Probability Theory 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Logic, infinity, and induction; applications include undecidability and stable marriage problem. Modular arithmetic and GCDs; applications include primality testing and cryptography. Polynomials; examples include error correcting codes and interpolation. Probability including sample spaces, independence, random variables, law of large numbers; examples include load balancing, existence arguments, Bayesian inference.

Rules & Requirements

Prerequisites: Sophomore mathematical maturity, and programming experience equivalent to that gained with a score of 3 or above on the Advanced Placement Computer Science A exam

Credit Restrictions: Students will receive no credit for Computer Science 70 after taking Mathematics 55.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Summer: 8 weeks - 6 hours of lecture and 4 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Rao, Vazirani, Wagner, Sahai

COMPSCI 84 Sophomore Seminar 1 or 2 Units

Terms offered: Fall 2007
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.

Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

COMPSCI C88C Computational Structures in Data Science 3 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025, Spring 2023, Fall 2022

Development of Computer Science topics appearing in Foundations of Data Science (C8); expands computational concepts and techniques of abstraction. Understanding the structures that underlie the programs, algorithms, and languages used in data science and elsewhere. Mastery of a particular programming language while studying general techniques for managing program complexity, e.g., functional, object-oriented, and declarative programming. Provides practical experience with composing larger systems through several significant programming projects.

Objectives & Outcomes

Course Objectives: Develop a foundation of computer science concepts that arise in the context of data analytics, including algorithm, representation, interpretation, abstraction, sequencing, conditional, function, iteration, recursion, types, objects, and testing, and develop proficiency in the application of these concepts in the context of a modern programming language at a scale of whole programs on par with a traditional CS introduction course.

Student Learning Outcomes: Students will be able to demonstrate a working knowledge of these concepts and a proficiency of programming based upon them sufficient to construct substantial stand-alone programs.

Rules & Requirements

Credit Restrictions: Students will receive no credit for DATA C88C after completing COMPSCI 61A.

Hours & Format

Fall and/or spring: 15 weeks - 2-2 hours of lecture, 2-2 hours of laboratory, and 0-1 hours of supplement per week

Summer: 8 weeks - 4-4 hours of lecture, 4-4 hours of laboratory, and 0-2 hours of supplement per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Ball, Culler, DeNero

Formerly known as: Computer Science 88

Also listed as: DATA C88C

COMPSCI C100 Principles & Techniques of Data Science 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025, Summer 2024 8 Week Session, Fall 2022, Fall 2021, Fall 2020

In this course, students will explore the data science lifecycle, including question formulation, data collection and cleaning, exploratory data analysis and visualization, statistical inference and prediction, and decision-making. This class will focus on quantitative critical thinking and key principles and techniques needed to carry out this cycle. These include languages for transforming, querying and analyzing data; algorithms for machine learning methods including regression, classification and clustering; principles behind creating informative data visualizations; statistical concepts of measurement error and prediction; and techniques for scalable data processing.

Rules & Requirements

Prerequisites: DATA C8 or STAT 20 with a C- or better, or Pass; and COMPSCI 61A, COMPSCI/DATA C88C, or ENGIN 7 with a C- or better, or Pass; Corequisite: MATH 54, 56, 110, EECS 16A, PHYSICS 89 or equivalent linear algebra (C- or better, or Pass, required if completed prior to Data C100)

Credit Restrictions: Students will receive no credit for DATA C100\STAT C100\COMPSCI C100 after completing DATA 100. A deficient grade in DATA C100\STAT C100\COMPSCI C100 may be removed by taking DATA 100.

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 1-1 hours of discussion, and 0-1 hours of laboratory per week

Summer: 8 weeks - 6-6 hours of lecture, 2-2 hours of discussion, and 0-2 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Gonzalez, Nourozi, Perez, Yan

Formerly known as: Statistics C100/Computer Science C100

Also listed as: DATA C100/STAT C100

COMPSCI 152 Computer Architecture and Engineering 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Instruction set architecture, microcoding, pipelining (simple and complex). Memory hierarchies and virtual memory. Processor parallelism: VLIW, vectors, multithreading. Multiprocessors.

Rules & Requirements

Prerequisites: COMPSCI 61C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Summer: 8 weeks - 6 hours of lecture and 4 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Asanovic, Culler, Kubiatowicz, Wawrzynek

COMPSCI 160 User Interface Design and Development 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
The design, implementation, and evaluation of user interfaces. User-centered design and task analysis. Conceptual models and interface metaphors. Usability inspection and evaluation methods. Analysis of user study data. Input methods (keyboard, pointing, touch, tangible) and input models. Visual design principles. Interface prototyping and implementation methodologies and tools. Students will develop a user interface for a specific task and target user group in teams.

Rules & Requirements

Prerequisites: COMPSCI 61B or COMPSCI 61BL

Credit Restrictions: Students will receive no credit for Computer Science 160 after taking Computer Science 260A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Agrawala, Canny, Hartmann, Paulos

COMPSCI 161 Computer Security 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Introduction to computer security. Cryptography, including encryption, authentication, hash functions, cryptographic protocols, and applications. Operating system security, access control. Network security, firewalls, viruses, and worms. Software security, defensive programming, and language-based security. Case studies from real-world systems.

Rules & Requirements

Prerequisites: COMPSCI 61B, COMPSCI 61C, and COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture and 1-1.5 hours of discussion per week

Summer: 8 weeks - 6-6 hours of lecture and 2-3 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Paxson, Song, Wagner

COMPSCI 162 Operating Systems and System Programming 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Basic concepts of operating systems and system programming. Utility programs, subsystems, multiple-program systems. Processes, interprocess communication, and synchronization. Memory allocation, segmentation, paging. Loading and linking, libraries. Resource allocation, scheduling, performance evaluation. File systems, storage devices, I/O systems. Protection, security, and privacy.

Rules & Requirements

Prerequisites: COMPSCI 61B, COMPSCI 61C, and COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Joseph, Kubiatowicz, Stoica

COMPSCI 164 Programming Languages and Compilers 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Survey of programming languages. The design of modern programming languages. Principles and techniques of scanning, parsing, semantic analysis, and code generation. Implementation of compilers, interpreters, and assemblers. Overview of run-time organization and error handling.

Rules & Requirements

Prerequisites: COMPSCI 61B and COMPSCI 61C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Bodik, Hilfinger, Necula

COMPSCI 168 Introduction to the Internet: Architecture and Protocols 4 Units

Terms offered: Summer 2025 8 Week Session, Spring 2025, Fall 2024
This course is an introduction to the Internet architecture. We will focus on the concepts and fundamental design principles that have contributed to the Internet's scalability and robustness and survey the various protocols and algorithms used within this architecture. Topics include layering, addressing, intradomain routing, interdomain routing, reliable delivery, congestion control, and the core protocols (e.g., TCP, UDP, IP, DNS, and HTTP) and network technologies (e.g., Ethernet, wireless).

Rules & Requirements

Prerequisites: COMPSCI 61B; COMPSCI 61C is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Katz, Paxson, Ratnasamy, Shenker, Stoica

COMPSCI 169A Introduction to Software Engineering 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Fall 2024
Ideas and techniques for designing, developing, and modifying large software systems. Service-oriented architecture, behavior-driven design with user stories, cloud computing, test-driven development, automated testing, cost and quality metrics for maintainability and effort estimation, practical performance and security in software operations, design patterns and refactoring, specification and documentation, agile project team organization and management.

Objectives & Outcomes

Student Learning Outcomes: Students will learn how to approach and add functionality to a legacy code base;
Students will learn how to identify, measure, and resolve maintainability problems in code;
Students will learn how to work with nontechnical customers and convert customer requirements into a software plan that can be effort-estimated, built, and deployed to the public cloud, including the use of behavior-driven design, user stories, and velocity;
Students will learn how to write automated tests and measure test coverage;
Students will learn practical security and performance considerations for SaaS applications.
Students will learn the architecture and machinery of software as a service; the agile/XP methodology for software development and how it compares with other methodologies, including "Plan-and-document" methodologies;
Students will learn the role of software design patterns in refactoring, and how to identify opportunities to use them;

Rules & Requirements

Prerequisites: COMPSCI C88C or DATA C88C or COMPSCI 61A or COMPSCI 47A; and COMPSCI 61B or COMPSCI 61BL or COMPSCI 47B

Credit Restrictions: Students will receive no credit for COMPSCI 169A after completing COMPSCI 169, or COMPSCI W169A. A deficient grade in COMPSCI 169A may be removed by taking COMPSCI 169, or COMPSCI W169A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Fox, Ball

COMPSCI 169L Software Engineering Team Project 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Open-ended design project enhancing or creating software for real customers in an agile team setting. Teamwork coordination, effective customer meetings, pre- and post-iteration team meetings, running scrums and standups, technical communication. Contributing as a team to an open-source project; tools and workflows associated with open source collaboration, including fork-and-pull, rebase, upstream merge, continuous deployment & integration.

Objectives & Outcomes

Course Objectives: Students will work in a team to develop new software or enhance existing software for a customer with a real business need.

Student Learning Outcomes: Students will learn how to conduct effective meetings with nontechnical customers and work with their feedback;
Students will learn how to coordinate teamwork on developing, testing, and deploying features; and in most cases, how to approach a legacy codebase and add features to it.
Students will learn to run a small team including rotation of team roles such as product owner, scrum master, and so on;

Rules & Requirements

Prerequisites: COMPSCI 169A or COMPSCI W169A

Credit Restrictions: Students will receive no credit for COMPSCI 169L after completing COMPSCI 169.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of discussion and 8 hours of fieldwork per week

Summer: 8 weeks - 6 hours of discussion and 16 hours of fieldwork per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Fox, Sen

COMPSCI 170 Efficient Algorithms and Intractable Problems 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Concept and basic techniques in the design and analysis of algorithms; models of computation; lower bounds; algorithms for optimum search trees, balanced trees and UNION-FIND algorithms; numerical and algebraic algorithms; combinatorial algorithms. Turing machines, how to count steps, deterministic and nondeterministic Turing machines, NP-completeness. Unsolvable and intractable problems.

Rules & Requirements

Prerequisites: COMPSCI 61B and COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Demmel, Papadimitriou, Rao, Wagner, Vazirani

COMPSCI 171 Cryptography 4 Units

Terms offered: Spring 2024, Spring 2021
Cryptography or cryptology is the science of designing algorithms and protocols for enabling parties to communicate and compute securely in an untrusted environment (e.g. secure communication, digital signature, etc.) Over the last four decades, cryptography has transformed from an ad hoc collection of mysterious tricks into a rigorous science based on firm complexity-theoretic foundations. This modern complexity-theoretic approach to cryptography will be the focus. E.g., in the context of encryption we will begin by giving a precise mathematical definition for what it means to be a secure encryption scheme and then give a construction (realizing this security notion) assuming various computational hardness assumptions (e.g. factoring).

Rules & Requirements

Prerequisites: COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Garg

COMPSCI 172 Computability and Complexity 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2022
Finite automata, Turing machines and RAMs. Undecidable, exponential, and polynomial-time problems. Polynomial-time equivalence of all reasonable models of computation. Nondeterministic Turing machines. Theory of NP-completeness: Cook's theorem, NP-completeness of basic problems. Selected topics in language theory, complexity and randomness.

Rules & Requirements

Prerequisites: COMPSCI 170

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Papadimitriou, Seshia, Sinclair, Vazirani

COMPSCI 174 Combinatorics and Discrete Probability 4 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022
Permutations, combinations, principle of inclusion and exclusion, generating functions, Ramsey theory. Expectation and variance, Chebychev's inequality, Chernov bounds. Birthday paradox, coupon collector's problem, Markov chains and entropy computations, universal hashing, random number generation, random graphs and probabilistic existence bounds.

Rules & Requirements

Prerequisites: COMPSCI 170

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Bartlett, Papadimitriou, Sinclair, Vazirani

COMPSCI 176 Algorithms for Computational Biology 4 Units

Terms offered: Fall 2020, Fall 2018, Fall 2017
Algorithms and probabilistic models that arise in various computational biology applications: suffix trees, suffix arrays, pattern matching, repeat finding, sequence alignment, phylogenetics, genome rearrangements, hidden Markov models, gene finding, motif finding, stochastic context free grammars, RNA secondary structure. There are no biology prerequisites for this course, but a strong quantitative background will be essential.

Rules & Requirements

Prerequisites: COMPSCI 70 and COMPSCI 170; experience programming in a language such as C, C++, Java, or Python

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Song

COMPSCI C176 Algorithms for Computational Biology 4 Units

Terms offered: Spring 2025, Fall 2022
This course will provide familiarity with algorithms and probabilistic models that arise in various computational biology applications, such as suffix trees, suffix arrays, pattern matching, repeat finding, sequence alignment, phylogenetics, hidden Markov models, gene finding, motif finding, linear/logistic regression, random forests, convolutional neural networks, genome-wide association studies, pathogenicity prediction, and sequence-to-epigenome prediction.

Objectives & Outcomes

Student Learning Outcomes: Understand the basic elements of molecular, cell, and evolutionary biology.
Understand the key probabilistic and machine learning models used in computational biology applications.
Understand various data structures and algorithms that arise in computational biology.

Rules & Requirements

Prerequisites: COMPSCI 70 and COMPSCI 170, MATH 54 or EECS 16A or an equivalent linear algebra course

Credit Restrictions: Students will receive no credit for COMPSCI C176 after completing COMPSCI 176. A deficient grade in COMPSCI C176 may be removed by taking COMPSCI 176.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Song, Yun, Ioannidis

Also listed as: CMPBIO C176

COMPSCI C177 Algorithmic Economics 4 Units

Terms offered: Spring 2025, Spring 2024
The class provides an introduction to algorithmic questions in economic design. The class will cover problems of public goods and social choice, as well as allocative questions and private consumption. The focus is on normative questions: From the perspective of social goals, these are efficiency, fairness, and equity. In terms of private goals, the focus is on revenue maximization. The course will cover voting, fair division, pricing and market mechanisms. There is an emphasis on the algorithmic questions that arise naturally in economic design.

Rules & Requirements

Prerequisites: Students should be comfortable with formal mathematical proofs, and will be expected to write proofs on their own

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: ECON C147

COMPSCI 180 Intro to Computer Vision and Computational Photography 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This advanced undergraduate course introduces students to computing with visual data (images and video). We will cover acquisition, representation, and manipulation of visual information from digital photographs (image processing), image analysis and visual understanding (computer vision), and image synthesis (computational photography). Key algorithms will be presented, ranging from classical to contemporary, with an emphasis on using these techniques to build practical systems. The hands-on emphasis will be reflected in the programming assignments, where students will acquire their own images and develop, largely from scratch, image analysis and synthesis tools for real-world applications.

Objectives & Outcomes

Course Objectives: Students will learn classic algorithms in image manipulation with Gaussian and Laplacian Pyramids, understand the hierarchy of image transformations including homographies, and how to warp an image with these transformations.
Students will learn how to apply Convolutional Neural Networks for computer vision problems and how they can be used for image manipulation.
Students will learn the fundamentals of 3D vision: stereo, multi-view geometry, camera calibration, structure-from-motion, multi-view stereo, and the plenoptic function.
Students will learn the fundamentals of image processing from the mechanics of a pin-hole camera, representation of images as pixels, physics of light and the process of image formation, to manipulating the visual information using signal processing techniques in the spatial and frequency domains.

Student Learning Outcomes: After this class, students will be comfortable implementing, from scratch, these algorithms in modern programming languages and deep learning libraries.

Rules & Requirements

Prerequisites: COMPSCI 61B; MATH 53; and MATH 54, MATH 56, MATH 110, or EECS 16A. COMPSCI C182 or COMPSCI 189 should be taken as a co-requisite

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Efros, Kanazawa

COMPSCI C182 Designing, Visualizing and Understanding Deep Neural Networks 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024, Spring 2008
Deep Networks have revolutionized computer vision, language technology, robotics and control. They have growing impact in many other areas of science and engineering. They do not however, follow a closed or compact set of theoretical principles. In Yann Lecun's words they require "an interplay between intuitive insights, theoretical modeling, practical implementations, empirical studies, and scientific analyses." This course attempts to cover that ground.

Objectives & Outcomes

Student Learning Outcomes: Students will come to understand visualizing deep networks. Exploring the training and use of deep networks with visualization tools.
Students will learn design principles and best practices: design motifs that work well in particular domains, structure optimization and parameter optimization.
Understanding deep networks. Methods with formal guarantees: generative and adversarial models, tensor factorization.

Rules & Requirements

Prerequisites: MATH 53, MATH 54, and COMPSCI 61B; COMPSCI 70 or STAT 134; COMPSCI 189 is recommended

Credit Restrictions: Students will receive no credit for COMPSCI 182 after completing COMPSCI W182, or COMPSCI L182. A deficient grade in COMPSCI 182 may be removed by taking COMPSCI L182, COMPSCI W182, COMPSCI W182, or COMPSCI L182.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Gonzalez

Formerly known as: Computer Science 182

Also listed as: DATA C182

COMPSCI 184 Foundations of Computer Graphics 4 Units

Terms offered: Summer 2025 8 Week Session, Spring 2025, Spring 2024

Techniques of modeling objects for the purpose of computer rendering: boundary representations, constructive solids geometry, hierarchical scene descriptions. Mathematical techniques for curve and surface representation. Basic elements of a computer graphics rendering pipeline; architecture of modern graphics display devices. Geometrical transformations such as rotation, scaling, translation, and their matrix representations. Homogeneous coordinates, projective and perspective transformations. Algorithms for clipping, hidden surface removal, rasterization, and anti-aliasing. Scan-line based and ray-based rendering algorithms. Lighting models for reflection, refraction, transparency.

Rules & Requirements

Prerequisites: COMPSCI 61B or COMPSCI 61BL; programming skills in C, C++, or Java; linear algebra and calculus

Credit Restrictions: Students will receive no credit for Comp Sci 184 after taking Comp Sci 284A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: O'Brien, Ng

COMPSCI 185 Deep Reinforcement Learning, Decision Making, and Control 3 Units

Terms offered: Prior to 2007

This course will cover the intersection of control, reinforcement learning, and deep learning. This course will provide an advanced treatment of the reinforcement learning formalism, the most critical model-free reinforcement learning algorithms (policy gradients, value function and Q-function learning, and actor-critic), a discussion of model-based reinforcement learning algorithms, an overview of imitation learning, and a range of advanced topics, including exploration, model-based learning with video prediction, transfer learning, multi-task learning, and meta-learning. Homework assignments will cover imitation learning, policy gradients, Q-learning, and model-based reinforcement learning, as well as a final project.

Rules & Requirements

Prerequisites: CS189/289A or equivalent is a prerequisite for the course. This course will assume some familiarity with reinforcement learning, numerical optimization and machine learning, as well as a basic working knowledge of how to train deep neural networks (which is taught in CS182 and briefly covered in CS189)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Levine

COMPSCI 186 Introduction to Database Systems 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024
Access methods and file systems to facilitate data access. Hierarchical, network, relational, and object-oriented data models. Query languages for models. Embedding query languages in programming languages. Database services including protection, integrity control, and alternative views of data. High-level interfaces including application generators, browsers, and report writers. Introduction to transaction processing. Database system implementation to be done as term project.
Rules & Requirements

Prerequisites: COMPSCI 61C or COMPSCI 47C. COMPSCI 47C may be taken as a co-requisite for transfer students

Credit Restrictions: Students will receive no credit for COMPSCI 186 after completing COMPSCI W186. A deficient grade in COMPSCI 186 may be removed by taking COMPSCI W186.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Cheung, Hellerstein

COMPSCI C187 Data Engineering 4 Units

Terms offered: Fall 2025, Spring 2025
This course will cover the principles and practices of managing data at scale, with a focus on use cases in data analysis and machine learning. We will cover the entire life cycle of data management and science, ranging from data preparation to exploration, visualization and analysis, to machine learning and collaboration, with a focus on ensuring reliable, scalable operationalization.
Rules & Requirements

Prerequisites: COMPSCI 61B, or INFO 206B, or equivalent courses in programming with a C- or better, or Pass; and COMPSCI C100 / DATA C100 / STAT C100, or COMPSCI 189, or INFO 251, or DATA 144, or equivalent upper-division course in data science with a C- or better, or Pass

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Hellerstein, Jain, Parameswaran, Yan

Formerly known as: Data Science, Undergraduate 101

Also listed as: DATA C101

COMPSCI 188 Introduction to Artificial Intelligence 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Ideas and techniques underlying the design of intelligent computer systems. Topics include search, game playing, knowledge representation, inference, planning, reasoning under uncertainty, machine learning, robotics, perception, and language understanding.
Rules & Requirements

Prerequisites: COMPSCI 61A, COMPSCI 61B, and COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture and 1-1.5 hours of discussion per week

Summer: 8 weeks - 6-6 hours of lecture and 2-3 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Abbeel, Klein, Russell

COMPSCI 189 Introduction to Machine Learning 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Theoretical foundations, algorithms, methodologies, and applications for machine learning. Topics may include supervised methods for regression and classication (linear models, trees, neural networks, ensemble methods, instance-based methods); generative and discriminative probabilistic models; Bayesian parametric learning; density estimation and clustering; Bayesian networks; time series models; dimensionality reduction; programming projects covering a variety of real-world applications.
Rules & Requirements

Prerequisites: MATH 53 and MATH 54; and COMPSCI 70 or consent of instructor

Credit Restrictions: Students will receive no credit for Comp Sci 189 after taking Comp Sci 289A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Abbeel, Bartlett, Darrell, El Ghaoui, Jordan, Klein, Malik, Russell

COMPSCI C191 Introduction to Quantum Computing 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
This multidisciplinary course provides an introduction to fundamental conceptual aspects of quantum mechanics from a computational and informational theoretic perspective, as well as physical implementations and technological applications of quantum information science. Basic sections of quantum algorithms, complexity, and cryptography, will be touched upon, as well as pertinent physical realizations from nanoscale science and engineering.
Rules & Requirements

Prerequisites: Linear Algebra (EECS 16A or PHYSICS 89 or MATH 54) AND either discrete mathematics (COMPSCI 70 or MATH 55), or quantum mechanics (PHYSICS 7C or PHYSICS 137A or CHEM 120A)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191/PHYSICS C191

COMPSCI 194 Special Topics 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Topics will vary semester to semester. See the Computer Science Division announcements.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of lecture per week

Summer: 8 weeks - 2-8 hours of lecture per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

COMPSCI 195 Social Implications of Computer Technology 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
Topics include electronic community; the changing nature of work; technological risks; the information economy; intellectual property; privacy; artificial intelligence and the sense of self; pornography and censorship; professional ethics. Students will lead discussions on additional topics.
Rules & Requirements

Credit Restrictions: Students will receive no credit for 195 after taking C195/Interdisciplinary Field Study C155 or H195.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Harvey

COMPSCI H195 Honors Social Implications of Computer Technology 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Topics include electronic community; the changing nature of work; technological risks; the information economy; intellectual property; privacy; artificial intelligence and the sense of self; pornography and censorship; professional ethics. Students may lead discussions on additional topics.
Rules & Requirements

Credit Restrictions: Student will receive no credit for H195 after taking 195 or C195.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Harvey

COMPSCI H196A Senior Honors Thesis Research 1 - 4 Units

Terms offered: Fall 2021, Fall 2020, Fall 2016
Thesis work under the supervision of a faculty member. To obtain credit the student must, at the end of two semesters, submit a satisfactory thesis to the Electrical Engineering and Computer Science department archive. A total of four units must be taken. The units many be distributed between one or two semesters in any way. H196A-H196B count as graded technical elective units, but may not be used to satisfy the requirement for 27 upper division technical units in the College of Letters and Science with a major in Computer Science.

Rules & Requirements

Prerequisites: Open only to students in the computer science honors program

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

COMPSCI H196B Senior Honors Thesis Research 1 - 4 Units

Terms offered: Spring 2023, Spring 2010, Spring 2009
Thesis work under the supervision of a faculty member. To obtain credit the student must, at the end of two semesters, submit a satisfactory thesis to the Electrical Engineering and Computer Science department archive. A total of four units must be taken. The units many be distributed between one or two semesters in any way. H196A-H196B count as graded technical elective units, but may not be used to satisfy the requirement for 27 upper division technical units in the College of Letters and Science with a major in Computer Science.

Rules & Requirements

Prerequisites: Open only to students in the computer science honors program

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

COMPSCI 197 Field Study 1 - 4 Units

Terms offered: Fall 2023, Spring 2019, Fall 2018
Students take part in organized individual field sponsored programs with off-campus companies or tutoring/mentoring relevant to specific aspects and applications of computer science on or off campus. Note Summer CPT or OPT students: written report required. Course does not count toward major requirements, but will be counted in the cumulative units toward graduation.

Rules & Requirements

Prerequisites: Consent of instructor (see department adviser)

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of fieldwork per week

Summer:
6 weeks - 2.5-10 hours of fieldwork per week
8 weeks - 2-7.5 hours of fieldwork per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

COMPSCI 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Group study of selected topics in Computer Sciences, usually relating to new developments.

Rules & Requirements

Prerequisites: 2.0 GPA or better; 60 units completed

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

COMPSCI 199 Supervised Independent Study 1 - 4 Units

Terms offered: Fall 2021, Spring 2020, Fall 2018
Supervised independent study. Enrollment restrictions apply.
Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Electrical Engineering

EL ENG 24 Freshman Seminar 1 Unit

Terms offered: Fall 2022, Fall 2021, Fall 2017
The Freshman Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman seminars are offered in all campus departments, and topics may vary from department to department and semester to semester.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

EL ENG 25 What Electrical Engineers Do--Feedback from Recent Graduates 1 Unit

Terms offered: Fall 2011
A Berkeley Electrical Engineering and Computer Sciences degree opens the door to many opportunities, but what exactly are they? Graduation is only a few years away and it's not too early to find out. In this seminar students will hear from practicing engineers who recently graduated. What are they working on? Are they working in a team? What do they wish they had learned better? How did they find their jobs?
Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Boser

EL ENG 39 Freshman/Sophomore Seminar 2 - 4 Units

Terms offered: Spring 2025, Spring 2023, Fall 2022
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester. Enrollment limits are set by the faculty, but the suggested limit is 25.
Rules & Requirements

Prerequisites: Priority given to freshmen and sophomores

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

EL ENG 42 Introduction to Digital Electronics 3 Units

Terms offered: Fall 2013, Summer 2013 8 Week Session, Spring 2013
Introduction to the principles of electrical engineering, starting from the basic concepts of voltage and current and circuit elements of resistors, capacitors, and inductors. Kirchhoff's voltage and current laws with Thevenin and Norton equivalents. Operational amplifiers with feedback. Semiconductor devices including diodes and MOSFETS and their IV characteristics. Applications of diodes for rectification, and design of MOSFETs in common source amplifiers. Digital logic gates and design using CMOS as well as simple flip-flops. Speed and scaling issues for CMOS. The course includes as motivating examples designs of high level applications including logic circuits, amplifiers, power supplies, and communication links.

Rules & Requirements

Prerequisites: MATH 52

Credit Restrictions: Students will receive no credit for 42 after taking 40 or 100.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 49 Electronics for the Internet of Things 4 Units

Terms offered: Spring 2020, Spring 2019, Fall 2018
Electronics has become pervasive in our lives as a powerful technology with applications in a wide range of fields including healthcare, environmental monitoring, robotics, or entertainment. This course teaches how to build electronic circuits that interact with the environment through sensors and actuators and how to communicate wirelessly with the internet to cooperate with other devices and with humans. In the laboratory students design and build representative samples such as solar harvesters, robots, that exchange information with or are controlled from the cloud.

Objectives & Outcomes

Course Objectives: Electronics has become a powerful and ubiquitous technology supporting solutions to a wide range of applications in fields ranging from science, engineering, healthcare, environmental monitoring, transportation, to entertainment. The objective of this course is to teach students majoring in these and related subjects how to use electronic devices to solve problems in their areas of expertise.
Through the lecture and laboratory, students gain insight into the possibilities and limitations of the technology and how to use electronics to help solve problems. Students learn to use electronics to interact with the environment through sound, light, temperature, motion using sensors and actuators, and how to use electronic computation to orchestrate the interactions and exchange information wirelessly over the internet.

Student Learning Outcomes: Deploy electronic sensors and interface them to microcontrollers through digital and analog channels as well as common protocols (I2C, SPI),
Design, build and test electronic devices leveraging these concepts.
Interact with the internet and cloud services using protocols such as http, MQTT, Blynk,
Interface DC motors, steppers and servos to microcontrollers,
Represent information with voltage, current, power, and energy and how to measure these quantities with laboratory equipment,
To use and program low-cost and low-power microcontrollers for sensing, actuation, and information processing, and find and use program libraries supporting these tasks
Understand and make basic low-pass and high-pass filters, Wheatstone bridge etc.
Use electronics to sense and actuate physical parameters such as temperature, humidity, sound, light, and motion,

Rules & Requirements

Prerequisites: ENGIN 7, COMPSCI 10, or equivalent background in computer programming (including COMPSCI 61A or COMPSCI C8 / INFO C8 / STAT C8); MATH 51 or equivalent background in Calculus

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 2 hours of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Boser

EL ENG 84 Sophomore Seminar 1 or 2 Units

Terms offered: Spring 2025, Fall 2022, Spring 2022
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.

Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 1.5-3.5 hours of seminar per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

EL ENG 97 Field Study 1 - 4 Units

Terms offered: Summer 2024 3 Week Session, Spring 2016, Fall 2015
Students take part in organized individual field sponsored programs with off-campus companies or tutoring/mentoring relevant to specific aspects and applications of computer science on or off campus. Note Summer CPT or OPT students: written report required. Course does not count toward major requirements, but will be counted in the cumulative units toward graduation.

Rules & Requirements

Prerequisites: Consent of instructor (see department adviser)

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of fieldwork per week

Summer:
6 weeks - 2.5-10 hours of fieldwork per week
8 weeks - 2-7.5 hours of fieldwork per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EL ENG 98 Directed Group Study for Undergraduates 1 - 4 Units

Terms offered: Fall 2021, Fall 2020, Fall 2016
Group study of selected topics in electrical engineering, usually relating to new developments.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EL ENG 99 Individual Study and Research for Undergraduates 1 - 4 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Supervised independent study and research for students with fewer than 60 units completed.

Rules & Requirements

Prerequisites: Freshman or sophomore standing and consent of instructor. Minimum GPA of 3.4 required

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EL ENG 105 Microelectronic Devices and Circuits 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
This course covers the fundamental circuit and device concepts needed to understand analog integrated circuits. After an overview of the basic properties of semiconductors, the p-n junction and MOS capacitors are described and the MOSFET is modeled as a large-signal device. Two port small-signal amplifiers and their realization using single stage and multistage CMOS building blocks are discussed. Sinusoidal steady-state signals are introduced and the techniques of phasor analysis are developed, including impedance and the magnitude and phase response of linear circuits. The frequency responses of single and multi-stage amplifiers are analyzed. Differential amplifiers are introduced.
Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Credit Restrictions: Students will receive no credit for EL ENG 105 after completing EL ENG 240A, or EL ENG 140.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG C106A Introduction to Robotics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
An introduction to the kinematics, dynamics, and control of robot manipulators, robotic vision, and sensing. The course covers forward and inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, and control. It presents elementary principles on proximity, tactile, and force sensing, vision sensors, camera calibration, stereo construction, and motion detection. The course concludes with current applications of robotics in active perception, medical robotics, and other areas.
Rules & Requirements

Prerequisites: EL ENG 120 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Bajcsy

Formerly known as: Electrical Engineering C125/Bioengineering C125

Also listed as: BIO ENG C125

EL ENG C106B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2017, Spring 2016
This course is a sequel to Electrical Engineering C106A/Bioengineering C125, which covers kinematics, dynamics and control of a single robot. This course will cover dynamics and control of groups of robotic manipulators coordinating with each other and interacting with the environment. Concepts will include an introduction to grasping and the constrained manipulation, contacts and force control for interaction with the environment. We will also cover active perception guided manipulation, as well as the manipulation of non-rigid objects. Throughout, we will emphasize design and human-robot interactions, and applications to applications in manufacturing, service robotics, tele-surgery, and locomotion.
Rules & Requirements

Prerequisites: EECS C106A / BIO ENG C125 or consent of the instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Bajcsy, Sastry

Also listed as: BIO ENG C125B

EL ENG 108 Introduction to Electric Power and Renewable Energy 4 Units

Terms offered: Spring 2025, Spring 2024
This course is designed to provide an introduction to electric power conversion, distribution, and generation with renewable energy sources. The course will introduce fundamental concepts in the area of electric power, such as complex and reactive power, phasors, impedance, magnetic circuits and transformers, power factor, power quality, three-phase power, ac-dc conversion, and a conceptual overview of renewable energy and the integration of sustainable energy sources on the electric grid.Real world applications, ranging from ground-fault circuit interrupters to residential power distribution and solar photovoltaic dc-ac inverters will be explored in live lecture demonstration.

Rules & Requirements

Prerequisites: MATH 54; PHYSICS 7B, EECS 16A; EECS 16B; and a basic working knowledge of RLC circuits

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Pilawa

EL ENG 113 Power Electronics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Power conversion circuits and techniques. Characterization and design of magnetic devices including transformers, reactors, and electromagnetic machinery. Characteristics of bipolar and MOS power semiconductor devices. Applications to motor control, switching power supplies, lighting, power systems, and other areas as appropriate.

Rules & Requirements

Prerequisites: EL ENG 105 or background in circuit analysis (KVL, KCL, voltage/current relationships, etc.)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Pilawa, Boles

EL ENG 113B Power Electronics Design 4 Units

Terms offered: Spring 2025, Spring 2024
This course is the second in a two-semester series to equip students with the skills needed to analyze, design, and prototype power electronic converters. While EE 113/213A provides an overview of power electronics fundamentals and applications, EE 113B/213B focuses on the practical design and hardware implementation of power converters. The primary focus of EE 113B/213B is time in the laboratory, with sequential modules on topics such as power electronic components, PCB layout, closed-loop control, and experimental validation. At the end of the course, students will have designed, prototyped, and validated a power converter from scratch, demonstrating a skill set that is critical for power electronics engineers in research and industry.

Rules & Requirements

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Boles

EL ENG 117 Electromagnetic Fields and Waves 4 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024
Review of static electric and magnetic fields and applications; Maxwell's equations; transmission lines; propagation and reflection of plane waves; introduction to guided waves, microwave networks, and radiation and antennas. Minilabs on statics, transmission lines, and waves. Explanation of cellphone antennas, WiFi communication, and other wireless technologies.

Rules & Requirements

Prerequisites: EECS 16B, MATH 53, and MATH 54; PHYSICS 7B or equivalent that covers AC circuits and electromagnetics up to Maxwell's equations

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Yablonovitch

EL ENG 118 Introduction to Optical Engineering 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Fundamental principles of optical systems. Geometrical optics and aberration theory. Stops and apertures, prisms, and mirrors. Diffraction and interference. Optical materials and coatings. Radiometry and photometry. Basic optical devices and the human eye. The design of optical systems. Lasers, fiber optics, and holography.

Rules & Requirements

Prerequisites: MATH 53; EECS 16A and EECS 16B, or MATH 54

Credit Restrictions: Students will receive no credit for Electrical Engineering 118 after taking Electrical Engineering 218A. A deficient grade in Electrical Engineering 119 may be removed by taking Electrical Engineering 118.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Waller, Kante

EL ENG 120 Signals and Systems 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Continuous and discrete-time transform analysis techniques with illustrative applications. Linear and time-invariant systems, transfer functions. Fourier series, Fourier transform, Laplace and Z-transforms. Sampling and reconstruction. Solution of differential and difference equations using transforms. Frequency response, Bode plots, stability analysis. Illustrated by analysis of communication systems and feedback control systems.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture and 1 hour of recitation per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 121 Introduction to Digital Communication Systems 4 Units

Terms offered: Fall 2025, Spring 2016, Fall 2014
Introduction to the basic principles of the design and analysis of modern digital communication systems. Topics include source coding, channel coding, baseband and passband modulation techniques, receiver design, and channel equalization. Applications to design of digital telephone modems, compact disks, and digital wireless communication systems. Concepts illustrated by a sequence of MATLAB exercises.

Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, and COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 122 Introduction to Communication Networks 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course focuses on the fundamentals of the wired and wireless communication networks. The course covers both the architectural principles for making these networks scalable and robust, as well as the key techniques essential for analyzing and designing them. The topics include graph theory, Markov chains, queuing, optimization techniques, the physical and link layers, switching, transport, cellular networks and Wi-Fi.

Rules & Requirements

Prerequisites: COMPSCI 70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 123 Digital Signal Processing 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Discrete time signals and systems: Fourier and Z transforms, DFT, 2-dimensional versions. Digital signal processing topics: flow graphs, realizations, FFT, chirp-Z algorithms, Hilbert transform relations, quantization effects, linear prediction. Digital filter design methods: windowing, frequency sampling, S-to-Z methods, frequency-transformation methods, optimization methods, 2-dimensional filter design.

Rules & Requirements

Prerequisites: EL ENG 120

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 126 Probability and Random Processes 4 Units

Terms offered: Spring 2017, Fall 2016, Spring 2016
This course covers the fundamentals of probability and random processes useful in fields such as networks, communication, signal processing, and control. Sample space, events, probability law. Conditional probability. Independence. Random variables. Distribution, density functions. Random vectors. Law of large numbers. Central limit theorem. Estimation and detection. Markov chains.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG C128 Feedback Control Systems 4 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024, Spring 2023
Analysis and synthesis of linear feedback control systems in transform and time domains. Control system design by root locus, frequency response, and state space methods. Applications to electro-mechanical and mechatronics systems.

Rules & Requirements

Prerequisites: EECS 16A or MEC ENG 100; MEC ENG 132 or EL ENG 120

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: MEC ENG C134

EL ENG 130 Integrated-Circuit Devices 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Overview of electronic properties of semiconductor. Metal-semiconductor contacts, pn junctions, bipolar transistors, and MOS field-effect transistors. Properties that are significant to device operation for integrated circuits. Silicon device fabrication technology.

Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Credit Restrictions: Students will receive no credit for El Eng 130 after taking El Eng 230A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 134 Fundamentals of Photovoltaic Devices 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course is designed to give an introduction to, and overview of, the fundamentals of photovoltaic devices. Students will learn how solar cells work, understand the concepts and models of solar cell device physics, and formulate and solve relevant physical problems related to photovoltaic devices. Monocrystalline, thin film and third generation solar cells will be discussed and analyzed. Light management and economic considerations in a solar cell system will also be covered.
Rules & Requirements

Prerequisites: EECS 16A and EECS 16B; or Math 54 and Physics 7B; or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Arias

EL ENG 137A Introduction to Electric Power Systems 4 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022
Overview of conventional electric power conversion and delivery, emphasizing a systemic understanding of the electric grid with primary focus at the transmission level, aimed toward recognizing needs and opportunities for technological innovation. Topics include aspects of a.c. system design, electric generators, components of transmission and distribution systems, power flow analysis, system planning and operation, performance measures, and limitations of legacy technologies.
Rules & Requirements

Prerequisites: PHYSICS 7B; EECS 16A and EECS 16B, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: von Meier

EL ENG 137B Introduction to Electric Power Systems 4 Units

Terms offered: Spring 2023, Spring 2022, Spring 2021
Overview of recent and potential future evolution of electric power systems with focus on new and emerging technologies for power conversion and delivery, primarily at the distribution level. Topics include power electronics applications, solar and wind generation, distribution system design and operation, electric energy storage, information management and communications, demand response, and microgrids.
Rules & Requirements

Prerequisites: EL ENG 137A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: von Meier

EL ENG 140 Linear Integrated Circuits 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Single and multiple stage transistor amplifiers. Operational amplifiers. Feedback amplifiers, 2-port formulation, source, load, and feedback network loading. Frequency response of cascaded amplifiers, gain-bandwidth exchange, compensation, dominant pole techniques, root locus. Supply and temperature independent biasing and references. Selected applications of analog circuits such as analog-to-digital converters, switched capacitor filters, and comparators. Hardware laboratory and design project.
Rules & Requirements

Prerequisites: EL ENG 105

Credit Restrictions: Students will receive no credit for El Eng 140 after taking El Eng 240A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Alon, Sanders

EL ENG 142 Integrated Circuits for Communications 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
Analysis and design of electronic circuits for communication systems, with an emphasis on integrated circuits for wireless communication systems. Analysis of noise and distortion in amplifiers with application to radio receiver design. Power amplifier design with application to wireless radio transmitters. Radio-frequency mixers, oscillators, phase-locked loops, modulators, and demodulators.

Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, and EL ENG 105

Credit Restrictions: Students will receive no credit for El Eng 142 after taking El Eng 242A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 143 Microfabrication Technology 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Integrated circuit device fabrication and surface micromachining technology. Thermal oxidation, ion implantation, impurity diffusion, film deposition, expitaxy, lithography, etching, contacts and interconnections, and process integration issues. Device design and mask layout, relation between physical structure and electrical/mechanical performance. MOS transistors and poly-Si surface microstructures will be fabricated in the laboratory and evaluated.

Rules & Requirements

Prerequisites: PHYSICS 7B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG 144 Fundamental Algorithms for Systems Modeling, Analysis, and Optimization 4 Units

Terms offered: Spring 2025, Fall 2015, Fall 2014
The modeling, analysis, and optimization of complex systems requires a range of algorithms and design software. This course reviews the fundamental techniques underlying the design methodology for complex systems, using integrated circuit design as example. Topics include design flows, discrete and continuous models and algorithms, and strategies for implementing algorithms efficiently and correctly in software. Laboratory assignments and a class project will expose students to state-of-the-art tools.

Rules & Requirements

Prerequisites: EECS 16A and COMPSCI 70, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Keutzer, Lee, Roychowdhury, Seshia

EL ENG C145B Medical Imaging Signals and Systems 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Biomedical imaging is a clinically important application of engineering, applied mathematics, physics, and medicine. In this course, we apply linear systems theory and basic physics to analyze X-ray imaging, computerized tomography, nuclear medicine, and MRI. We cover the basic physics and instrumentation that characterizes medical image as an ideal perfect-resolution image blurred by an impulse response. This material could prepare the student for a career in designing new medical imaging systems that reliably detect small tumors or infarcts.

Rules & Requirements

Prerequisites: Prerequisites are introductory level skills in Python/Matlab; and either EECS 16A, EECS 16B, and EL ENG 120; or MATH 54, BIO ENG 105, and BIO ENG 101

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Conolly

Also listed as: BIO ENG C165

EL ENG C145L Introductory Electronic Transducers Laboratory 3 Units

Terms offered: Fall 2014, Fall 2013, Fall 2012
Laboratory exercises exploring a variety of electronic transducers for measuring physical quantities such as temperature, force, displacement, sound, light, ionic potential; the use of circuits for low-level differential amplification and analog signal processing; and the use of microcomputers for digital sampling and display. Lectures cover principles explored in the laboratory exercises; construction, response and signal to noise of electronic transducers and actuators; and design of circuits for sensing and controlling physical quantities.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Derenzo

Also listed as: BIO ENG C145L

EL ENG C145M Introductory Microcomputer Interfacing Laboratory 3 Units

Terms offered: Spring 2013, Spring 2012, Spring 2011
Laboratory exercises constructing basic interfacing circuits and writing 20-100 line C programs for data acquisition, storage, analysis, display, and control. Use of the IBM PC with microprogrammable digital counter/timer, parallel I/O port. Circuit components include anti-aliasing filters, the S/H amplifier, A/D and D/A converters. Exercises include effects of aliasing in periodic sampling, fast Fourier transforms of basic waveforms, the use of the Hanning filter for leakage reduction, Fourier analysis of the human voice, digital filters, and control using Fourier deconvolution. Lectures cover principles explored in the lab exercises and design of microcomputer-based systems for data acquisitions, analysis and control.

Rules & Requirements

Prerequisites: EE 16A & 16B

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Derenzo

Also listed as: BIO ENG C145M

EL ENG C145O Laboratory in the Mechanics of Organisms 3 Units

Terms offered: Spring 2015, Spring 2014, Spring 2013, Spring 2012
Introduction to laboratory and field study of the biomechanics of animals and plants using fundamental biomechanical techniques and equipment. Course has a series of rotations involving students in experiments demonstrating how solid and fluid mechanics can be used to discover the way in which diverse organisms move and interact with their physical environment. The laboratories emphasize sampling methodology, experimental design, and statistical interpretation of results. Latter third of course devoted to independent research projects. Written reports and class presentation of project results are required.

Rules & Requirements

Prerequisites: INTEGBI 135 or consent of instructor. For Electrical Engineering and Computer Sciences students: EL ENG 105, EL ENG 120 or COMPSCI 184

Credit Restrictions: Students will receive no credit for C135L after taking 135L.

Hours & Format

Fall and/or spring: 15 weeks - 6 hours of laboratory, 1 hour of discussion, and 1 hour of fieldwork per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Integrative Biology 135L

Also listed as: BIO ENG C136L/INTEGBI C135L

EL ENG 146L Application Specific Integrated Circuits Laboratory 2 Units

Terms offered: Spring 2015
This is a lab course that covers the design of modern Application-Specific Integrated Circuits (ASICs). The labs lay the foundation of modern digital design by first setting-up the scripting and hardware description language base for specification of digital systems and interactions with tool flows. Software testing of digital designs is covered leading into a set of labs that cover the design flow. Digital synthesis, floorplanning, placement and routing are covered, as well as tools to evaluate design timing and power. Chip-level assembly is covered, instantiation of custom IP blocks: I/O pads, memories, PLLs, etc. The labs culminate with a project design – implementation of a 3-stage RISC-V processor with register file and caches.
Objectives & Outcomes

Course Objectives: This course is a one-time offering to supplement the CS150 course offered in the Fall 2014, with a lab and project section that cover the Application-Specific Integrated Circuit Design. The CS150 lectures in the Fall 2014 already covered the necessary lecture material, so students who took the CS150 lab in the Fall of 2014 will have a chance to expand their skills into the area of Application-Specific Integrated Circuit design.
Hence the pre-requisite for this course is that a student has taken the CS150 course in the Fall 2014.

Rules & Requirements

Prerequisites: EECS 16B; EL ENG 105 recommended

Credit Restrictions: Students will receive no credit for Electrical Engineering 146L after taking Fall 2014 version of Electrical Engineering 141/241A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Stojanovic

EL ENG 147 Introduction to Microelectromechanical Systems (MEMS) 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course will teach fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication. It will pay special attention to teaching of fundamentals necessary for the design and analysis of devices and systems in mechanical, electrical, fluidic, and thermal energy/signal domains, and will teach basic techniques for multi-domain analysis. Fundamentals of sensing and transduction mechanisms including capacitive and piezoresistive techniques, and design and analysis of micmicromachined miniature sensors and actuators using these techniques will be covered.
Rules & Requirements

Prerequisites: EECS 16A and EECS 16B

Credit Restrictions: Students will receive no credit for El Eng 147 after taking El Eng 247A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Maharbiz, Nguyen, Pister

EL ENG 192 Mechatronic Design Laboratory 4 Units

Terms offered: Spring 2021, Spring 2020, Spring 2019
Design project course, focusing on application of theoretical principles in electrical engineering to control of a small-scale system, such as a mobile robot. Small teams of students will design and construct a mechatronic system incorporating sensors, actuators, and intelligence.
Rules & Requirements

Prerequisites: EECS 16A, EECS 16B, COMPSCI 61A, COMPSCI 61B, COMPSCI 61C, and EL ENG 120

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 10 hours of laboratory per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Fearing

EL ENG 194 Special Topics 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Topics will vary semester to semester. See the Electrical Engineering announcements.

Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EL ENG H196A Senior Honors Thesis Research 1 - 4 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Thesis work under the supervision of a faculty member. A minimum of four units must be taken; the units may be distributed between one and two semesters in any way. To obtain credit a satisfactory thesis must be submitted at the end of the two semesters to the Electrical and Engineering and Computer Science Department archive. Students who complete four units and a thesis in one semester receive a letter grade at the end of H196A. Students who do not, receive an IP in H196A and must enroll in H196B.

Rules & Requirements

Prerequisites: Open only to students in the Electrical Engineering and Computer Science honors program

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. This is part one of a year long series course. A provisional grade of IP (in progress) will be applied and later replaced with the final grade after completing part two of the series. Final exam required.

EL ENG H196B Senior Honors Thesis Research 1 - 4 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014
Thesis work under the supervision of a faculty member. A minimum of four units must be taken; the units may be distributed between one and two semesters in any way. To obtain credit a satisfactory thesis must be submitted at the end of the two semesters to the Electrical and Engineering and Computer Science Department archive. Students who complete four units and a thesis in one semester receive a letter grade at the end of H196A. Students who do not, receive an IP in H196A and must enroll in H196B.

Rules & Requirements

Prerequisites: Open only to students in the Electrical Engineering and Computer Science honors program

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Letter grade. This is part two of a year long series course. Upon completion, the final grade will be applied to both parts of the series. Final exam required.

EL ENG 197 Field Study 1 - 4 Units

Terms offered: Fall 2023, Fall 2022, Fall 2021
Students take part in organized individual field sponsored programs with off-campus companies or tutoring/mentoring relevant to specific aspects and applications of computer science on or off campus. Note Summer CPT or OPT students: written report required. Course does not count toward major requirements, but will be counted in the cumulative units toward graduation.

Rules & Requirements

Prerequisites: Consent of instructor (see department adviser)

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of fieldwork per week

Summer:
6 weeks - 2.5-10 hours of fieldwork per week
8 weeks - 2-7.5 hours of fieldwork per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EL ENG 198 Directed Group Study for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024
Group study of selected topics in electrical engineering, usually relating to new developments.

Rules & Requirements

Prerequisites: 2.0 GPA or better; 60 units completed

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EL ENG 199 Supervised Independent Study 1 - 4 Units

Terms offered: Summer 2024 10 Week Session, Spring 2023, Fall 2018
Supervised independent study. Enrollment restrictions apply.

Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.