Electrical Engineering and Computer Sciences

Bachelor of Science (BS)

The Berkeley Electrical Engineering and Computer Sciences major (EECS), offered through the College of Engineering, combines fundamentals of computer science and electrical engineering in one major.

The EECS Department offers two undergraduate programs: Electrical and Computer Engineering (ECE), and Computer Science and Engineering (CSE). The ECE Program (Electrical Engineering) is best suited for students interested in focusing on Electrical Engineering upper division classes after completing the lower division requirements. The transcripts of ECE students indicate that their degree is from the Electrical and Computer Engineering program. There are no specific requirements for the ECE program beyond those of the EECS major. The CSE Program (Computer Science) is best suited for students interested in focusing on Computer Science upper division classes after completing the lower division requirements. The transcripts of students in CSE indicate that their degree is from the Computer Science and Engineering Program.

Note that there are two different major programs for Computer Science (http://www.eecs.berkeley.edu/Programs/two_ways.html) at Berkeley. One major leads to the Bachelor of Arts (BA) degree from the College of Letters and Science, and the other, the CSE option within the EECS major, leads to the Bachelor of Science (BS). An essential difference between the two majors is that the EECS program requires a greater number of math and science courses than the CS program, which requires a greater number of non-technical, or breadth, courses. The computer science major under L&S is not accredited. For further information on the BA program, please see the Computer Science program page in this Bulletin (http://guide.berkeley.edu/archive/2014-15/ undergraduate/degree-programs/computer-science).

Accreditation

Both of the EECS programs are accredited by ABET through September 2015.

Honors Program

The Honors Degree Program is designed to provide very talented undergraduate students with more flexibility at the undergraduate level. Honors students select an academic concentration outside of EECS. In addition, students receive a special faculty adviser, engage in research, receive official notation of the honors degree on their Berkeley transcript, and are invited to special events with faculty and EECS Honors alumni.

For more information regarding this program, please click here. (http://www.eecs.berkeley.edu/education/degrees.shtml/#honors)

Admission to the Major

Prospective undergraduates to the College of Engineering will apply for admission to a specific program in the College. For further information, please see the College of Engineering's website (http://coe.berkeley.edu/students/prospective-students/admissions.html).

Admission to Engineering via a Change of College application for current UC Berkeley students is highly unlikely and very competitive as there few, if any, spaces that open in the College each year to students admitted to other colleges at UC Berkeley. For further information regarding a Change of College to Engineering, please see the College's website (http://coe.berkeley.edu/students/current-undergraduates/change-of-college).

Five-Year BS/MS Program

The Five Year Bachelor/Master's Program, called the 5th Year MS Program for short, offers qualified EECS and L&S Computer Science undergraduate students a unique opportunity to begin graduate study during their undergraduate years, thereby accelerating the Master's degree by requiring only one additional year beyond the Bachelor's degree. This is not a concurrent degree program. Students earn their Bachelor's degree first and then the Master's. However, careful planning during the undergraduate program allows motivated students to begin a research project and complete some Master's course requirements while still in undergraduate standing. Depending on how quickly a student progresses through the undergraduate program, the additional graduate year may come sooner than the fifth year at Berkeley. The Five Year Program is not intended for those who wish to pursue a PhD. For further information regarding this program, please see the Department's website (http://www.eecs.berkeley.edu/FiveYearMS).

Minor Program

The EECS minor, offered through the College of Engineering, is an optional program for students interested in coherent EECS study outside of their major. It is open to any undergraduate who has declared a major other than EECS on the UC Berkeley campus; completed two of the four lower division course requirements; and has a GPA (in required lower-division courses) of no more than 0.2 points below the Letters & Science Computer Science Major GPA threshold for the semester in which they are applying. For further information regarding the prerequisites and other requirements, please see the Minor Requirements tab on this page.

The EECS Department also offers a minor in Computer Science. For information regarding this program, please see the Computer Science program page in this Bulletin (http://guide.berkeley.edu/archive/2014-15/ undergraduate/degree-programs/computer-science).

Joint Majors

The EECS Department also offers two joint majors, with other departments in the College of Engineering. For further information on these programs, please click the links below: Electrical Engineering and Computer Sciences/Materials Science and Engineering (http://guide.berkeley.edu/archive/2014-15/undergraduate/ degree-programs/electrical-engineering-computer-sciences-materials) (Department of Materials Science and Engineering) Electrical Engineering and Computer Sciences/Nuclear Engineering (http://guide.berkeley.edu/archive/2014-15/undergraduate/degreeprograms/electrical-engineering-computer-sciences-nuclear-joint-major) (Department of Nuclear Engineering)

In addition to the University, campus, and college requirements, listed on the College Requirements tab, students must fulfill the below requirements specific to their major program.

General Guidelines

- All technical courses (courses in engineering, mathematics, chemistry, physics, statistics, biological sciences, and computer science) must be taken for a letter grade.
- No more than one upper-division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
- 3. A minimum overall grade point average (GPA) of 2.0 is required for all work undertaken at UC Berkeley.
- 4. A minimum GPA of 2.0 is required for all technical courses taken in satisfaction of major requirements.

For information regarding residence requirements and unit requirements, please see the College Requirements tab.

For a detailed plan of study by year and semester, please see the Plan of Study tab.

Summary of Major Requirements

For more detailed curriculum options for the EECS major, please see the EECS Undergraduate notes, available here (http://www.eecs.berkeley.edu/Programs/Notes).

Natural Sciences: Three courses

Mathematics: Five courses

EECS Lower-division Core: Five courses

Upper-division EECS Electives: 20 units minimum

Technical Engineering courses: 45 units minimum

Courses taken to satisfy the EECS Lower-division Core and EECS Upper-division Elective count toward this 45 units.

If courses in these two categories do not total at least 45 units, additional technical, letter-graded courses must be taken to fulfill this requirement

Free Electives:

Students may need to select up to 17 units of Free Electives, in order to meet the 120 units required for graduation. Free electives can be any technical or non-technical course of the student's interest, offered by any department at UC Berkeley, with no restrictions. Free electives can be any technical or non-technical course of the student's interest, offered by any department at UC Berkeley, with no restrictions.

Natural Sciences

PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
Select one course	e from the following:	
ASTRON 7A	Introduction to Astrophysics	
ASTRON 7B	Introduction to Astrophysics	
BIOLOGY 1A	General Biology Lecture	
& 1AL	and General Biology Laboratory	
BIOLOGY 1B	General Biology Lecture and Laboratory	
CHEM 1A	General Chemistry	
& 1AL	and General Chemistry Laboratory	
CHEM 1B	General Chemistry	
CHEM 3A	Chemical Structure and Reactivity	

CHEM 3B	Chemical Structure and Reactivity
CHEM 4A	General Chemistry and Quantitative Analysis
CHEM 4B	General Chemistry and Quantitative Analysis
MCELLBI 32 & 32L	Introduction to Human Physiology and Introduction to Human Physiology Laboratory

PHYSICS 7C Physics for Scientists and Engineers

Any upper-division letter graded course of 3 units or more in Astronomy, Biology, Chemistry, Earth and Planetary Science (other than 170AC or courses numbered 197-199), Integrative Biology, Molecular Cell Biology, Physics, or Plant & Microbial Biology

Mathematics

MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
COMPSCI 70	Discrete Mathematics and Probability Theory	4

EECS Lower-division Core

EL ENG 20	Structure and Interpretation of Systems and Signals	4		
EL ENG 40	Introduction to Microelectronic Circuits	4		
COMPSCI 61A	The Structure and Interpretation of Computer Programs	4		
COMPSCI 61B	Data Structures	4		
or COMPSCI 61BIData Structures and Programming Methodology				
COMPSCI 61C	Machine Structures	4		
or COMPSCI 61CIMachine Structures (Lab-Centric)				

Upper-division EECS Electives

Select a minimum of 2- units from the following:

At least one senior design course must be selected.

EL ENG C125	Course Not Available	4
EL ENG C128	Feedback Control Systems	4
EL ENG 130	Integrated-Circuit Devices	4
EL ENG 140	Linear Integrated Circuits	4
EL ENG 141	Introduction to Digital Integrated Circuits	4
EL ENG 143	Microfabrication Technology	4
EL ENG C149	Introduction to Embedded Systems	4
EL ENG 192	Mechatronic Design Laboratory	4
COMPSCI C149	Introduction to Embedded Systems	4
COMPSCI 150	Components and Design Techniques for Digital Systems	5
COMPSCI 160	User Interface Design and Development	4
COMPSCI 162	Operating Systems and System Programming	4
COMPSCI 164	Programming Languages and Compilers	4
COMPSCI 169	Software Engineering	4
COMPSCI 184	Foundations of Computer Graphics	4
COMPSCI 186	Introduction to Database Systems	4

Minor programs are areas of concentration requiring fewer courses than an undergraduate major. These programs are optional but can provide depth and breadth to a UC Berkeley education. The College of Engineering does not offer additional time to complete a minor, but it is usually possible to finish within the allotted time with careful course planning. Students are encouraged to meet with their ESS Adviser to discuss the feasibility of completing a minor program.

All the engineering departments offer minors. Students may also consider pursuing a minor in another school or college.

General Guidelines

- 1. All courses taken to fulfill the minor requirements must be taken for graded credit.
- A minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the prerequisite courses is required for acceptance into the minor program.
- 3. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
- No more than one upper-division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
- Completion of the minor program cannot delay a student's graduation.

Requirements

Lower-division

EL ENG 20	Structure and Interpretation of Systems and Signals	4		
Select one from the following:				
EL ENG 40	Introduction to Microelectronic Circuits			
PHYSICS 7B & EL ENG 42	Physics for Scientists and Engineers and Introduction to Digital Electronics			
EL ENG 100	Electronic Techniques for Engineering			
Select one from the following:				
COMPSCI 61A	The Structure and Interpretation of Computer			
	Programs ²			
or ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	i		
Select one from the following:				
COMPSCI 61B Data Structures				
COMPSCI 61BIData Structures and Programming Methodology				
COMPSCI 61C Machine Structures				
COMPSCI 61CIMachine Structures (Lab-Centric)				
Upper-division				
Select three upper-division EECS courses, for a total of 9 units minimum ¹				

¹ EL ENG 100 may not be used as one the three upper-division courses.

Students in the College of Engineering must complete 120 semester units with the following provisions:

1. Completion of the requirements of one Engineering major program (http://coe.berkeley.edu/students/guide/departments) of study.

2. A minimum overall grade point average of 2.000 (C average) and a minimum 2.000 grade point average in upper division technical course work required of the major.

3. The final 30 units must be completed in residence in the College of Engineering on the Berkeley campus in two consecutive semesters.

4. All technical courses (math, science & engineering), required of the major or not, must be taken on a letter graded basis (unless they are only offered P/NP).

5. Entering freshman are allowed a maximum of eight semesters to complete their degree requirements. Entering junior transfers are allowed a maximum of four semesters to complete their degree requirements. Summer terms are optional and do not count toward the maximum. Students are responsible for planning and satisfactorily completing all graduation requirements within the maximum allowable semesters.

Humanities and Social Science Requirement

To promote a rich and varied educational experience outside of the technical requirements for each major, the College of Engineering has a Humanities and Social Sciences breadth requirement, which must be completed to graduate. This requirement is built into all the Engineering programs of study. The requirement includes two approved reading and composition courses and four additional approved courses, within which a number of specific conditions must be satisfied.

1. Complete a minimum of six courses (3 units or more) from the approved Humanities/Social Sciences (H/SS) lists (http:// coe.berkeley.edu/hssreq) .

2. Two of the six courses must fulfill the Reading and Composition Requirement. These courses must be taken for a letter grade (C- or better required), and MUST be completed by no later than the end of the sophomore year (4th semester of enrollment). The first half of R&C, the "A" course, must be completed by the end of the freshman year; the second half of R&C, the "B "course, by no later than the end of the sophomore year. For detailed lists of courses that fulfill Reading and Composition requirements, please see the Reading and Composition page (http://guide.berkeley.edu/archive/2014-15/undergraduate/collegesschools/engineering/reading-composition-requirement) in this bulletin.

3. The four additional courses must be chosen from the H/SS comprehensive list. These courses may be taken on a Pass/Not Passed Basis (P/NP).

4. At least two of the six courses must be upper division (courses numbered 100-196).

5. At least two courses must be from the same department and at least one of the two must be upper division. This is called the *Series requirement. AP tests can be combined with a course to complete the series requirement. For example, AP History (any) combined with an upper division History course would satisfy the series requirement

6. One of the six courses must satisfy the campus American Cultures Requirement. For detailed lists of courses that fulfill American Cultures requirements, please see the American Cultures page (http:// guide.berkeley.edu/archive/2014-15/undergraduate/colleges-schools/ engineering/american-cultures-requirement) in this bulletin. 7. A maximum of two exams (Advanced Placement, International Baccalaureate, or A-Level) may be used toward completion of the H/SS requirement. Visit this link (http://coe.berkeley.edu/exams)

8. No courses offered by an Engineering department (IEOR, CE, etc.) other than BIOE 100, CS C79, ENGIN 125, ENGIN 130AC, 157AC, ME 191K and ME 191AC may be used to complete H/SS requirements.

9. Courses may fulfill multiple categories. For example, if you complete City and Regional Planning 115 and 118AC that would satisfy the series requirement, the two upper division courses requirement and the American Cultures Requirement.

10. The College of Engineering (COE) uses modified versions of five of the College of Letters and Science (L&S) breadth requirements lists to provide options to our students for completing the Humanities and Social Science requirement. Our requirement is different than that of L & S, so the guidelines posted on the top of each L & S breadth list do NOT apply to COE students.

11. Foreign language courses MAY be used to complete H/SS requirements. L & S does not allow students to use many language courses, so their lists will not include all options open to Engineering students. For a list of language options, visit http://coe.berkeley.edu/FL

*NOTE: for the Series Requirement: The purpose of the series requirement is to provide depth of knowledge in a certain area. Therefore, a two-course sequence not in the same department may be approved by petition, in cases in which there is a clear and logical connection between the courses involved.

For more detailed information regarding the courses listed below (e.g., elective information, GPA requirements, etc.), please see the Major Requirements tab.

				Freshman
	Fall	Units	Spring	Units
COMPSCI 61A		4	MATH 1B	4
Natural Science course		4	PHYSICS 7A	4
MATH 1A		4	COMPSCI 61B or 61BL	4
Reading and Composition course from List A		4	4 Reading and Composition course from List B	
		16		16
				Sophomore
	Fall	Units	Spring	Units
EL ENG 40		4	COMPSCI 61C or 61CL	4
MATH 53		4	EL ENG 20	4
PHYSICS 7B		4	MATH 54	4
umanities/Social Sciences course 3-4 Humanities Social Sciences course		Humanities/ Social Sciences course	3-4	
		15-16		15-16
				Junior
	Fall	Units	Spring	Units
COMPSCI 70		4	EECS Upper-	12
	division			

EECS Upper-division Electives		8 Humanities/ Social Sciences course		3-4
Ethics/Social Implications of Technology course		3-4		
	1	15-16		15-16
				Senior
	Fall (Units	Spring	Units
Upper-division Technical Electives		6 Free Electi	ves	14
Humanities/Social Sciences course		3-4		
Free Electives		3		
	1	12-13		14

Total Units: 118-123

Mission

- 1. Preparing graduates to pursue post-graduate education in electrical engineering, computer science, or related fields
- Preparing graduates for success in technical careers related to electrical and computer engineering, or computer science and engineering
- 3. Preparing graduates to become leaders in fields related to electrical and computer engineering or computer science and engineering

Learning Goals for the Major

- 1. An ability to apply knowledge of mathematics, science and engineering
- 2. An ability to configure, apply test conditions, and evaluate outcomes of experimental systems
- 3. An ability to design systems, components, or processes that conform to given specifications and cost constraints
- 4. An ability to work cooperatively, respectfully, creatively, and responsibly as a member of a team
- 5. An ability to identify, formulate, and solve engineering problems
- 6. An understanding of the norms of expected behavior in engineering practice and their underlying ethical foundations
- 7. An ability to communicate effectively by oral, written, and graphical means
- 8. An awareness of global and societal concerns and their importance in developing engineering solutions
- 9. An ability to independently acquire and apply required information, and an appreciation of the associated process of life-long learning
- 10A knowledge of contemporary issues
- 11 An in-depth ability to use a combination of software, instrumentation, and experimental techniques practiced in circuits, physical electronics, communication, networks and systems, hardware, programming, and computer science theory

Select a subject to view courses

- Computer Science (p. 5)
- Electrical Engineering and Computer Science (p. 20)

Computer Science

COMPSCI 3L Introduction to Symbolic Programming 4 Units Introduction to computer programming, emphasizing symbolic computation and functional programming style. Students will write a project of at least 200 lines of code in Scheme (a dialect of the LISP programming language).

Rules & Requirements

Prerequisites: High school algebra

Credit Restrictions: Students may remove a deficiency in 3 by taking 3L.

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: Clancy

COMPSCI 3S Introduction to Symbolic Programming (Self-Paced) 1 - 4 Units

The same material as 3 but in a self-paced format; introduction to computer programming, emphasizing symbolic computation and functional programming style, using the Scheme programming language. Units assigned depend on amount of work completed. The first two units must be taken together.

Rules & Requirements

Prerequisites: High school algebra

Credit Restrictions: Refer to computer science service course restrictions. Course may be repeated up to 4 units.

Repeat rules: Course may be repeated for a maximum of 4 units.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of self-paced and 3-9 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9A Matlab for Programmers 2 Units

Introduction to the constructs in the Matlab programming language, aimed at students who already know how to program. Array and matrix operations, functions and function handles, control flow, plotting and image manipulation, cell arrays and structures, and the Symbolic Mathematics toolbox.

Rules & Requirements

Prerequisites: Programming experience equivalent to that gained in Computer Science 10; familiarity with applications of matrix processing

Credit Restrictions: Refer to computer science service course restrictions.

Repeat rules: Course may be repeated for a maximum of 4 units.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9C C for Programmers 2 Units Self-paced course in the C programming language for students who already know how to program. Computation, input and output, flow of control, functions, arrays, and pointers, linked structures, use of dynamic storage, and implementation of abstract data types. **Rules & Requirements**

Prerequisites: Programming experience with pointers (or addresses in assembly language) and linked data structures equivalent to that gained

in Computer Science 9B or 61A, or Engineering 7

Credit Restrictions: Refer to computer science service course restrictions.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9D Scheme and Functional Programming for Programmers 2 Units

Self-paced course in functional programming, using the Scheme programming language, for students who already know how to program. Recursion; higher-order functions; list processing; implementation of rule-based querying.

Rules & Requirements

Prerequisites: Programming experience similar to that gained in Computer Science 10 or Engineering 7

Credit Restrictions: Refer to computer science service course restrictions.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9E Productive Use of the UNIX Environment 2 Units Use of UNIX utilities and scripting facilities for customizing the programming environment, organizing files (possibly in more than one computer account), implementing a personal database, reformatting text, and searching for online resources.

Rules & Requirements

Prerequisites: Programming experience similar to that gained in Computer Science 61A or Engineering 7; DOS or UNIX experience

Credit Restrictions: Refer to computer science service course restrictions.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9F C++ for Programmers 2 Units

Self-paced introduction to the constructs provided in the C++ programming language for procedural and object-oriented programming, aimed at students who already know how to program. **Rules & Requirements**

Prerequisites: Programming experience equivalent to that gained in Computer Science 9B or 61A, or Engineering 7

Credit Restrictions: Refer to computer science service course restrictions in the <General Catalog>.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9G JAVA for Programmers 2 Units Self-paced course in Java for students who already know how to program. Applets; variables and computation; events and flow of control; classes and objects; inheritance; GUI elements; applications; arrays, strings, files, and linked structures; exceptions; threads. **Rules & Requirements**

Prerequisites: 9C or 9F or 61A plus experience with object-oriented programming or C-based language

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 9H Python for Programmers 2 Units

Introduction to the constructs provided in the Python programming language, aimed at students who already know how to program. Flow of control; strings, tuples, lists, and dictionaries; CGI programming; file input and output; object-oriented programming; GUI elements.

Rules & Requirements

Prerequisites: Programming experience equivalent to that gained in Computer Science 10

Credit Restrictions: Refer to computer science service course restrictions.

Hours & Format

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructor: Garcia

COMPSCI 10 The Beauty and Joy of Computing 4 Units 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.

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, Harvey

COMPSCI W10 The Beauty and Joy of Computing 4 Units

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. 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 webbased 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, Harvey

COMPSCI 39J Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 39K Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 39M Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 39N Freshman/Sophomore Seminar 1.5 - 4 Units

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: 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 39P Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 39Q Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 39R Freshman/Sophomore Seminar 1.5 - 4 Units 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: 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 47A Completion of Work in Computer Science 61A 1 Unit 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: 61B or equivalent, 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 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 with sufficient partial credit in 61B may, with consent of instructor, complete the credit in this selfpaced course.

Rules & Requirements

Prerequisites: A course in data structures, 9G or equivalent, 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 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, 9C or equivalent, and consent of instructor

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

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

Introduction to programming and computer science. This course exposes students to techniques of abstraction at several levels: (a) within a programming language, using higher-order functions, manifest types, data-directed programming, and message-passing; (b) between programming languages, using functional and rule-based languages as examples. It also relates these techniques to the practical problems of implementation of languages and algorithms on a von Neumann machine. There are several significant programming projects. **Rules & Requirements**

Prerequisites: Mathematics 1A (may be taken concurrently); programming experience equivalent to that gained in 3 or the Advanced Placement Computer Science A course

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

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 61AS The Structure and Interpretation of Computer Programs (Self-Paced) 1 - 4 Units

Introductory programming and computer science. Abstraction as means to control program complexity. Programming paradigms: functional, object-oriented, client/server, and declarative (logic). Control abstraction: recursion and higher order functions. Introduction to asymptotic analysis of algorithms. Data abstraction: abstract data types, type-tagged data, first class data types, sequences implemented as lists and as arrays, generic operators implemented with data-directed programming and with message passing. Implementation of object-oriented programming with closures over dispatch procedures. Introduction to interpreters and compilers. There are several significant programming projects. Course may be completed in one or two semesters. Students must complete a mimimum of two units during their first semester of 61AS. **Rules & Requirements**

Prerequisites: Mathematics 1A (may be taken concurrently). Programming experience equivalent to that gained in 10 or the Advanced Placement Computer Science A course is recommended, but is not essential; students without this experience will begin at an earlier point in the online course

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

Repeat rules: Course may be repeated for a maximum of 4 units.Course may be repeated for a maximum of 4 units.

Hours & Format

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

Summer:

6 weeks - 15 hours of laboratory per week 8 weeks - 11 hours of laboratory per week

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructors: Garcia, Harvey, Hilfinger

COMPSCI 61B Data Structures 4 Units

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: 61A or Engineering 7

Credit Restrictions: Students will receive no credit for 61B after taking 47B or 61BL. Deficiency in 61BL may be removed by taking 61B.

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 The same material as in 61B, but in a laboratory-based format. **Rules & Requirements**

Prerequisites: 61A or Engineering 7

Credit Restrictions: Students will receive no credit for 61BL after taking 47B or 61B. Deficiency in 61B may be removed by taking 61BL.

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 Machine Structures 4 Units

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

Credit Restrictions: Students will receive no credit for 61C after taking 47C or 61CL. Deficiency in 61C may be removed by taking 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, Franklin, Katz, Patterson

COMPSCI 61CL Machine Structures (Lab-Centric) 4 Units The same material as in 61C but in a lab-centric format. **Rules & Requirements**

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

Credit Restrictions: Students will receive no credit for 61CL after taking 47C or 61C. Deficiency in 61C may be removed by taking 61CL.

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, Patterson

COMPSCI 70 Discrete Mathematics and Probability Theory 4 Units 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 in 3 or the Advanced Placement Computer Science A course

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

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture 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: Papadimitriou, Rao, Sinclair, Trevisan, Vazirani, Wagner

COMPSCI C79 Societal Risks and the Law 3 Units

Defining, perceiving, quantifying and measuring risk; identifying risks and estimating their importance; determining whether laws and regulations can protect us from these risks; examining how well existing laws work and how they could be improved; evaluting costs and benefits. Applications may vary by term. This course cannot be used to complete engineering unit or technical elective requirements for students in the College of Engineering.

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 not required.

Also listed as: POL SCI C79/STAT C79

COMPSCI 97 Field Study 1 - 4 Units

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. Course may be repeated for credit when topic changes.

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 98 Directed Group Study 1 - 4 Units Seminars for group study of selected topics, which will vary from year to year. Intended for students in the lower division. **Rules & Requirements**

Prerequisites: Consent of instructor

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

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 99 Individual Study and Research for Undergraduates 1 - 2 Units

A course for lower division students in good standing who wish to undertake a program of individual inquiry initiated jointly by the student and a professor. There are no other formal prerequisites, but the supervising professor must be convinced that the student is able to profit by the program.

Rules & Requirements

Prerequisites: GPA of 3.4 or better

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

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.

COMPSCI 146L Programmable Digital Systems Laboratory 2 Units Hardware description languages for digital system design and interactions with tool flows. Design, implementation, and verification of digital designs. Digital synthesis, partitioning, placement, routing, and simulation for Field-Programmable Gate Arrays. Large digital-system design concepts. Project design component – example, a full processor implementation with peripherals. **Objectives & Outcomes**

Student Learning Outcomes: This course is a one-time offering to supplement the EE141 course offered in the Fall 2014, with a lab and project section that cover the design of larger digital systems on a programmable chip platform (FPGA). The EE141 lectures in the Fall 2014 already covered the necessary lecture material, so students who took the EE141 lab in the Fall of 2014 will have a chance to expand their skills into the area of FPGA Digital System Design. Hence the pre-requisite for this

Rules & Requirements

Prerequisites: Computer Science 61C, Electrical Engineering 105 recommended and Electrical Engineering 141 (taken Fall 2014) - mandatory

course is that a student has taken the EE141 course in the Fall 2014.

Credit Restrictions: Students will receive no credit for Computer Science 146L after taking Fall 2014 version of Computer Science 150.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory and 1 hour 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: Stojanovic

COMPSCI C149 Introduction to Embedded Systems 4 Units This course introduces students to the basics of models, analysis tools, and control for embedded systems operating in real time. Students learn how to combine physical processes with computation. Topics include models of computation, control, analysis and verification, interfacing with the physical world, mapping to platforms, and distributed embedded systems. The course has a strong laboratory component, with emphasis on a semester-long sequence of projects.

Rules & Requirements

Prerequisites: 20N; Computer Science 61C; Computer Science 70 or Math 55

Credit Restrictions: Students will receive no credit for Electrical Engineering C149/Computer Science C149 after
taking Electrical Engineering C249M/Computer Science C249M. Students may remove a deficient grade in Electrical Engineering C149/Computer Science C149 after taking Electrical Engineering 124.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture 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: Lee, Seshia

Also listed as: EL ENG C149

COMPSCI 150 Components and Design Techniques for Digital Systems 5 Units

Basic building blocks and design methods to contruct synchronous digital systems, such as general purpose processors, hardware accelerators, and application specific processors. Representations and design methodologies for digital systems. Logic design using combinatorial and sequential circuits. Digital system implementation considering hardware descriptions languages, computer-aided design tools, field-programmable gate array architectures, and CMOS logic gates and state elements. Interfaces between peripherals, processor hardware, and software. Formal hardware laboratories and substantial design project. **Rules & Requirements**

Prerequisites: Computer Science 61C, Electrical Engineering 40

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: Computer Science/Undergraduate

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

Instructors: Katz, Pister, Wawrzynek

COMPSCI 152 Computer Architecture and Engineering 4 Units Instruction set architecture, microcoding, pipelining (simple and complex). Memory hierarchies and virtual memory. Processor parallelism: VLIW, vectors, multithreading. Multiprocessors. **Rules & Requirements**

Prerequisites: 61C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 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 The design, implementation, and evaluation of user interfaces. Usercentered 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: Computer Science 61B or 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

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: 61C (Machine Structures), plus either 70 (Discrete Mathematics) or Mathematics 55

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: Paxson, Song, Tygar, Wagner

COMPSCI 162 Operating Systems and System Programming 4 Units 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: Computer Science 61B, 61C, and 70

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 0 hours of laboratory 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 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: 61B and 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

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: Computer Science 61B and 162

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: Katz, Paxson, Ratnasamy, Shenker, Stoica

COMPSCI 169 Software Engineering 4 Units

Ideas and techniques for designing, developing, and modifying large software systems. Function-oriented and object-oriented modular design techniques, designing for re-use and maintainability. Specification and documentation. Verification and validation. Cost and quality metrics and estimation. Project team organization and management. Students will work in teams on a substantial programming project.

Rules & Requirements

Prerequisites: Computer Science 61B and 61C, and either Computer Science 70 or Mathematics 113

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: Brewer, Fox, Necula, Sen

COMPSCI 170 Efficient Algorithms and Intractable Problems 4 Units 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, NPcompleteness. Unsolvable and intractable problems. **Rules & Requirements**

Prerequisites: Computer Science 61B and 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: Computer Science/Undergraduate

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

Instructors: Demmel, Papadimitriou, Rao, Wagner, Vazirani

COMPSCI 172 Computability and Complexity 4 Units

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: 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 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: 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 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: Computer Science 70 and 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 184 Foundations of Computer Graphics 4 Units 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: Computer Science 61B or 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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructors: O'Brien, Sequin, Barsky, Ramamoorthi, Agrawala

COMPSCI 186 Introduction to Database Systems 4 Units 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: 61B and 61C

Credit Restrictions: Students will receive no credit for Comp Sci 186 after taking Comp Sci 286A.

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: Franklin, Hellerstein

COMPSCI 188 Introduction to Artificial Intelligence 4 Units 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: Computer Science 61A; Computer Science 61B; Computer Science 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: Abbeel, Klein, Russell

COMPSCI 189 Introduction to Machine Learning 4 Units

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: Mathematics 53 and 54; Computer Science 70; Computer Science 188 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

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 Quantum Information Science and Technology 3 Units 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. **Hours & Format**

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

Additional Details

Subject/Course Level: Computer Science/Undergraduate

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

Instructors: Crommie, Vazirani, Whaley

Also listed as: CHEM C191/PHYSICS C191

COMPSCI 194 Special Topics 1 - 4 Units 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 as topic varies. 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: Computer Science/Undergraduate

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

COMPSCI 195 Social Implications of Computer Technology 1 Unit 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

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 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 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

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. Course may be repeated for credit when topic changes.

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

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. Course may be repeated for credit when topic changes.

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 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 when topic changes.

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 and Computer Science

EL ENG 16A Designing Information Devices and Systems I 4 Units This course and its follow-on EE16B focus on the fundamentals of designing and building modern information devices and systems that interface with the real world. The course sequence provides a comprehensive introduction to core EECS topics in circuit design, signals, and systems in an application-driven context. The courses are delivered assuming mathematical maturity and aptitude at roughly the level of having completed MATH 1A-1B, and are aimed at entering students as well as non-majors seeking a broad introduction to the field. **Rules & Requirements**

Credit Restrictions: Students will receive no credit for Electrical Engineering 16A after completing Electrical Engineering 20 or 40.

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.

Instructors: Alon, Ayazifar, Lustig, Maharbiz, Subramanian, Tomlin, Courtade, Niknejad, Sahai

EL ENG 16B Designing Information Devices and Systems II 4 Units This course is a follow-on to Electrical Engineering 16A, and focuses on the fundamentals of designing and building modern information devices and systems that interface with the real world. The course sequence provides a comprehensive introduction to core EECS topics in circuit design, signals, and systems in an application-driven context. The courses are delivered assuming mathematical maturity and aptitude at roughly the level of having completed MATH 1A-1B, and are aimed at entering students as well as non-majors seeking a broad introduction to the field.

Rules & Requirements

Prerequisites: Electrical Engineering 16A, Designing Information Devices and Systems I

Credit Restrictions: Students will receive no credit for Electrical Engineering 16B after completing Electrical Engineering 20 or 40.

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.

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

EL ENG 20 Structure and Interpretation of Systems and Signals 4 Units Mathematical modeling of signals and systems. Continous and discrete signals, with applications to audio, images, video, communications, and control. State-based models, beginning with automata and evolving to LTI systems. Frequency domain models for signals and frequency response for systems, and sampling of continuous-time signals. A Matlab-based laboratory is an integral part of the course.

Rules & Requirements

Prerequisites: Mathematics 1B

Credit Restrictions: Students will receive no credit for Electrical Engineering 20N after completing Electrical Engineering 20. A deficient grade in Electrical Engineering 20 may be removed by taking Electrical Engineering 20N.

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: Zakhor

EL ENG 24 Freshman Seminar 1 Unit

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 when topic changes.

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

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 40 Introduction to Microelectronic Circuits 4 Units Fundamental circuit concepts and analysis techniques in the context of digital electronic circuits. Transient analysis of CMOS logic gates; basic integrated-circuit technology and layout.

Rules & Requirements

Prerequisites: Mathematics 1B

Credit Restrictions: Students will receive one unit of credit for 40 taking 42 and no credit after taking 100.

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 Engineering/Undergraduate

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

EL ENG 42 Introduction to Digital Electronics 3 Units

This course serves as an introduction to the principles of electrical engineering, starting from the basic concepts of voltage and current and circuit elements of resistors, capacitors, and inductors. Circuit analysis is taught using Kirchhoff's voltage and current laws with Thevenin and Norton equivalents. Operational amplifiers with feedback are introduced as basic building blocks for amplication and filtering. Semiconductor devices including diodes and MOSFETS and their IV characteristics are covered. Applications of diodes for rectification, and design of MOSFETs in common source amplifiers are taught. Digital logic gates and design using CMOS as well as simple flip-flops are introduced. Speed and scaling issues for CMOS are considered. The course includes as motivating examples designs of high level applications including logic circuits, amplifiers, power supplies, and communication links. **Rules & Requirements**

Prerequisites: Mathematics 1B

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 43 Introductory Electronics Laboratory 1 Unit Using and understanding electronics laboratory equipment such as oscilloscope, power supplies, function generator, multimeter, curvetracer, and RLC-meter. Includes a term project of constructing and testing a robot or other appropriate electromechanical device. **Rules & Requirements**

Prerequisites: 42 (may be taken concurrently) or equivalent or consent of instructor

Hours & Format

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

Summer: 8 weeks - 3.5 hours of laboratory 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 97 Field Study 1 - 4 Units

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. Course may be repeated for credit when topic changes.

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 Group study of selected topics in electrical engineering, usually relating to new developments.

Rules & Requirements

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

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

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. Course may be repeated for credit when topic changes.

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 100 Electronic Techniques for Engineering 4 Units This course serves as an introduction to the principles of electrical engineering, starting from the basic concepts of voltage and current and circuit elements of resistors, capacitors, and inductors. Circuit analysis is taught using Kirchhoff's voltage and current laws with Thevenin and Norton equivalents. Operational amplifiers with feedback are introduced as basic building blocks for amplification and filtering. Semiconductor devices including diodes and MOSFETS and their IV characteristics are covered. Applications of diodes for rectification, and design of MOSFETs in common source amplifiers are taught. Digital logic gates and design using CMOS as well as simple flip-flops are introduced. Speed and scaling issues for CMOS are considered. The course includes as motivating examples designs of high level applications including logic circuits, amplifiers, power supplies, and communication links. **Rules & Requirements**

Prerequisites: Mathematics 1B

Credit Restrictions: Students will receive one unit of credit for 100 after taking 42 and no credit after taking 40.

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 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 105 Microelectronic Devices and Circuits 4 Units

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: 40

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

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: EE 120 or equivalent, 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 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, telesurgery, and locomotion. **Rules & Requirements**

Prerequisites: Electrical Engineering C106A/Bioengineering 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 125B

EL ENG 113 Power Electronics 4 Units

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: 105 or consent 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 Engineering/Undergraduate

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

EL ENG 117 Electromagnetic Fields and Waves 4 Units

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. **Rules & Requirements**

Prerequisites: 40, Mathematics 53, 54, knowledge of phasor analysis (e.g. as taught in 105)

Hours & Format

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

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

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

Formerly known as: 117A-117B

EL ENG 118 Introduction to Optical Engineering 3 Units 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**

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.

Instructor: Waller

Formerly known as: Electrical Engineering 119

EL ENG 120 Signals and Systems 4 Units

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: 20N, Mathematics 53, 54

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 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: 120, 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 Engineering/Undergraduate

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

EL ENG 122 Introduction to Communication Networks 4 Units 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: Computer Science 70. Computer Science 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 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, frequencytransformation methods, optimization methods, 2-dimensional filter design.

Rules & Requirements

Prerequisites: 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 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**

Rules & Requirement

Prerequisites: 20

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 127 Optimization Models in Engineering 4 Units This course offers an introduction to optimization models and their applications, ranging from machine learning and statistics to decisionmaking and control, with emphasis on numerically tractable problems, such as linear or constrained least-squares optimization. **Rules & Requirements**

Prerequisites: MATH 54 or equivalent or consent of instructor

Credit Restrictions: Students will receive no credit for Electrical Engineering 127 after taking Electrical Engineering 227A.

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: El Ghaoui

EL ENG C128 Feedback Control Systems 4 Units 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.

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 129 Neural and Nonlinear Information Processing 3 Units Principles of massively parallel real-time computation, optimization, and information processing via nonlinear dynamics and analog VLSI neural networks, applications selected from image processing, pattern recognition, feature extraction, motion detection, data compression, secure communication, bionic eye, auto waves, and Turing patterns. **Rules & Requirements**

Prerequisites: 120 or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Electrical Engineering/Undergraduate

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

Instructor: Chua

EL ENG 130 Integrated-Circuit Devices 4 Units 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: 40 or 100

Credit Restrictions: Students will receive no credit for EI Eng 130 after taking EI 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 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: 40 or 100 or Engineering 45

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 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; Electrical Engineering 40, 100, or Engineering 45; 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 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: Electrical Engineering 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

Single and multiple stage transistor amplifiers. Operational amplifiers. Feedback amplifiers, 2-port formulation, source, load, and feedback network loading. Frequency response of cascaded amplifiers, gainbandwidth 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: Electrical Engineering 105

Credit Restrictions: Students will receive no credit for EI Eng 140 after taking EI 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 141 Introduction to Digital Integrated Circuits 4 Units CMOS devices and deep sub-micron manufacturing technology. CMOS inverters and complex gates. Modeling of interconnect wires. Optimization of designs with respect to a number of metrics: cost, reliability, performance, and power dissipation. Sequential circuits, timing considerations, and clocking approaches. Design of large system blocks, including arithmetic, interconnect, memories, and programmable logic arrays. Introduction to design methodologies, including hands-on experience.

Rules & Requirements

Prerequisites: Electrical Engineering 40; Electrical Engineering 105 and Computer Science 150 recommended

Credit Restrictions: Students will receive no credit for Electrical Engineering 141 after taking Electrical Engineering 241A.

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, Rabaey

EL ENG 142 Integrated Circuits for Communications 4 Units 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: EL ENG 20 and El Eng 140

Credit Restrictions: Students will receive no credit for EI Eng 142 after taking EI 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

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: 40 and 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

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: 20; Computer Science 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 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: Electrical Engineering 20 and Engineering 7 or equivalent; Knowledge of Matlab or linear algebra assumed

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 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 lowlevel 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

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: 40, COMPSCI 61B or a working knowledge of ANSI C programming or consent of instructor

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 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: Integrative Biology 135 or consent of instructor; for Electrical Engineering and Computer Science students, Electrical Engineering 105, 120 or Computer Science 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 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: Electrical Engineering 40; Electrical Engineering 105 recommended and Computer Science 150 (taken Fall 2014) - mandatory

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

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: Electrical Engineering 40 or 100 or consent of instructor

Credit Restrictions: Students will receive no credit for EI Eng 147 after taking EI 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 C149 Introduction to Embedded Systems 4 Units This course introduces students to the basics of models, analysis tools, and control for embedded systems operating in real time. Students learn how to combine physical processes with computation. Topics include models of computation, control, analysis and verification, interfacing with the physical world, mapping to platforms, and distributed embedded systems. The course has a strong laboratory component, with emphasis on a semester-long sequence of projects.

Rules & Requirements

Prerequisites: 20N; Computer Science 61C; Computer Science 70 or Math 55

Credit Restrictions: Students will receive no credit for Electrical Engineering C149/Computer Science C149 after
taking Electrical Engineering C249M/Computer Science C249M. Students may remove a deficient grade in Electrical Engineering C149/Computer Science C149 after taking Electrical Engineering 124.

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: Lee, Seshia

Also listed as: COMPSCI C149

EL ENG 192 Mechatronic Design Laboratory 4 Units

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: 120, Computer Science 61B or 61C, 150 or equivalent

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 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 as topic varies. 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

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 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

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. Course may be repeated for credit when topic changes.

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

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. Course may be repeated for credit when topic changes.

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 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 when topic changes.

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.