Energy Engineering

Bachelor of Science (BS)

The Energy Engineering major offered through the Engineering Science Program interweaves the fundamental of classical and modern physics, chemistry, and mathematics with the energy engineering applications. A great strength of the major is its flexibility. The firm base in physics and mathematics is augmented with a selection of engineering course options that prepare the student to tackle the complex energy-related problems faced by society. Because the program emphasizes science and mathematics, students are well-prepared to pursue graduate studies in physics or engineering. Energy Engineering is a multidisciplinary field requiring an integration of physical principles with engineering analysis, augmented with the realities of policy and engineering economics. The program incorporates courses from many departments on campus to create a discipline that is rigorously based in science, mathematics, and engineering, while addressing a wide variety of environmental issues.

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) .

Minor Program

The Energy Engineering minor has arisen as a natural outgrowth of the large amount of energy-related research in the College of Engineering. For a number of years, courses have been developed across the College of Engineering, and the Energy Engineering minor is designed to coordinate these courses for students who have an interest in systems that are associated with all aspects of energy systems, such as generation, transmission and consumption. The Energy Minor, offered through the College of Engineering, is an optional program that encourages coherence in the work students undertake around energy engineering.

For admission to the minor, students must have a minimum over-all Grade Point Average (GPA) of 3.00, and has completed all of the prerequisite courses. For information regarding the prerequisites, please see the Minor Requirements tab on this page.

After completion of the prerequisite courses, students will need to complete and submit a Petition for Admission form (http://engineeringscience.berkeley.edu/wp-content/uploads/2013/09/Energy-Minor-Application-2103-141.pdf) to the Undergraduate Staff Adviser. Students must apply at least one semester prior to graduation (i.e., Students cannot be on the official degree list at the time of application). Students will also need to submit a copy of their transcript and a course plan at the time of application.

Upon completion of the minor requirements, submit a Petition for Completion of the Undergraduate Minor (http://www.nuc.berkeley.edu/sites/default/files/ne-minor-completion.pdf) to the Undergraduate Staff Adviser. This must be completed no later than two weeks prior to the end of the semester.

Other Majors offered by the Engineering Science Program

Engineering Mathematics and Statistics (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/engineering-math-statistics)
Engineering Physics (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/engineering-physics)
Environmental Engineering Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/environmental-engineering-science)

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

1. All technical courses (courses in engineering, mathematics, chemistry, physics, statistics, biological sciences, and computer science) must be taken for a letter grade.
2. 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.

Lower-division Requirements

Select one of the following:

CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	
CHEM 4A	General Chemistry and Quantitative Analysis [1]	
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4
or COMPSCI 61A	The Structure and Interpretation of Computer Programs	
ENGIN 93	Energy Engineering Seminar	1
MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
MEC ENG 40	Thermodynamics	3
or ENGIN 115	Engineering Thermodynamics	

MEC ENG C85	Introduction to Solid Mechanics	3
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
Select two Engineering Prep courses, in consultation with faculty adviser:		
One must be selected from the following:		
EL ENG 40	Introduction to Microelectronic Circuits	
ENGIN 45	Properties of Materials	
One may be the other not chosen above, or one of the following:		
CIV ENG 11	Engineered Systems and Sustainability	
CIV ENG 70	Engineering Geology	
CHEM 1B	General Chemistry	
CHEM 3A	Chemical Structure and Reactivity	
EL ENG 20	Structure and Interpretation of Systems and Signals	
PHYSICS 7C	Physics for Scientists and Engineers	

1 CHEM 4A is intended for students majoring in Chemistry or a closely-related field.

Upper-division Requirements

Because of the interdisciplinary nature of this major, electives may be approved throughout the year.

In addition to the requirements listed below, students may need to choose up to three 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.

CIV ENG 100	Elementary Fluid Mechanics	4
or MEC ENG 106	Fluid Mechanics	
CIV ENG 107	Climate Change Mitigation	3
or GEOG 142	Climate Dynamics	
CIV ENG 108	Course Not Available	3
or CIV ENG 111	Environmental Engineering	
EL ENG 134	Fundamentals of Photovoltaic Devices	4
EL ENG 137A	Introduction to Electric Power Systems	4
ENE,RES C100	Energy and Society [1]	4
MAT SCI 136	Materials in Energy Technologies	4
MEC ENG 109	Heat Transfer	3
NUC ENG 161	Nuclear Power Engineering	4
ENGIN 194	Undergraduate Research	3
Economics: Select one course from the following:		
CIV ENG 156	Infrastructure Planning and Management	
ENE,RES C180	Ecological Economics in Historical Context	
ENGIN 120	Principles of Engineering Economics	
ENVECON 147	Regulation of Energy and the Environment [2]	
ENVECON C15	Economic Development [2]	
ENVECON 153	Population, Environment, and Development [2]	
ENVECON 154	Economics of Poverty and Technology [2]	
ESPM 102D	Climate and Energy Policy [2]	
POLECON 101	Contemporary Theories of Political Economy [2]	
An ECON course chosen in consultation with the faculty adviser		
Math/Statistical Analysis: Select one course from the following:		
CIV ENG 93	Engineering Data Analysis	
COMPSCI 70	Discrete Mathematics and Probability Theory	
ENGIN 117	Methods of Engineering Analysis	
IND ENG 172	Probability and Risk Analysis for Engineers	
MATH 55	Discrete Mathematics	
STAT 134	Concepts of Probability	
Sustainability: Select one course from the following:		
CIV ENG 111	Environmental Engineering	
CIV ENG 113N	Ecological Engineering for Water Quality Improvement	
CIV ENG 115	Water Chemistry	
CY PLAN 119	Planning for Sustainability [3]	
ENE,RES 101	Ecology and Society	
Technical Elective: Select one Technical Elective in consultation with faculty adviser		

1 ENE,RES C100 satisfies both a major requirement and one of the upper-division Humanities/Social Sciences requirements.

2 This course satisfies both the Economics requirement and one of the upper-division Humanities/Social Sciences requirements.

3 This course satisfies both the Sustainability requirement and one of the upper-division Humanities/Social Sciences requirements.

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.
2. 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.
4. No more than one upper-division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
5. Completion of the minor program cannot delay a student's graduation.

Lower-division Prerequisites

MATH 1A	Calculus	4
MATH 1B	Calculus	4

MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
Select one of the following:		
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	
CHEM 4A	General Chemistry and Quantitative Analysis	
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4

Upper-division Minor Requirements

MEC ENG 40	Thermodynamics (or approved equivalent)	3
or ENGIN 115	Engineering Thermodynamics	
EL ENG 137A	Introduction to Electric Power Systems	4
Select one of the following:		4
ENE,RES C10(	Energy and Society	
CIV ENG 106	Course Not Available	
CIV ENG 107	Climate Change Mitigation	
CIV ENG 111	Environmental Engineering	
Select two of the following:		8
ARCH 140	Energy and Environment	
CY PLAN 119	Planning for Sustainability	
CIV ENG 106	Course Not Available	
CIV ENG 107	Climate Change Mitigation	
CIV ENG 108	Course Not Available	
CIV ENG 111	Environmental Engineering	
CIV ENG 113N	Ecological Engineering for Water Quality Improvement	
CIV ENG 115	Water Chemistry	
CIV ENG 156	Infrastructure Planning and Management	
EL ENG 134	Fundamentals of Photovoltaic Devices	
EL ENG 137B	Introduction to Electric Power Systems	
ENE,RES C10(	Energy and Society	
ENE,RES 101	Ecology and Society	
ENE,RES C18(	Ecological Economics in Historical Context	
ENGIN 120	Principles of Engineering Economics	
ENGIN 194	Undergraduate Research	
ENVECON 147	Regulation of Energy and the Environment	
ENVECON C15	Economic Development	
ENVECON 153	Population, Environment, and Development	
ENVECON 154	Economics of Poverty and Technology	
ESPM 102D	Climate and Energy Policy	
GEOG 142	Climate Dynamics	
IND ENG 172	Probability and Risk Analysis for Engineers	
or STAT 134	Concepts of Probability	
MAT SCI 136	Materials in Energy Technologies	
MEC ENG 106	Fluid Mechanics	
MEC ENG 109	Heat Transfer	
NUC ENG 161	Nuclear Power Engineering	
POLECON 101	Contemporary Theories of Political Economy	

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/colleges-schools/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**
Chemistry: CHEM 1A and CHEM 1AL or CHEM 4A	4	Reading and Composition Course from List B		4
MATH 1A	4	MATH 1B		4
Reading and Composition Course from List A	4	PHYSICS 7A		4
Free Elective	3	ENGIN 7 or COMPSCI 61A		4
ENGIN 93	1			
	16			**16**
				Sophomore
Fall	**Units**	**Spring**		**Units**
ENE,RES C100	4	MEC ENG C85 or CIV ENG C30		3
Engineering Prep course	3-4	Engineering Prep course		3-4
MATH 53	4	MATH 54		4
PHYSICS 7B	4	MEC ENG 40 or ENGIN 115		3-4
	15-16			**13-15**
				Junior
Fall	**Units**	**Spring**		**Units**
CIV ENG 100 or MEC ENG 106	3-4	Economics course		3-4
MAT SCI 136	4	Math/ Statistical Analysis course		3-4
NUC ENG 161	4	MEC ENG 109		3
EL ENG 137A	4	Humanities/ Social Science course		3-4
	15-16			**12-15**
				Senior
Fall	**Units**	**Spring**		**Units**
CIV ENG 108 or CIV ENG 111	3	ENGIN 194		3
CIV ENG 107 or GEOG 142	3-4	EL ENG 134		4
Sustainability course	3	Technical Elective		3
Humanities/Social Sciences course	3-4	Humanities/ Social Science course		3-4
Free Elective	4	Free Elective		4
	16-18			**17-18**

Total Units: 120-130

Energy Engineering

ENGIN 7 Introduction to Computer Programming for Scientists and Engineers 4 Units
Elements of procedural and object-oriented programming. Induction, iteration, and recursion. Real functions and floating-point computations for engineering analysis. Introduction to data structures. Representative examples are drawn from mathematics, science, and engineering. The course uses the MATLAB programming language. Sponsoring departments: Civil and Environmental Engineering and Mechanical Engineering.
Rules & Requirements

Prerequisites: Mathematics 1B (maybe taken concurrently)

Credit Restrictions: Students will receive no credit for Engineering 7 after completing Engineering W7. A deficient grade in Engineering W7 may be repeated by taking Engineering 7.

Hours & Format

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

Summer: 10 weeks - 3 hours of lecture, 1.5 hours of discussion, and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Formerly known as: 77

ENGIN W7 Introduction to Computer Programming for Scientists and Engineers 4 Units
Elements of procedural and object-oriented programming. Induction, iteration, and recursion. Real functions and floating-point computations for engineering analysis. Introduction to data structures. Representative examples are drawn from mathematics, science, and engineering. The course uses the MATLAB programming language.
Rules & Requirements

Prerequisites: Mathematics 1B (may be taken concurrently)

Credit Restrictions: Students will receive no credit for Engineering W7 after completing Engineering 7 or 77. A deficient grade in Engineering 7 or 77 may be removed by taking Engineering W7.

Hours & Format

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

Summer: 10 weeks - 6 hours of web-based lecture and 7.5 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Papadopoulos

ENGIN 10 Engineering Design and Analysis 3 Units
This is a is an introduction to the profession of engineering and its different disciplines through a variety of individual design and analysis projects. Hands on creativity,teamwork, and effective communication are emphasized. Common lecture sessions address the essence of engineering design, the practice of engineering analysis, the societal context for engineering projects and the ethics of the engineering profession. Students develop design and analysis skills, and practice applying these skills to illustrative problems drawn from various mechanical engineering topics such as material testing,aerodynamics, controls and design.
Objectives & Outcomes

Course Objectives: Develop teamwork skills.
Emphasize communication skills, both written and oral.
Enhance students critical thinking and design skills.
Introduce students to a broad view of engineering analysis and design.
Introduce students to professional ethics and the societal context of engineering practice.
Offer experience in hands on,creative engineering projects.
Provide an introduction to different fields of engineering.
Reinforce the importance of mathematics and science in engineering design and analysis.,The objectives of the course are to:enhance critical thinking and design skills;introduce students to a broad view of engineering analysis and design;reinforce the importance of mathematics and science in engineering design and analysis;emphasize communication skills, both written and oral;develop teamwork skills;offer experience in hands on,creative engineering projects;provide an introduction to different fields of engineering; andintroduce students to professional ethics and the societal context of engineering practice.

Student Learning Outcomes: Appreciate the importance of professional and ethical responsibility in engineering.
Begin to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
Begin to use the techniques, skills, and engineering tools necessary for contemporary and future engineering practice.

Develop early abilities identifying, formulating, and solving engineering problems.
Gain experience in working in multidisciplinary teams.
Obtain experience in effective communication.
Recognize the role of mathematics and science in engineering.
Understand the design of systems, components, and processes to meet desired needs within realistic constraints.,Through active participation in this course,students will:begin to recognize the role of mathematics and science in engineering; understand the design of systems, components, and processes to meet desired needs within realistic constraints;gain experience in working in multi-
disciplinary teams;develop early abilities in identifying, formulating, and solving engineering problems;appreciate the importance of professional and ethical responsibility in engineering;obtain experience in effective communication;begin to understand the impact of engineering solutions in a global, economic, environmental,and societal context; and begin to use the techniques, skills, and engineering tools necessary for contemporary and future engineering practice.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 10 Engineering Design and Analysis 3 Units
This is a is an introduction to the profession of engineering and its different disciplines through a variety of individual design and analysis projects. Hands on creativity,teamwork, and effective communication are emphasized. Common lecture sessions address the essence of engineering design, the practice of engineering analysis, the societal context for engineering projects and the ethics of the engineering profession. Students develop design and analysis skills, and practice applying these skills to illustrative problems drawn from various mechanical engineering topics such as material testing,aerodynamics, controls and design.
Objectives & Outcomes

Course Objectives: Develop teamwork skills.
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Enhance students critical thinking and design skills.
Introduce students to a broad view of engineering analysis and design.
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Recognize the role of mathematics and science in engineering.
Understand the design of systems, components, and processes to meet desired needs within realistic constraints.,Through active participation in this course,students will:begin to recognize the role of mathematics and science in engineering; understand the design of systems, components, and processes to meet desired needs within realistic constraints;gain experience in working in multi-
disciplinary teams;develop early abilities in identifying, formulating, and solving engineering problems;appreciate the importance of professional and ethical responsibility in engineering;obtain experience in effective communication;begin to understand the impact of engineering solutions in a global, economic, environmental,and societal context; and begin to use the techniques, skills, and engineering tools necessary for contemporary and future engineering practice.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 15 Design Methodology 2 Units
Introduction to design methodology, problem definition, and the search for creative solutions. Social, political, legal, and ethical aspects of design solutions. Topics and discussions include the structure of engineering organizations, the product development cycle, mechanical dissection, reverse engineering, patents, failure case studies, product liability, and engineering ethics.
Objectives & Outcomes

Course Objectives: To introduce the engineering design process, its scope, and its limitations. To have students understand the responsibilities of an engineer for designs that are created.

Student Learning Outcomes: The ability to use methodical techniques to identify engineering problems and develop practical solutions.
The ability to work effectively in a team environment.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Lieu

ENGIN 24 Freshman Seminar 1 Unit
The Berkeley Seminar Program is designed to provide students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Berkeley Seminars are offered in all college departments, and topics vary from department to department and semester to semester.
Rules & Requirements

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 hour of lecture per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 25 Visualization for Design 2 Units
Development of 3-dimensional visualization skills for engineering design. Sketching as a tool for design communication. Presentation of 3-dimensional geometry with 2-dimensional engineering drawings. This course will introduce the use of 2-dimensional CAD on computer workstations as a major graphical analysis and design tool. A group design project is required. Teamwork and effective communication are emphasized.

Objectives & Outcomes

Course Objectives: Improve 3-dimensional visualization skills; enable a student to create and understand engineering drawings; introduce 2-dimensional computer-aided geometry modeling as a visualization, design, and analysis tool; enhance critical thinking and design skills; emphasize communication skills, both written and oral; develop teamwork skills; offer experience in hands-on engineering projects; develop early abilities in identifying, formulating, and solving engineering problems; introduce students to the societal context of engineering practice.

Student Learning Outcomes: Upon completion of the course, students shall be able to communicate 3-dimensional geometry effectively using sketches; operate 2-dimensional CAD software with a high degree of skill and confidence; understand and create engineering drawings; visualize 3-dimensional geometry from a series of 2-dimensional drawings.

Rules & Requirements

Credit Restrictions: Students will receive no credit for Engineering 25 after completing both Engineering 10 and 28.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: Lieu, McMains

ENGIN 26 Three-Dimensional Modeling for Design 2 Units
Three-dimensional modeling for engineering design. This course will emphasize the use of CAD on computer workstations as a major graphical analysis and design tool. Students develop design skills, and practice applying these skills. A group design project is required. Hands-on creativity, teamwork, and effective communication are emphasized.

Objectives & Outcomes

Course Objectives: Introduce computer-based solid, parametric, and assembly modeling as a tool for engineering design; enhance critical thinking and design skills; emphasize communication skills, both written and oral; develop teamwork skills; offer experience in hands-on, creative engineering projects; reinforce the societal context of engineering practice; develop early abilities in identifying, formulating, and solving engineering problems.

Student Learning Outcomes: Upon completion of the course, students shall be able to operate 3-dimensional solid modeling software tools with a high degree of skill and confidence; specify dimensions for parts and assemblies such that they can be fabricated, and fit such that they function with the desired result; produce rapid-prototype models of parts and assemblies to demonstrate their desired functionality; understand the design of systems, components, and processes to meet desired needs within realistic constraints.

Rules & Requirements

Prerequisites: None

Credit Restrictions: Students will receive no credit for Engineering 26 after completing Engineering 10 and 28.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: Lieu, McMains, Youssefi

ENGIN 27 Introduction to Manufacturing and Tolerancing 2 Units
Geometric dimensioning and tolerancing (GD&T), tolerance analysis for fabrication, fundamentals of manufacturing processes (metal cutting, welding, joining, casting, molding, and layered manufacturing).
Objectives & Outcomes

Course Objectives: Enable a student to create and understand tolerances in engineering drawings; enhance critical thinking and design skills; emphasize communication skills, both written and oral; offer hands-on experience in manufacturing; develop abilities in identifying, formulating, and solving engineering problems; introduce students to the context of engineering practice.

Student Learning Outcomes: Upon completion of the course, students shall be able to fabricate basic parts in the machine shop; understand and communicate tolerance requirements in engineering drawings using industry standard GD&T; use metrology tools to evaluate if physical parts are within specified tolerances; demonstrate familiarity with manufacturing processes; and design parts that can be fabricated realistically and economically using these processes.

Rules & Requirements

Prerequisites: Engineering 25 (can be taken concurrently)

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: McMains, Lieu, Dornfeld, Taylor

ENGIN 28 Basic Engineering Design Graphics 3 Units
Introduction to the engineering design process and graphical communications tools used by engineers. Conceptual design of products. Tolerance analysis for fabrication. Documentation of design through engineering drawing. Development of spatial reasoning skills. Basic descriptive geometry. Parametric solid modeling and feature based design. Use of Computer-Assisted Design as a design tool.
Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Lieu

ENGIN 39B 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

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

Hours & Format

Fall and/or spring: 15 weeks - 1.5-4 hours of seminar per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 39E 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

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

Hours & Format

Fall and/or spring: 15 weeks - 1.5-4 hours of seminar per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 39F 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

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

Hours & Format

Fall and/or spring: 15 weeks - 1.5-4 hours of seminar per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 45 Properties of Materials 3 Units
Application of basic principles of physics and chemistry to the engineering properties of materials. Special emphasis devoted to relation between microstructure and the mechanical properties of metals, concrete, polymers, and ceramics, and the electrical properties of semiconducting materials. Sponsoring Department: Materials Science and Engineering
Rules & Requirements

Prerequisites: PHYSICS 7A

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 47 Supplementary Work in Lower Division Engineering 1 - 3 Units
May be taken only with permission of the Dean of the College of Engineering. Students with partial credit in a lower division engineering course may complete the work under this heading.
Rules & Requirements

Prerequisites: Limited to students who must make up a fraction of a required lower division course

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: 8 weeks - 1.5-5.5 hours of independent study per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 92 Perspectives in Engineering 1 Unit
This series of lectures provides students, especially undeclared Engineering students, with information on the various engineering disciplines to guide them toward choice of major. Lecturers describe research activities, how they made their own career choices, and indicate future opportunities. Recommended for all Engineering Science students and required for Engineering undeclared students.
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 hour of lecture per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 93 Energy Engineering Seminar 1 Unit
Weekly seminar with different speakers on energy-related topics. The goal is to expose students to a broad range of energy issues.
Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Zohdi

ENGIN 98 Directed Group Studies for Lower Division Undergraduates 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

Summer:
6 weeks - 2.5-10 hours of directed group study per week
8 weeks - 1.5-7.5 hours of directed group study per week
10 weeks - 1.5-6 hours of directed group study per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 115 Engineering Thermodynamics 4 Units
Fundamental laws of thermodynamics for simple substances; application to flow processes and to nonreacting mixtures; statistical thermodynamics of ideal gases and crystalline solids; chemical and materials thermodynamics; multiphase and multicomponent equilibria in reacting systems; electrochemistry. Sponsoring Departments: Materials Science and Engineering and Nuclear Engineering.
Rules & Requirements

Prerequisites: PHYSICS 7B, MATH 54; Chemistry 1B recommended

Credit Restrictions: Students will receive no credit for Engineering 115 after taking Mechanical Engineering 105 or Chemical Engineering 141.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: Glaeser, Olander

ENGIN 117 Methods of Engineering Analysis 3 Units
Methods of theoretical engineering analysis; techniques for analyzing partial differential equations and the use of special functions related to engineering systems. Sponsoring Department: Mechanical Engineering.
Rules & Requirements

Prerequisites: Mathematics 53, 54

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 120 Principles of Engineering Economics 3 Units
Economic analysis for engineering decision making: Capital flows, effect of time and interest rate. Different methods of evaluation of alternatives. Minimum-cost life and replacement analysis. Depreciation and taxes. Uncertainty; preference under risk; decision analysis. Capital sources and their effects. Economic studies.
Rules & Requirements

Prerequisites: Completion of 60 units of an approved engineering curriculum

Credit Restrictions: Students will receive 2 units for 120 after taking Civil Engineering 167.

Hours & Format

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

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Adler

ENGIN 125 Ethics, Engineering, and Society 3 Units
How should engineers analyze and resolve the ethical issues inherent in engineering? This seminar-style course provides an introduction to how theories, concepts, and methods from the humanities and social science can be applied to ethical problems in engineering. Assignments incorporate group and independent research designed to provide students an opportunity to contribute novel findings to the emerging field of engineering ethics while building their analytical and communication skills. This course cannot be used to fulfill any engineering technical requirements (units or courses).
Hours & Format

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

Summer:
6 weeks - 5 hours of lecture and 3 hours of discussion per week
8 weeks - 4 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 128 Advanced Engineering Design Graphics 3 Units
Advanced graphics tools for engineering design. Parametric solid modeling. Assembly modeling. Presentation using computer animation and multimedia techniques.
Rules & Requirements

Prerequisites: 28

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructor: Lieu

ENGIN 147 Supplementary Work in Upper Division Engineering 1 - 3 Units
May be taken only with permission of the Dean of the College of Engineering. Students with partial credit in an upper division engineering course may complete the work under this heading.
Rules & Requirements

Prerequisites: Limited to students who must make up a fraction of a required upper division course

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 157AC Engineering, The Environment, and Society 4 Units
This course engages students at the intersection of environmental justice, social justice, and engineering to explore how problems that are commonly defined in technical terms are at their roots deeply socially embedded. Through partnerships with community-based organizations, students are trained to recognize the socio-political nature of technical problems so that they may approach solutions in ways that prioritize social justice. Topics covered include environmental engineering as it relates to air, water, and soil contamination; race, class, and privilege; expertise; ethics; and engaged citizenship. This course cannot be used to complete any engineering technical or unit requirements.
Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Also listed as: IAS 157AC

ENGIN 177 Advanced Programming with MATLAB 3 Units
The course builds an understanding, demonstrates engineering uses, and provides hand-on experience for object-oriented programming as well as exposes a practical knowledge of advanced features available in MATLAB. The course will begin with a brief review of basic MATLAB features and quickly move to class organization and functionality. The introduced concepts are reinforced by examining the advanced graphical features of MATLAB. The material will also include the effective use of programs written in C and FORTRAN, and will cover SIMULINK, a MATLAB toolbox providing for an effective ways of model simulations. Throughout the course, the emphasis will be placed on examples and homework assignments from engineering disciplines.
Rules & Requirements

Prerequisites: 7 or 77; Mathematics 53 and 54 (one of these may be taken concurrently)

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: Frenklach, Packard

ENGIN 194 Undergraduate Research 3 Units
Students who have completed a satisfactory number of advanced courses may pursue original research under the direction of one of the members of the staff. Final report and presentation required.
Rules & Requirements

Prerequisites: Consent of instructor and adviser, junior or senior standing

Repeat rules: Course may be repeated for credit, but only three units may be used toCourse may be repeated for credit, but only three units may be used to satisfy a technical elective. satisfy a technical elective. Course may be repeated for credit when topic changes.

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

ENGIN 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units
Group study of selected topics.
Rules & Requirements

Prerequisites: Upper division standing, plus particular courses to be specified by 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

Summer: 8 weeks - 1.5-7.5 hours of directed group study per week

Additional Details

Subject/Course Level: Engineering/Undergraduate

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