

Environmental Engineering Science

Bachelor of Science (BS)

The environmental engineering science (EES) major is an interdisciplinary program pairing engineering fundamentals with courses in the environmental and natural sciences. The EES curriculum provides a broader foundation in the sciences, allowing students to take classes in a variety of departments both inside and outside of the College of Engineering. At the same time, it allows students to focus their studies on environmental issues more than is possible in other engineering programs. EES provides a solid interdisciplinary foundation that is necessary for creating real-world solutions to global environmental challenges, such as providing a robust supply of safe drinking water, and meeting societal demands for energy without causing air pollution or interfering with the Earth's climate systems.

Admission to the Major

Prospective undergraduates of the College of Engineering must apply for admission to one specific major/degree program. 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 very competitive as there are few spaces open in engineering 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

A minor in environmental engineering is available through the Department of Civil and Environmental Engineering.

Other Majors offered by the Engineering Science Program

Energy Engineering (<http://guide.berkeley.edu/archive/2016-17/undergraduate/degree-programs/energy-engineering>) (Major and Minor)
Engineering Mathematics and Statistics (<http://guide.berkeley.edu/archive/2016-17/undergraduate/degree-programs/engineering-math-statistics>) (Major only)
Engineering Physics (<http://guide.berkeley.edu/archive/2016-17/undergraduate/degree-programs/engineering-physics>) (Major only)

In addition to the University, campus, and college requirements, 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 Major Requirements

MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory ¹	4
or 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
CIV ENG 11	Engineered Systems and Sustainability ³	3
CIV ENG C30/MEC ENG C85	Introduction to Solid Mechanics	3
Basic science electives, select three from the following: ²		12-15
BIOLOGY 1A & 1AL	General Biology Lecture and General Biology Laboratory	
BIOLOGY 1B	General Biology Lecture and Laboratory	
CHEM 1B	General Chemistry	
CHEM 3A & 3AL	Chemical Structure and Reactivity and Organic Chemistry Laboratory	
CHEM 3B & 3BL	Chemical Structure and Reactivity and Organic Chemistry Laboratory	
CHEM 4B	General Chemistry and Quantitative Analysis ¹	
EPS 50	The Planet Earth	
PHYSICS 7C	Physics for Scientists and Engineers	

¹ CHEM 4A and CHEM 4B are intended for students majoring in chemistry or a closely-related field.

² Approved scores on Biology AP, IB, or A-Level exams can satisfy two of the three basic science electives.

³ Junior transfer admits are exempt from completing CIV ENG 11.

Upper Division Major Requirements

CIV ENG 100	Elementary Fluid Mechanics	3-4
or MEC ENG 106	Fluid Mechanics	
or CHM ENG 150A	Transport Processes	
CIV ENG 103	Introduction to Hydrology	3
or CIV ENG 115	Water Chemistry	
MEC ENG 40	Thermodynamics	3-4
or ENGIN 115	Engineering Thermodynamics	
or CHM ENG 141	Chemical Engineering Thermodynamics	
CIV ENG 111	Environmental Engineering	3

Math/computing elective, select one course from the following: 3-4

ENGIN 117	Methods of Engineering Analysis	
ENGIN 177	Advanced Programming with MATLAB	
MATH 104	Introduction to Analysis	
MATH 110	Linear Algebra	
MATH 126	Introduction to Partial Differential Equations	
MATH 128A	Numerical Analysis	
MATH 170	Mathematical Methods for Optimization	
MATH 185	Introduction to Complex Analysis	
STAT 133	Concepts in Computing with Data	
STAT 134	Concepts of Probability	

Advanced science sequence, select 8-10 units from one of the following groups: 8-10

CHEM 112A	Course Not Available	
& CHEM 112B	and Course Not Available	
CHEM 120A	Physical Chemistry	
& CHEM 120B	and Physical Chemistry	
& CHEM 125	and Physical Chemistry Laboratory	
EPS 101	Field Geology and Digital Mapping	
& EPS 108	and Geodynamics	
& EPS 116	and Structural Geology and Tectonics	
& EPS 117	and Geomorphology	
& EPS 124	and Isotopic Geochemistry	
& EPS C146	and Geological Oceanography	
EPS C180	Air Pollution	
& EPS C181	and Atmospheric Physics and Dynamics	
& EPS C182	and Atmospheric Chemistry and Physics	
& GEOG 142	Laboratory and Climate Dynamics	
ESPM 102A	Terrestrial Resource Ecology	
& ESPM C103	and Principles of Conservation Biology	
& ESPM 111	and Ecosystem Ecology	
& ESPM 112	and Microbial Ecology	
& ESPM 120	and Soil Characteristics	
& ESPM C128	and Chemistry of Soils	
& ESPM 131	and Soil Microbial Ecology	
MCELLBI 102	Survey of the Principles of Biochemistry and	
& MCELLBI C1	Molecular Biology	
& MCELLBI C1	and General Microbiology	
	and General Microbiology Laboratory	

Cluster courses: select 12 units from one of the clusters listed below. 12
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¹ The 12 units of cluster courses are in addition to the engineering and science courses used to fulfill other requirements for the major.

Approved Cluster Courses

Air Pollution and Climate Change

ARCH 140	Energy and Environment	4
BIO ENG C181	The Berkeley Lectures on Energy: Energy from Biomass	3
CIV ENG C106	Air Pollution	3
CIV ENG 107	Climate Change Mitigation	3
EL ENG 134	Fundamentals of Photovoltaic Devices	4
EL ENG 137A	Introduction to Electric Power Systems	4
EL ENG 137B	Introduction to Electric Power Systems	4

MAT SCI 136	Materials in Energy Technologies	4
MEC ENG 109	Heat Transfer	3
MEC ENG 140	Combustion Processes	3
MEC ENG 146	Energy Conversion Principles	3
NUC ENG 161	Nuclear Power Engineering	4

Biotechnology

BIO ENG C181	The Berkeley Lectures on Energy: Energy from Biomass	3
CHM ENG 140	Introduction to Chemical Process Analysis	4
CHM ENG 142	Chemical Kinetics and Reaction Engineering	4
CHM ENG 170A	Biochemical Engineering	3
CHM ENG 170B	Biochemical Engineering	3
CHM ENG C170L	Biochemical Engineering Laboratory	3
CIV ENG 112	Environmental Engineering Design	3
CIV ENG 114	Environmental Microbiology	3
MCELLBI C112	General Microbiology	6
& C112L	and General Microbiology Laboratory	
MCELLBI C116	Microbial Diversity	3
PLANTBI 120	Biology of Algae	2
PLANTBI 120L	Laboratory for Biology of Algae	2
PLANTBI 122	Bioenergy	2
PLANTBI 180	Environmental Plant Biology	2

Ecosystems and Ecological Engineering

CIV ENG 114	Environmental Microbiology	3
ESPM C103	Principles of Conservation Biology	4
ESPM C104	Modeling and Management of Biological Resources	4
INTEGBI C149	Molecular Ecology	4
INTEGBI 151	Plant Physiological Ecology	4
INTEGBI 151L	Plant Physiological Ecology Laboratory	2
INTEGBI 152	Environmental Toxicology	4
INTEGBI 153	Ecology	3
INTEGBI 154	Plant Ecology	3

Environmental Fluid Mechanics

CIV ENG 101	Fluid Mechanics of Rivers, Streams, and Wetlands	3
CIV ENG 103	Introduction to Hydrology	3
CIV ENG 105	Environmental Fluid Mechanics and Hydrology	3
CIV ENG 173	Groundwater and Seepage	3
EPS 117	Geomorphology	4
EPS C129	Biometeorology	3

Geoengineering

CIV ENG 171	Rock Mechanics	3
CIV ENG 173	Groundwater and Seepage	3
CIV ENG 175	Geotechnical and Geoenvironmental Engineering	3
CIV ENG 176	Environmental Geotechnics	3
CIV ENG C178	Applied Geophysics	3
CIV ENG 281	Engineering Geology	3
EPS 117	Geomorphology	4

Water Quality

CIV ENG 112	Environmental Engineering Design	3
CIV ENG 114	Environmental Microbiology	3
CIV ENG 115	Water Chemistry	3
CIV ENG C116	Chemistry of Soils	3

CIV ENG 173	Groundwater and Seepage	3
ESPM 120	Soil Characteristics	3
INTEGBI 152	Environmental Toxicology	4

Students in the College of Engineering must complete no fewer than 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 2.00 (C average) and a minimum 2.00 grade point average in upper division technical coursework required of the major.
3. The final 30 units and two semesters must be completed in residence in the College of Engineering on the Berkeley campus.
4. All technical courses (math, science and engineering), required of the major or not, must be taken on a letter graded basis (unless they are only offered P/NP).
5. Entering freshmen 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. (Note: junior transfers admitted missing three or more courses from the lower division curriculum are allowed five semesters.) 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.
6. Adhere to all college policies and procedures (<http://engineering.berkeley.edu/academics/undergraduate-guide>) as they complete degree requirements.
7. Complete the lower division program before enrolling in upper division engineering courses.

Humanities and Social Science (H/SS) Requirement

To promote a rich and varied educational experience outside of the technical requirements for each major, the College of Engineering has a six-course Humanities and Social Sciences breadth requirement (<http://engineering.berkeley.edu/student-services/degree-requirements/humanities-and-social-sciences>), which must be completed to graduate. This requirement, built into all the engineering programs of study, includes two reading and composition courses (R&C), and four additional courses within which a number of specific conditions must be satisfied. Follow these guidelines to fulfill this requirement:

1. Complete a minimum of six courses from the approved Humanities/Social Sciences (H/SS) lists (<http://coe.berkeley.edu/hssreq>).
2. Courses must be a minimum of 3 semester units (or 4 quarter units).
3. Two of the six courses must fulfill the college's Reading and Composition (R&C) 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 (fourth 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, must be completed by no later than the end of the sophomore year. View a detailed lists of courses (<http://ls-advise.berkeley.edu/requirement/rcourses.html>) that fulfill Reading and Composition requirements, or use the College of Letters and Sciences search engine (<http://ls-breadth.berkeley.edu>) to view R&C courses offered in a given semester.

4. The four additional courses must be chosen within College of Engineering guidelines from the H/SS lists (see below). These courses may be taken on a Pass/Not Passed basis (P/NP).
5. Two of the six courses must be upper division (courses numbered 100-196).
6. One of the six courses must satisfy the campus American Cultures requirement. For detailed lists of courses that fulfill American Cultures requirements, visit the American Cultures (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/engineering/american-cultures-requirement>) site.
7. A maximum of two exams (Advanced Placement, International Baccalaureate, or A-Level) may be used toward completion of the H/SS requirement. View the list of exams (<http://engineering.berkeley.edu/academics/undergraduate-guide/exams-ap-ib-level-and-transfer-credit-information>) that can be applied toward H/SS requirements.
8. Courses may fulfill multiple categories. For example, if you complete CY PLAN 118AC (<http://guide.berkeley.edu/search/?P=CY%20PLAN%20118AC>) that would satisfy the American Cultures requirement and one upper division H/SS requirement.
9. No courses offered by any engineering department other than BIO ENG 100 (<http://guide.berkeley.edu/search/?P=BIO%20ENG%20100>), COMPSI C79 (<http://guide.berkeley.edu/search/?P=COMPSI%20C79>), ENGIN 125 (<http://guide.berkeley.edu/search/?P=ENGIN%20125>), ENGIN 157AC (<http://guide.berkeley.edu/search/?P=ENGIN%20157AC>), MEC ENG 191K (<http://guide.berkeley.edu/search/?P=MEC%20ENG%20191K>) and MEC ENG 191AC (<http://guide.berkeley.edu/search/?P=MEC%20ENG%20191AC>) may be used to complete H/SS requirements.
10. Foreign language courses may be used to complete H/SS requirements. View the list of language options (<http://ls-advise.berkeley.edu/requirement/fl.html>).
11. Courses numbered 97, 98, 99, or above 196 may not be used to complete any H/SS requirement.
12. The College of Engineering 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 H/SS requirement. No courses on the L&S Biological Sciences or Physical Sciences breadth lists may be used to complete H/SS requirements. Within the guidelines above, choose courses from any of the lists below.
 - Arts and Literature (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/letters-science/breadth-requirement-arts-literature>)
 - Foreign Language (<http://ls-advise.berkeley.edu/requirement/fl.html>)
 - Historical Studies (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/letters-science/breadth-requirement-historical-studies>)
 - International Studies (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/letters-science/breadth-requirement-international-studies>)
 - Philosophy and Values (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/letters-science/breadth-requirement-philosophy-values>)

- Social and Behavioral Studies (<http://guide.berkeley.edu/archive/2016-17/undergraduate/colleges-schools/letters-science/breadth-requirement-social-behavioral-sciences>)

Class Schedule Requirements

- Minimum units per semester: 12.0.
- Maximum units per semester: 20.5.
- Minimum technical courses: College of Engineering undergraduates must enroll each semester in no fewer than two technical courses (of a minimum of 3 units each) required of the major program of study in which the student is officially declared. (Note: for most majors, normal progress will require enrolling in 3-4 technical courses each semester).
- All technical courses (math, science, engineering), required of the major or not, must be taken on a letter graded basis (unless only offered as P/NP).
- A student's proposed schedule must be approved by a faculty adviser (or on approval from the dean or a designated staff adviser) each semester prior to enrolling in courses.

Minimum Academic (Grade) Requirements

- A minimum overall and semester grade point average of 2.00 (C average) is required of engineering undergraduates. A student will be subject to dismissal from the University if during any fall or spring semester their overall UC GPA falls below a 2.00, or their semester GPA is less than 2.00.
- Students must achieve a minimum grade point average of 2.00 (C average) in upper division technical courses required of the major curriculum each semester. A student will be subject to dismissal from the University if their upper division technical grade point average falls below 2.00.
- A minimum overall grade point average of 2.00, and a minimum 2.00 grade point average in upper division technical course work required of the major is needed to earn a Bachelor of Science in Engineering.

Unit Requirements

To earn a Bachelor of Science in Engineering, students must complete at least 120 semester units of courses subject to certain guidelines:

- Completion of the requirements of one engineering major program (<http://coe.berkeley.edu/students/guide/departments>) of study.
- A maximum of 16 units of special studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed towards the 120 units; a maximum of four is allowed in a given semester.
- A maximum of 4 units of physical education from any school attended will count towards the 120 units.
- Students may receive unit credit for courses graded P (including P/ NP units taken through EAP) up to a limit of one-third of the total units taken and passed on the Berkeley campus at the time of graduation.

Normal Progress

Students in the College of Engineering must enroll in a full-time program and make normal progress each semester toward the bachelor's degree. The continued enrollment of students who fail to achieve minimum academic progress shall be subject to the approval of the dean. (Note: students with official accommodations established by the Disabled Students' Program, with health or family issues, or with other reasons

deemed appropriate by the dean may petition for an exception to normal progress rules.)

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

Freshman				
	Fall	Units	Spring	Units
CHEM 4A or 1A <i>and</i> 1AL ¹		4	MATH 1B	4
MATH 1A		4	PHYSICS 7A	4
Reading & Composition course from List A		4	CIV ENG 11 ⁶	3
Humanities/Social Sciences course		3-4	ENGIN 7	4
		15-16		15
Sophomore				
	Fall	Units	Spring	Units
MATH 53		4	MATH 54	4
PHYSICS 7B		4	CIV ENG C30 or MEC ENG C85	3
First Basic Science Elective ²		4-5	Second and Third Basic Science Electives ²	8-10
Reading & Composition course from List B		4		
		16-17		15-17
Junior				
	Fall	Units	Spring	Units
CIV ENG 100, MEC ENG 106, or CHM ENG 150A		3-4	MEC ENG 40, ENGIN 115, or CHM ENG 141	3
CIV ENG 103 or 115		3	Math/Computing Elective ³	3-4
CIV ENG 111		3	Cluster courses ⁴	6
Humanities/Social Sciences course		3-4	Humanities/Social Sciences course	3-4
Free Electives		3		
		15-17		15-17
Senior				
	Fall	Units	Spring	Units
Cluster course ⁴		3	Cluster course ⁴	3
Advanced Science Sequence course ⁵		4-5	Advanced Science Sequence course ⁵	4-5
Free Electives		8	Humanities/Social Sciences course	3-4
			Free Electives	4
		15-16		14-16

Total Units: 120-131

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

- ² Select three basic science electives from: BIOLOGY 1A plus BIOLOGY 1AL, BIOLOGY 1B, CHEM 1B, CHEM 3A plus CHEM 3AL, CHEM 3B plus CHEM 3BL, CHEM 4B, EPS 50, PHYSICS 7C. Note: approved scores on Biology AP, IB or A-Level Exams can satisfy two of the three basic science electives.
- ³ Select one from the following: ENGIN 117, ENGIN 177, MATH 104, MATH 110, MATH 126, MATH 128A, MATH 170, MATH 185, STAT 133, or STAT 134.
- ⁴ Cluster courses: 12 units required. See Major Requirements tab for list of approved cluster courses.
- ⁵ Advanced science sequence: 8-10 units required. See Major Requirements tab for list of approved advanced science sequence courses.
- ⁶ Junior transfer admits are exempt from completing CIV ENG 11.

Environmental Engineering Science

ENGIN 7 Introduction to Computer Programming for Scientists and Engineers 4 Units

Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
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.

Introduction to Computer Programming for Scientists and Engineers:
Read More [+]

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

Introduction to Computer Programming for Scientists and Engineers:
Read Less [-]

ENGIN W7 Introduction to Computer Programming for Scientists and Engineers 4 Units

Terms offered: Summer 2016 10 Week Session, Summer 2015 10 Week Session, Summer 2014 10 Week Session

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.

Introduction to Computer Programming for Scientists and Engineers:
Read More [+]

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 - 2 hours of web-based lecture, 4 hours of laboratory, and 1 hour of web-based discussion per week

Summer: 10 weeks - 6 hours of web-based lecture, 0 hours of laboratory, 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

Introduction to Computer Programming for Scientists and Engineers:
Read Less [-]

ENGIN 15 Design Methodology 2 Units

Terms offered: Fall 2015, Spring 2015

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.

Design Methodology: Read More [+]

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

Design Methodology: Read Less [-]

ENGIN 24 Freshman Seminar 1 Unit

Terms offered: Spring 2012, Fall 2011, Fall 2008

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.

Freshman Seminar: Read More [+]

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.

Freshman Seminar: Read Less [-]

ENGIN 25 Visualization for Design 2 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017

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.

Visualization for Design: Read More [+]

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.

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

Visualization for Design: Read Less [-]

ENGIN 26 Three-Dimensional Modeling for Design 2 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017

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.

Three-Dimensional Modeling for Design: Read More [+]

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.

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

Three-Dimensional Modeling for Design: Read Less [-]

ENGIN 27 Introduction to Manufacturing and Tolerancing 2 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017

Geometric dimensioning and tolerancing (GD&T), tolerance analysis for fabrication, fundamentals of manufacturing processes (metal cutting, welding, joining, casting, molding, and layered manufacturing).

Introduction to Manufacturing and Tolerancing: Read More [+]

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

Introduction to Manufacturing and Tolerancing: Read Less [-]

ENGIN 39B Freshman/Sophomore Seminar 1.5 - 4 Units

Terms offered: Spring 2010, Spring 2009, Spring 2008

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.

Freshman/Sophomore Seminar: Read More [+]

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.

Freshman/Sophomore Seminar: Read Less [-]

ENGIN 39E Freshman/Sophomore Seminar 1.5 - 4 Units

Terms offered: Spring 2010, Spring 2009, Spring 2008

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.

Freshman/Sophomore Seminar: Read More [+]

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.

Freshman/Sophomore Seminar: Read Less [-]

ENGIN 39F Freshman/Sophomore Seminar 1.5 - 4 Units

Terms offered: Fall 2010

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.

Freshman/Sophomore Seminar: Read More [+]

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.

Freshman/Sophomore Seminar: Read Less [-]

ENGIN 40 Engineering Thermodynamics 4 Units

Terms offered: Fall 2017

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.

Engineering Thermodynamics: Read More [+]

Rules & Requirements

Prerequisites: Physics 7B, Mathematics 54; Chemistry 1B recommended

Credit Restrictions: Students will receive no credit for Engineering 40 after taking Engineering 115, Chemical Engineering 141 or Mechanical Engineering 40.

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.

Instructors: Bolind, Persson

Engineering Thermodynamics: Read Less [-]

ENGIN 45 Properties of Materials 3 Units

Terms offered: Spring 2017, Fall 2016, Spring 2016

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 Properties of Materials: Read More [+]

Objectives Outcomes

Course Objectives: To introduce students to the Materials Science and Engineering Discipline.

To introduce students to the concept of choosing proper materials for specific applications.

To introduce students to the relationships between the structure, processing, properties and performance of materials.,

Student Learning Outcomes: The student should be able to read, interpret, and utilize binary equilibrium phase diagrams to control phases and microstructure.

The student should be able to relate materials properties to chemical bonding

The student should be able to select appropriate classes of materials (i.e., metals, ceramics, polymers, glasses, etc.) for specific engineering applications

The student should understand and describe crystalline and non-crystalline structures including concepts of lattices, points, directions, planes, Miller Indices, etc.

The student should understand defects and their influence on the performance of materials.

The student should understand electronic properties and how those properties vary in different classes of materials.

The student should understand how thermal, mechanical, chemical, etc. processing can be applied to control phase transformation kinetics in engineering material systems

The student should understand mechanical behavior of materials including stress – strain curves, strengthening, failure, etc.

The student should understand the relationships between materials processing, structure, properties, and performance.,

Rules & Requirements

Prerequisites: Physics 7A (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: Martin, Messersmith

Properties of Materials: Read Less [-]

ENGIN 45L Properties of Materials Laboratory 1 Unit

Terms offered: Spring 2017, Fall 2016

This course presents laboratory applications of the basic principles introduced in the lecture-based course E45 – Properties of Materials. Properties of Materials Laboratory: Read More [+]

Objectives Outcomes

Course Objectives: The long term objectives of this course are to provide undergraduate materials science and engineering and other engineering and science

students hands-on experiences in foundational materials science topics and to serve as a practical extension to the lecture-based course E45 – Properties of Materials

To introduce the students to engineering ethics and safe laboratory procedures

Student Learning Outcomes: The student should be able to illustrate the basic properties of strength and toughness of a material, including the stress vs. strain curve, and the microstructure of a fracture surface.,

The student should understand how phase diagrams are constructed from cooling curves and should be able to compare as-solidified microstructures of different binary alloys.

The student should understand how thermal treatments in restorative processing of materials that have been mechanically deformed.

The student should understand the effect of thermal processing on the properties of steel, and understand how to apply TTT diagrams to ferrous metallurgy.

The student should understand the nature of electrical conductivity in materials, and be able to investigate the changes in electrical resistivity of metals, semiconductors and insulators, and to be able to understand the influence of impurities on the resistivity of these materials.

The students should be able to understand what is meant by the mechanical behavior of materials

The students should be introduced to concepts of professional engineering ethics and best practices approaches to laboratory work.

Rules & Requirements

Prerequisites: E45 should be taken concurrently

Hours & Format

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

Additional Details

Subject/Course Level: Engineering/Undergraduate

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

Instructors: Martin, Messersmith

Properties of Materials Laboratory: Read Less [-]

ENGIN 47 Supplementary Work in Lower Division Engineering 1 - 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2012

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.

Supplementary Work in Lower Division Engineering: Read More [+]

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.

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.

Supplementary Work in Lower Division Engineering: Read Less [-]

ENGIN 92 Perspectives in Engineering 1 Unit

Terms offered: Fall 2017, Fall 2016, Fall 2015

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.

Perspectives in Engineering: Read More [+]

Rules & Requirements

Repeat rules: Course may be repeated for credit.

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.

Perspectives in Engineering: Read Less [-]

ENGIN 93 Energy Engineering Seminar 1 Unit

Terms offered: Fall 2017, Fall 2016, Fall 2015

Weekly seminar with different speakers on energy-related topics. The goal is to expose students to a broad range of energy issues.

Energy Engineering Seminar: Read More [+]

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

Energy Engineering Seminar: Read Less [-]

ENGIN 98 Directed Group Studies for Lower Division Undergraduates 1 - 4 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017

Seminars for group study of selected topics, which will vary from year to year. Intended for students in the lower division.

Directed Group Studies for Lower Division Undergraduates: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit.

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.

Directed Group Studies for Lower Division Undergraduates: Read Less [-]

ENGIN 115 Engineering Thermodynamics 4 Units

Terms offered: Fall 2016, Fall 2015, Spring 2015

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.

Engineering Thermodynamics: Read More [a+]

Rules & Requirements

Prerequisites: Physics 7B, Math 54; Chemistry 1B recommended

Credit Restrictions: Students will receive no credit for Engineering 115 after taking Chemical Engineering 141 or Mechanical Engineering 40

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.

Instructors: Bolind, Persson

Engineering Thermodynamics: Read Less [-]

ENGIN 117 Methods of Engineering Analysis 3 Units

Terms offered: Fall 2017, Fall 2015, Fall 2014

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. Methods of Engineering Analysis: Read More [a+]

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.

Methods of Engineering Analysis: Read Less [-]

ENGIN 120 Principles of Engineering Economics 3 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017

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.

Principles of Engineering Economics: Read More [a+]

Rules & Requirements

Prerequisites: Completion of 60 units of an approved engineering curriculum

Credit Restrictions: Students will receive no credit for Engineering 120 after taking Industrial Engineering 120.

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

Principles of Engineering Economics: Read Less [-]

ENGIN 125 Ethics, Engineering, and Society 3 Units

Terms offered: Spring 2014, Fall 2013, Spring 2013

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).

Ethics, Engineering, and Society: Read More [a+]

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.

Ethics, Engineering, and Society: Read Less [-]

ENGIN 128 Advanced Engineering Design Graphics 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015

Advanced graphics tools for engineering design. Parametric solid modeling. Assembly modeling. Presentation using computer animation and multimedia techniques.

Advanced Engineering Design Graphics: Read More [+]

Rules & Requirements

Prerequisites: Engineering 26

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

Advanced Engineering Design Graphics: Read Less [-]

ENGIN 147 Supplementary Work in Upper Division Engineering 1 - 3 Units

Terms offered: Fall 2016, Fall 2015, Spring 2015

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.

Supplementary Work in Upper Division Engineering: Read More [+]

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.

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.

Supplementary Work in Upper Division Engineering: Read Less [-]

ENGIN 157AC Engineering, The Environment, and Society 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

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.

Engineering, The Environment, and Society: Read More [+]

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

Engineering, The Environment, and Society: Read Less [-]

ENGIN 177 Advanced Programming with MATLAB 3 Units

Terms offered: Spring 2017, Spring 2015, Spring 2014

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.

Advanced Programming with MATLAB: Read More [+]

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

Advanced Programming with MATLAB: Read Less [-]

ENGIN 180 Preparing for the Fields and Jobs of the Future 3 Units

Terms offered: Spring 2018

The course is concerned with giving students the tools to prepare for the fields and jobs of the future.

Across all university departments and majors, the numbers of students who do not work in the fields in which they've received their degrees is not only significant, but growing. For example, anywhere from 20-40% of STEM graduates do not work in the fields in which they received their degrees.

This does not mean that students shouldn't major in STEM, but that one of the primary purposes of higher education is learning how to learn. Accordingly, this course presents a number of frameworks that are critical for thinking about that which has not yet been invented.

Preparing for the Fields and Jobs of the Future: Read More [+]

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 not required.

Instructor: Ian I. Mitroff

Preparing for the Fields and Jobs of the Future: Read Less [-]

ENGIN 194 Undergraduate Research 3 Units

Terms offered: Fall 2017, Spring 2017, Fall 2016

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.

Undergraduate Research: Read More [+]

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 to satisfy a technical elective.

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.

Undergraduate Research: Read Less [-]

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

Terms offered: Spring 2018, Spring 2017, Fall 2016

Group study of selected topics.

Directed Group Studies for Advanced Undergraduates: Read More [+]

Rules & Requirements

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

Repeat rules: Course may be repeated for credit.

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.

Directed Group Studies for Advanced Undergraduates: Read Less [-]