

Engineering Mathematics and Statistics

Bachelor of Science (BS)

The Engineering Mathematics and Statistics major offered through the Engineering Science Program offers students an opportunity to study pure and applied mathematics as essential components of modern engineering. By combining courses in pure mathematics, applied mathematics, statistics, the physical sciences, and engineering, a student may individualize a program of study, of theory, or of applications of both. It provides a broad foundation for graduate studies in theoretical branches of engineering, as well as in mathematics, and can prepare students for a career in specific sectors of industry or business.

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 Science degree programs via a Change of College application for current UC Berkeley students is competitive as there are few — if any — spaces available in this major for 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

There is no minor program in Engineering Mathematics and Statistics.

Other Majors offered by the Engineering Science Program

Energy Engineering (<http://guide.berkeley.edu/archive/2017-18/undergraduate/degree-programs/energy-engineering>) (Major and Minor)
 Engineering Physics (<http://guide.berkeley.edu/archive/2017-18/undergraduate/degree-programs/engineering-physics>) (Major)
 Environmental Engineering Science (<http://guide.berkeley.edu/archive/2017-18/undergraduate/degree-programs/environmental-engineering-science>) (Major)

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 taken in satisfaction of major requirements 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 4A	General Chemistry and Quantitative Analysis ¹	4
or CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
PHYSICS 7C	Physics for Scientists and Engineers	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4
or COMPSCI 61A	The Structure and Interpretation of Computer Programs	
ENGIN 177	Advanced Programming with MATLAB	3
or COMPSCI 61B	Data Structures	
or COMPSCI 61BI	Data Structures and Programming Methodology	
Lower division technical electives		
Select two from the following: ²		
COMPSCI C8	Foundations of Data Science	
COMPSCI 61A	The Structure and Interpretation of Computer Programs ³	
COMPSCI 61B	Data Structures ³	
COMPSCI 61B	Data Structures and Programming Methodology ³	
COMPSCI 61C	Great Ideas of Computer Architecture (Machine Structures)	
COMPSCI 61C	Machine Structures (Lab-Centric)	
COMPSCI 70	Discrete Mathematics and Probability Theory	
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers ³	
ENGIN 25 & ENGIN 26	Visualization for Design and Three-Dimensional Modeling for Design	
or ENGIN 27	Introduction to Manufacturing and Tolerancing	
(Two of E25, 26, 27 count as one course for this requirement.)		
MAT SCI 45 & 45L	Properties of Materials and Properties of Materials Laboratory	
MATH 55	Discrete Mathematics	
MEC	Introduction to Solid Mechanics	
ENG C85/		
CIV ENG C30		

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

² Other courses may be used if approved by a faculty adviser.

³ This course may only be used as a lower division technical elective if not being used to satisfy other requirements above.

Upper Division Requirements

Due to the interdisciplinary nature of this major, electives must be selected and approved in consultation with a faculty adviser.

MATH 110	Linear Algebra	4
MATH 104	Introduction to Analysis	4
MATH 105	Second Course in Analysis	4
or MATH 185	Introduction to Complex Analysis	
MATH 128A	Numerical Analysis	4
STAT 134	Concepts of Probability	4
Select three math/statistics technical electives		10-12
Select one course in mathematics, one course in statistics, and one course from either, from the following:		
MATH 105	Second Course in Analysis	
MATH 113	Introduction to Abstract Algebra	
MATH 118	Fourier Analysis, Wavelets, and Signal Processing	
MATH 123	Ordinary Differential Equations	
MATH 125A	Mathematical Logic	
MATH 126	Introduction to Partial Differential Equations	
MATH 130	The Classical Geometries	
MATH 135	Introduction to the Theory of Sets	
MATH 140	Metric Differential Geometry	
MATH 142	Elementary Algebraic Topology	
MATH 170	Mathematical Methods for Optimization	
MATH 185	Introduction to Complex Analysis	
MATH 189	Mathematical Methods in Classical and Quantum Mechanics	
ENGIN 117	Methods of Engineering Analysis (counts as a Math Elective)	
STAT 135	Concepts of Statistics	
STAT 150	Stochastic Processes	
STAT 151A	Linear Modelling: Theory and Applications	
STAT 152	Sampling Surveys	
STAT 153	Introduction to Time Series	
STAT 154	Modern Statistical Prediction and Machine Learning	
STAT 157	Seminar on Topics in Probability and Statistics	
STAT 158	The Design and Analysis of Experiments	
Additional upper division technical electives: select 16 units of upper division engineering courses, in consultation with faculty adviser ¹		16

¹ Technical electives must include 16 units of upper division engineering courses, selected in consultation with the student's faculty adviser, in order to provide depth in an area of engineering with high mathematical content—typically, most of these courses will come from a single engineering department, but courses that complement each other from different departments are also permissible. NOTE: IND ENG 172 is an alternate course to STAT 134. Students may not receive credit for both STAT 134 and IND ENG 172. IND ENG 172 cannot be used to fulfill engineering unit requirements; it can only be used as a substitution for STAT 134. Engineering courses cannot include: any course taken on a P/ NP basis; BIO ENG 100, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 190E), ENGIN 125, ENGIN 157AC, IND ENG 172, ENGIN 180, IND ENG 185, IND ENG 186, IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, MEC ENG 191K.

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://engineering.berkeley.edu/academics/undergraduate-programs>) 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 list 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/2017-18/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>) 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>), COMPSCI C79 (<http://guide.berkeley.edu/search/?P=COMPSCI%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 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/2017-18/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/2017-18/undergraduate/colleges-schools/letters-science/breadth-requirement-historical-studies>)
 - International Studies (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/letters-science/breadth-requirement-international-studies>)
 - Philosophy and Values (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/letters-science/breadth-requirement-philosophy-values>)
 - Social and Behavioral Studies (<http://guide.berkeley.edu/archive/2017-18/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 for 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 for 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://engineering.berkeley.edu/academics/undergraduate-programs>) 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.)

University of California Requirements

Entry Level Writing (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/natural-resources/entry-level-writing-requirement>)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing Requirement. Fulfillment of this requirement is also a prerequisite to enrollment in all reading and composition courses at UC Berkeley.

American History and American Institutions (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/natural-resources/american-history-institutions-requirement>)

The American History and Institutions requirements are based on the principle that a U.S. resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

Campus Requirement

American Cultures (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/natural-resources/american-cultures-requirement>)

American Cultures (AC) is the one requirement that all undergraduate students at UC Berkeley need to take and pass in order to graduate. The requirement offers an exciting intellectual environment centered on the study of race, ethnicity and culture in the United States. AC courses offer students opportunities to be part of research-led, highly accomplished teaching environments, grappling with the complexity of American Culture.

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
CHEM 4A or 1A <i>and</i> 1AL ¹		4	MATH 1B
MATH 1A		4	PHYSICS 7A
Reading & Composition Course from List A		4	ENGIN 7 or COMPSCI 61A
Humanities/Social Sciences Course		3-4	First Lower Division Technical Elective ²
		15-16	15-16

Sophomore			
	Fall	Units	Spring
MATH 53		4	MATH 54
PHYSICS 7B		4	PHYSICS 7C
Second Lower Division Technical Elective ²		3-4	ENGIN 177, COMPSCI 61B, or COMPSCI 61BL
Reading & Composition Course from List B		4	Humanities/ Social Sciences Course
Free Elective		1	Free Elective
		16-17	15-17
Junior			
	Fall	Units	Spring
MATH 104		4	MATH 105 or 185
MATH 110		4	MATH 128A
STAT 134		4	Upper Division Technical Elective ^{3,4}
Humanities/Social Science Course		3-4	Humanities/ Social Science Course
Free Elective		1	Free Elective
		16-17	15-17
Senior			
	Fall	Units	Spring
Upper Division Technical Electives ^{3,4}		11-12	Upper Division Technical Electives ^{3,4}
Free Electives		3-4	Free Electives
		14-16	15-16

Total Units: 121-132

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

² Two lower division courses in engineering, mathematics, or statistics, chosen in consultation with the faculty adviser; options include CIV ENG C30/MEC ENG C85, COMPSCI C8, COMPSCI 61A, COMPSCI 61B, COMPSCI 61BL, COMPSCI 61C, COMPSCI 61CL, COMPSCI 70, ENGIN 7, ENGIN 25, ENGIN 26, ENGIN 27 (two of ENGIN 25, ENGIN 26, ENGIN 27 must be completed to count as one course), MAT SCI 45 plus MAT SCI 45L, MATH 55, but other courses may also be used if approved by a faculty adviser. Courses used to satisfy the two computer science course requirements may NOT also be used for lower division technical electives. They can only be used to complete one requirement.

³ Technical electives must include 16 units of upper division engineering courses, selected in consultation with the student's faculty adviser, in order to provide depth in an area of engineering with high mathematical content—typically, most of these courses will come from a single engineering department, but courses that complement each other from different departments are also permissible. NOTE: IND ENG 172 is an alternate course to STAT 134. Students may not receive credit for both STAT 134 and IND ENG 172. IND ENG 172 cannot be used to fulfill engineering unit requirements; it can only be used as a substitution for STAT 134. Engineering courses cannot include: any course taken on a P/NP basis; BIO ENG 100, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 190E), ENGIN 125, ENGIN 157AC, ENGIN 180, IND ENG 172, IND ENG 185, IND ENG 186, IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, MEC ENG 191K.

⁴ Three additional upper division technical electives as follows: one in mathematics, one in statistics, and one from either math or statistics from among: MATH 105, MATH 113, MATH 118, MATH 123, MATH 125A, MATH 126, MATH 130, MATH 135, MATH 140, MATH 142, MATH 170, MATH 185, MATH 189, ENGIN 117 (counts as a math elective); STAT 135, STAT 150, STAT 151A, STAT 152, STAT 153, STAT 154, STAT 157, STAT 158.

Engineering Mathematics and Statistics

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

Terms offered: Fall 2018, Summer 2018 10 Week Session, Spring 2018
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 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 when topic changes. 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: Fall 2018, Spring 2018, Fall 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: Fall 2018, Spring 2018, Fall 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: Fall 2018, Spring 2018, Fall 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](#) [\[+\]](#)

Rules & Requirements

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

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](#) [\[+\]](#)

Rules & Requirements

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

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 [+]

Rules & Requirements

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

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 2018, 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 2016, Fall 2012, Spring 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 without restriction.

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 2018, Fall 2017, Fall 2016

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 without restriction.

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 2018, Fall 2017, Fall 2016

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: Fall 2018, Spring 2018, Fall 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 without restriction.

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 [+]

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 [+]

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: Fall 2018, Spring 2018, Fall 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 [\[+\]](#)

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 [\[+\]](#)

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 2018, Fall 2017, Fall 2016

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 without restriction.

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: Spring 2018, Fall 2017, Spring 2017

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 without restriction.

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 without restriction.

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 \[-\]](#)