Industrial Engineering and Operations Research

Bachelor of Science (BS)

The Bachelor of Science (BS) degree in Industrial Engineering and Operations Research (IEOR) is designed to prepare students for technical careers in production or service industries. It provides a strong foundation for those headed for engineering management positions or for those intending to go on to specialized graduate study in operations research, industrial engineering, or business administration.

Students interested in Industrial Engineering and Operations Research may also be interested in the Operations Research and Management Science major in the College of Letters & Science. For further information on this program, please see the Operations Research and Management Science page (http://guide.berkeley.edu/undergraduate/degree-programs/operations-research-management-science/) in this Guide.

Course of Study Overview

The core of the program includes basic science, mathematics including probability and statistics, engineering optimization, and stochastic models. This forms the methodological foundation for upper division IEOR electives involving the analysis and design of production and service systems, information systems, and human work systems and organization, among others.

Accreditation

This program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org/).

Admission to the Major

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

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

Minor Program

The department offers a minor in IEOR. Students must have a minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the minor's prerequisite courses in order to be considered for departmental acceptance into the minor.

For the minor to be added to the transcript, students must file the Declaration of Minor form with the Office of Undergraduate Advising in 4145 Etcheverry Hall before or during the semester prior to their last semester on campus, and complete the minor requirements by their final term.

In addition to the University, campus, and college requirements, students must fulfill the below requirements specific to their major program.

General Guidelines

1. All 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 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]	4-5
or CHEM 4A	General Chemistry and Quantitative Analysis	
or BIOLOGY 1A & 1AL	General Biology Lecture and General Biology Laboratory	
or BIOLOGY 1B	General Biology Lecture and Laboratory	
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
Programming: Select one of the following: [2]		4
COMPSCI 61A	The Structure and Interpretation of Computer Programs [4]	
COMPSCI C8	Foundations of Data Science [4]	
Engineering Breadth Electives: Select at least 9 units from the following:		9
BIO ENG 10	Introduction to Biomedicine for Engineers [4]	
BIO ENG 102	Biomechanics: Analysis and Design [4]	
CIV ENG 11	Engineered Systems and Sustainability [3]	
CIV ENG C30/ MEC ENG C85	Introduction to Solid Mechanics [3]	
CIV ENG 60	Structure and Properties of Civil Engineering Materials [3]	
CIV ENG 70	Engineering Geology [3]	
CIV ENG 126	Engineering Dynamics and Vibrations [3]	
CIV ENG 132	Applied Structural Mechanics [3]	
CIV ENG 155	Transportation Systems Engineering [3]	
DES INV 15	Design Methodology [3]	
EECS 16A	Designing Information Devices and Systems I [4]	

EECS 16B	Designing Information Devices and Systems II [4]
ENGIN 11	A Hands-on Introduction to Radiation Detection: Getting to know our Radioactive World [3]
ENGIN 26	Three-Dimensional Modeling for Design [2]
ENGIN 29	Manufacturing and Design Communication [4]
or ENGIN 25 & ENGIN 27	Visualization for Design and Introduction to Manufacturing and Tolerancing
ENGIN 40	Engineering Thermodynamics [4]
MAT SCI 45 & 45L	Properties of Materials and Properties of Materials Laboratory
MAT SCI 111	Properties of Electronic Materials [4]
MEC ENG 40	Thermodynamics [3]
MEC ENG C85/ CIV ENG C30	Introduction to Solid Mechanics [3]
MEC ENG 126	The Science and Engineering of Cooking [4]
MEC ENG 132	Dynamic Systems and Feedback [3]

1 CHEM 4A is for students majoring in chemistry or a closely related field. CHEM 1A and CHEM 1AL, or CHEM 4A are prerequisites for BIOLOGY 1A.

2 Students must acquire fluent programming skills as demonstrated by completion of coursework in a high-level language such as Python, C, C++ or Java. This requirement may be completed by taking COMPSCI C8 or COMPSCI 61A or equivalent. The CS 9xx series self-paced courses are intended for those already skilled as programmers in a high-level language to learn a second language and thus are not appropriate for meeting this requirement. Junior transfer admits who have completed a programming course of 3 units or more in Python, C, C++, or Java have fulfilled this requirement.

Upper Division Requirements

ENGIN 120	Principles of Engineering Economics [1]	3
or IND ENG 120	Principles of Engineering Economics	
IND ENG 160	Nonlinear and Discrete Optimization	3
IND ENG 162	Linear Programming and Network Flows	3
IND ENG 165	Engineering Statistics, Quality Control, and Forecasting	4
IND ENG 172	Probability and Risk Analysis for Engineers [2]	4
or STAT 134	Concepts of Probability	
or STAT C140	Probability for Data Science	
or DATA C140	Probability for Data Science	
IND ENG 173	Introduction to Stochastic Processes	3
IND ENG 174	Simulation for Enterprise-Scale Systems	3
IND ENG 180	Senior Project	4
IND ENG Electives: Select 6 courses from the following:		21
IND ENG 115	Industrial and Commercial Data Systems [3]	
IND ENG 130	Methods of Manufacturing Improvement [3]	
IND ENG 142	Introduction to Machine Learning and Data Analytics [3]	
IND ENG 150	Production Systems Analysis [3]	
IND ENG 151	Service Operations Design and Analysis [3]	
IND ENG 153	Logistics Network Design and Supply Chain Management [3]	
IND ENG 164	Introduction to Optimization Modeling [3]	
IND ENG 166	Decision Analytics [3]	
IND ENG 169	Integer Optimization [3]	
IND ENG 170	Industrial Design and Human Factors [3]	
IND ENG 171	Technology Firm Leadership [3]	
Ethics Requirement: Select one course from the following: [3]		
BIO ENG 100	Ethics in Science and Engineering [3]	
DATA C104/ HISTORY C184D/ STS C104D	Human Contexts and Ethics of Data - DATA/ History/STS [4]	
ENE,RES C100/ PUB POL C184	Energy and Society [4]	
ENE,RES W100/ PUB POL W184	Energy and Society [4]	
ENGIN 125	Ethics, Engineering, and Society [3]	
ENGIN/IAS 157AC	Engineering, The Environment, and Society [4]	
UGBA 107	The Social, Political, and Ethical Environment of Business [3]	

1 Students will not receive credit for both IND ENG 120 and ENGIN 120.

2 IND ENG 172 is an alternative course for STAT 134 or STAT C140/DATA C140. In semesters when IND ENG 172 is offered, it is recommended that students take IND ENG 172 instead of STAT 134 or STAT C140/DATA C140. Students will receive unit credit for only one of these courses.

3 These courses also satisfy one upper division humanities/social sciences course.

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

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

General Guidelines

1. All minors must be declared no later than one semester before a student's Expected Graduation Term (EGT). If the semester before EGT is fall or spring, the deadline is the last day of RRR week. If the semester before EGT is summer, the deadline is the final Friday of Summer Sessions. To declare a minor, contact the department advisor for information on requirements, and the declaration process.

2. To be considered for the minor, students must have a declared major other than IEOR or ORMS and submit the Minor Petition in IEOR.

3. Submit the Petition form (to the IEOR Student Services Office) when you have at least four (4) of the minor requirements completed. Minor petitions are accepted year-round on a rolling basis.
   # A minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the prerequisite courses is required for acceptance into the minor program.

4. Students must have completed all course requirements.
   # All courses taken to fulfill the minor requirements must be taken for graded credit. For information about letter grade exceptions for courses taken in Spring 2020 to Spring 2021, please contact the department.
   # A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
   # No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
   # Completion of the minor program cannot delay a student's graduation.
5. Students taking the minor are also required to submit the IEOR Minor Completion Form when they are enrolled in their last required course, by the last day of instruction of their final term.

Requirements

Prerequisites		
IND ENG 172	Probability and Risk Analysis for Engineers [4]	
or STAT 134	Concepts of Probability	
or STAT C134	Probability for Data Science	
or DATA C140	Probability for Data Science	
IND ENG 165	Engineering Statistics, Quality Control, and Forecasting [4]	
or STAT 135	Concepts of Statistics	
Upper Division Requirements		
List A: One course from below		
IND ENG 160	Nonlinear and Discrete Optimization [3]	
IND ENG 162	Linear Programming and Network Flows [3]	
List B: One course from below		
IND ENG 142	Introduction to Machine Learning and Data Analytics [3]	
IND ENG 166	Decision Analytics [3]	
IND ENG 173	Introduction to Stochastic Processes [3]	
List C: Two courses from below		
IND ENG 115	Industrial and Commercial Data Systems [3]	
IND ENG 130	Methods of Manufacturing Improvement [3]	
IND ENG 150	Production Systems Analysis [3]	
IND ENG 151	Service Operations Design and Analysis [3]	
IND ENG 153	Logistics Network Design and Supply Chain Management [3]	
IND ENG 170	Industrial Design and Human Factors [3]	
IND ENG 171	Technology Firm Leadership [3]	

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 (https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/) 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) that can fulfill requirements for the student's major 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 five semesters to complete their degree requirements. Summer terms are optional and do not count toward the maximum. Students are responsible for planning and satisfactorily completing all graduation requirements within the maximum allowable semesters.
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 Sciences (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. See the humanities and social sciences (https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/humanities-and-social-sciences/) section of our website for details.

Class Schedule Requirements

- Minimum units per semester: 12.0
- Maximum units per semester: 20.5
- Minimum technical courses: College of Engineering undergraduates must include at least two letter graded technical courses (of at least 3 units each) in their semester program. Every semester students are expected to make satisfactory progress in their declared major. Satisfactory progress is determined by the student's Engineering Student Services Advisor. (Note: For most majors, normal progress (https://engineering.berkeley.edu/academics/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282) will require enrolling in 3-4 technical courses each semester). Students who are not in compliance with this policy by the end of the fifth week of the semester are subject to a registration block that will delay enrollment for the following semester.
- All technical courses (math, science, engineering) that satisfy requirements for the major must be taken on a letter-graded basis (unless only offered as P/NP).

Minimum Academic (Grade) Requirements

- Minimum overall and semester grade point averages of 2.00 (C average) are required of engineering undergraduates. Students 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 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 are required to earn a Bachelor of Science in the College of 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 (https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/) of study.
- A maximum of 16 units of special studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed to count towards the B.S. degree, and no more than 4 units in any single term can be counted.
- A maximum of 4 units of physical education from any school attended will count towards the 120 units.
- Passed (P) grades may account for no more than one third of the total units completed at UC Berkeley, Fall Program for Freshmen (FPF), UC Education Abroad Program (UCEAP), or UC Berkeley Washington Program (UCDC) toward the 120 overall minimum unit requirement. Transfer credit is not factored into the limit. This includes transfer units from outside of the UC system, other UC campuses, credit-bearing exams, as well as UC Berkeley Extension XB units.

Normal Progress

Students in the College of Engineering must enroll in a full-time program and make normal progress (https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282) 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 (https://www.ucop.edu/elwr/)

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. Satisfaction 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/undergraduate/education/#universityrequirementstext)

The American History and Institutions requirements are based on the principle that a U.S. resident who has 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/undergraduate/education/#campusrequirementstext)

The American Cultures requirement is a Berkeley campus requirement, one that all undergraduate students at Berkeley need to pass in order to graduate. You satisfy the requirement by passing, with a grade not lower than C- or P, an American Cultures course. You may take an American Cultures course any time during your undergraduate career at Berkeley. The requirement was instituted in 1991 to introduce students to the diverse cultures of the United States through a comparative framework. Courses are offered in more than fifty departments in many different disciplines at both the lower and upper division level.

The American Cultures requirement and courses constitute an approach that responds directly to the problem encountered in numerous disciplines of how better to present the diversity of American experience to the diversity of American students whom we now educate.

Faculty members from many departments teach American Cultures courses, but all courses have a common framework. The courses focus on themes or issues in United States history, society, or culture; address theoretical or analytical issues relevant to understanding race, culture, and ethnicity in American society; take substantial account of groups drawn from at least three of the following: African Americans, indigenous peoples of the United States, Asian Americans, Chicano/Latino Americans, and European Americans; and are integrative and comparative in that students study each group in the larger context of American society, history, or culture.

This is not an ethnic studies requirement, nor a Third World cultures requirement, nor an adjusted Western civilization requirement. These courses focus upon how the diversity of America's constituent cultural traditions have shaped and continue to shape American identity and experience.

Visit the Class Schedule (http://classes.berkeley.edu/) or the American Cultures website (http://americancultures.berkeley.edu/) for the specific American Cultures courses offered each semester. For a complete list of approved American Cultures courses at UC Berkeley and California Community Colleges, please see the American Cultures Subcommittee's website (https://academic-senate.berkeley.edu/committees/amcult/). See your academic adviser if you have questions about your responsibility to satisfy the American Cultures breadth requirement.

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 1A & 1AL[1]	5	MATH 1B	4	
MATH 1A	4	PHYSICS 7A	4	
Reading & Composition Part A Course[3]	4	ENGIN 7	4	
Engineering Breadth Course[2]	3	Reading & Composition Part B Course[3]	4	
Optional Freshman Seminar or ENGIN 92	0-1			
	16-17			**16**

				Sophomore
	Fall Units		**Spring Units**	
MATH 53	4	MATH 54	4	

PHYSICS 7B	4	ENGIN 120 or IND ENG 120	3
Engineering Breadth Course[2]	3	COMPSCI C8 or 61A[4]	4
Humanities/Social Sciences Course[3]	3-4	Engineering Breadth Course[2]	3
		Humanities/ Social Sciences Course[3]	3-4
	14-15		**17-18**

Junior

Fall Units		Spring Units	
IND ENG 160	3	IND ENG 165	4
IND ENG 162	3	IND ENG 173	3
IND ENG 172, STAT 134, or STAT C140[5]	4	IND ENG Electives[6]	6
IND ENG Elective[6]	3	Humanities/ Social Sciences Course[3]	3-4
Humanities/Social Sciences Course with ethics content[3]	3-4		
	16-17		**16-17**

Senior

Fall Units		Spring Units	
IND ENG Electives[6]	6	IND ENG 174	3
Free Electives[7]	9	IND ENG 180	4
		IND ENG Electives[6]	3
		Free Elective[7]	3
	15		**13**

Total Units: 123-128

1 CHEM 4A, BIOLOGY 1A and BIOLOGY 1AL, or BIOLOGY 1B may also be used to fulfill this requirement. CHEM 4A is intended for students majoring in chemistry or a closely-related field. CHEM 1A and CHEM 1AL, or CHEM 4A are prerequisites for BIOLOGY 1A.

2 Engineering Breadth: 9 units must be completed from the following list: BIO ENG 10, BIO ENG 102, CIV ENG 11, CIV ENG C30, CIV ENG 60, CIV ENG 70, CIV ENG 126, CIV ENG 132, CIV ENG 155, DES INV 15, EECS 16A, EECS 16B, ENGIN 11, ENGIN 26, ENGIN 29 (or ENGIN 25 & ENGIN 27), ENGIN 40, MAT SCI 45, MAT SCI 45L, MAT SCI 111, MEC ENG 40, MEC ENG C85, MEC ENG 132.

3 The Humanities/Social Sciences (H/SS) requirement includes two approved reading and composition courses and four additional approved courses, with which a number of specific conditions must be satisfied. The first half (R&C Part A) must be completed by the end of the freshman year; the second half (R&C Part B) must be completed by no later than the end of the sophomore year. The remaining courses may be taken at any time during the program. See engineering.berkeley.edu/hss (https://engineering.berkeley.edu/academics/undergraduate-guide/degree-requirements/humanities-and-social-sciences/) for complete details and a list of approved courses. One of the H/SS courses must be an approved ethics course. See "Major Requirements" tab for list of approved ethics courses.

4 Students must acquire fluent programming skills as demonstrated by completion of coursework in a high-level language such as Python, C, C++ or Java. This requirement may be completed by taking COMPSCI C8 or COMPSCI 61A or equivalent. The CS 9xx series self-paced courses are intended for those already skilled as programmers in a high-level language to learn a second language and thus are not appropriate for meeting this requirement. Junior transfer admits who have completed a programming course of 3 units or more in Python, C, C++, or Java have fulfilled this requirement.

5 IND ENG 172 is an alternative course for STAT 134 or STAT C140. In semesters when IND ENG 172 is offered, it is recommended that students take IND ENG 172. Students will receive credit for only one of these courses.

6 Students must take a minimum of six courses from the following: IND ENG 115, IND ENG 130, IND ENG 142, IND ENG 150, IND ENG 151, IND ENG 153, IND ENG 164, IND ENG 166, IND ENG 169, IND ENG 170, IND ENG 171.

7 Free electives can be any technical or non-technical course, a course of your interest offered by any department. There are no restrictions.

Learning Goals for the Major

The IEOR Department has five general objectives for its Bachelor of Science (BS) degree program. It aims for BS degree graduates to become highly skilled in:

1. Quantitative modeling and analysis of a broad array of systems-level decision problems concerned with economic efficiency, productivity, and quality.
2. Development and creative use of analytical and computational methods for solving these problems.
3. Collection of and analysis of data, and the use of database and decision-support tools.
4. Comprehension and analysis of uncertainty.
5. In addition, the department expects their graduates to obtain the broader skills, background, and knowledge necessary to be an effective professional in a rapidly changing global economy.

All Berkeley engineering graduates acquire the following skills and knowledge:

1. Ability to apply knowledge of mathematics, science, and engineering.
2. Ability to design and conduct experiments, analyze, and interpret data.
3. Ability to design a system, component, or process to meet desired needs.
4. Ability to function on multi-disciplinary teams.
5. Ability to identify, formulate, and solve engineering problems.
6. Understanding of professional and ethical responsibility.
7. Ability to communicate effectively.
8. Understand impact of engineering solutions in a global and societal context.
9. Recognition of need for and ability to engage in life-long learning.
10. Knowledge of contemporary issues.
11. Ability to use techniques, skills, and modern engineering tools for engineering practice.

More specific outcomes of the IEOR BS degree program are as follows:

1. Identify opportunities for improvement in practical settings.
2. Document process, material and information flows.
3. Collect and structure data to support decision-making.
4. Define appropriate goals and constraints for decision-making.
5. Formulate mathematical optimization models for decision-making.
6. Model the probabilistic aspects of a system.
7. Validate modeling assumptions and model implications.
8. Explore model sensitivity to assumptions and parameters.
9. Apply appropriate solution techniques for optimization problems.
10. Perform statistical analysis to identify patterns, test hypotheses, and make estimates or forecasts.
11. Utilize decision support (e.g., optimization, simulation, decision analysis) software.
12. Use business software (e.g., Excel) and the Internet to analyze and solve problems.
13. Utilize quantitative tools for specific applications (e.g., inventory, scheduling, supply chain design, quality control).
14. Adapt or modify known solution approaches for new problem settings.
15. Consider humans and organizations in designing systems.
16. Communicate orally and in writing.
17. Work in a team.
18. Understand professional and ethical responsibilities.
19. Recognize need for and possess ability to engage in lifelong learning.

Major Maps help undergraduate students discover academic, co-curricular, and discovery opportunities at UC Berkeley based on intended major or field of interest. Developed by the Division of Undergraduate Education in collaboration with academic departments, these experience maps will help you:

- **Explore** your major and gain a better understanding of your field of study
- **Connect** with people and programs that inspire and sustain your creativity, drive, curiosity and success
- **Discover** opportunities for independent inquiry, enterprise, and creative expression
- **Engage** locally and globally to broaden your perspectives and change the world
- **Reflect** on your academic career and prepare for life after Berkeley

Use the major map below as a guide to planning your undergraduate journey and designing your own unique Berkeley experience.

View the Industrial Engineering and Operations Research Major Map PDF. **(**https://vcue.berkeley.edu/sites/default/files/industrial_engineering_and_operations_research.pdf**)**

Advising Values

Student Success: Above all, the department is dedicated to maximizing student potential and to helping students succeed in their University experiences. The department encourages students to explore their minds and their hearts, challenges them to do their best work, and helps them realize their talents and passions and achieve their goals.

Equity & Inclusion: The department is committed to creating an inclusive environment in which any individual or group can be and feel welcomed, respected, supported and valued. It aspires to provide fair treatment, access, opportunity, and advancement for all students and to identify and eliminate barriers that prevent the full participation of all.

Health & Well-Being: The department collaborates with campus partners to keep the IEOR community healthy by helping students balance the physical, intellectual, emotional, social, occupational, spiritual, and environmental aspects of life.

Advising Excellence: In all that it does, the department strives to deliver personalized advising services of the highest quality. It seeks to continuously educate itself on developments in the field and to evaluate, improve, and streamline its services to support students in obtaining the best education and experience possible.

Student Groups and Organizations

The Industrial Engineering and Operations Research (IEOR) Department is very proud that its students not only excel in academics but also in social organization. The department hosts three professional student organizations that engage in activities such as advising, recruiting and graduate schools information, alumni relations, academic conference organization, and social events. For information regarding student groups, please see the following websites:

IEOR Alumni (http://ieor.berkeley.edu/alumni/)
Alpha Pi Mu (http://apm.ieor.berkeley.edu/) (Industrial Engineering Honor Society)
IISE Student Chapter (https://iise.berkeley.edu/) (Institute of Industrial and Systems Engineers)

Study Abroad

The College of Engineering encourages all undergraduates in the college to study abroad. Whether students are interested in fulfilling general education requirements, taking courses related to their major/career, or simply living and studying in a country that is of interest to them, the department will work with students to make it happen. For information about study abroad programs, please see the Berkeley Study Abroad website (http://studyabroad.berkeley.edu/).

Career Services

The Career Center offers personalized career counseling and a wide variety of professional development workshops on topics such as networking as a job search strategy, getting results from the internet job search, internship search and success strategies, and applying for graduate school. For further information, please see the Career Services website (https://career.berkeley.edu/).

Industrial Engineering and Operations Research

Expand all course descriptions [+]Collapse all course descriptions [-]

IND ENG 24 Freshman Seminars 1 Unit

Terms offered: Fall 2017, Fall 2016, Fall 2015
The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.
Freshman Seminars: Read More [+]
Objectives & Outcomes

Course Objectives: Provide an introduction to the field of Industrial Engineering and Operations Research through a series of lectures.

Student Learning Outcomes: Learn more about Industrial Engineering and Operations Research.

Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Freshman Seminars: Read Less [-]

IND ENG 66 A Bivariate Introduction to IE and OR 3 Units

Terms offered: Fall 2016
This Freshman-level Introductory course will provide an intuitive overview of the fundamental problems addressed and methods in the fields of Industrial Engineering and Operations Research including Constrained Optimization, Human Factors, Data Analytics, Queues and Chains, and Linear Programming. The course will focus on two-dimensional, i.e., bivariate, examples where the problems and methods are amenable to visualization and geometric intuition. The course will discuss applications such as dieting, scheduling, and transportation. This course will not require pre-requisites and will present the core concepts in a self-contained manner that is accessible to Freshmen to provide the foundation for future coursework.
A Bivariate Introduction to IE and OR: Read More [+]
Objectives & Outcomes

Course Objectives: •
Provide a broad survey of the important topics in IE and OR, and develop intuition about problems, algorithms, and abstractions using bivariate examples (2D).
•
Describe different mathematical abstractions used in IEOR (e.g., graphs, queues, Markov chains), and how to use these abstractions to model real-world problems.
•
Introduce students to the data analysis process including: developing a hypothesis, acquiring data, processing the data, testing the hypothesis, and presenting results.
•
Provide students with concrete examples of how the mathematical tools from the class apply to real problems such as dieting, scheduling, and transportation.

Rules & Requirements

Credit Restrictions: Course restricted to Freshman students.

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Goldberg

A Bivariate Introduction to IE and OR: Read Less [-]

IND ENG 98 Supervised Group Study and Research 1 - 3 Units

Terms offered: Spring 2019, Fall 2015, Spring 2015
Supervised group study and research by lower division students.
Supervised Group Study and Research: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

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

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

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of directed group study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Supervised Group Study and Research: Read Less [-]

IND ENG 99 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Prior to 2007
Supervised independent study for lower division students.
Supervised Independent Study and Research: Read More [+]
Rules & Requirements

Prerequisites: Freshman or sophomore standing and consent of instructor

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

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of independent study per week
10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Supervised Independent Study and Research: Read Less [-]

IND ENG 115 Industrial and Commercial Data Systems 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Design and implementation of databases, with an emphasis on industrial and commercial applications. Relational algebra, SQL, normalization. Students work in teams with local companies on a database design project. WWW design and queries.
Industrial and Commercial Data Systems: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Goldberg

Industrial and Commercial Data Systems: Read Less [-]

IND ENG 120 Principles of Engineering Economics 3 Units

Terms offered: Prior to 2007
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. Formerly Engineering 120.
Principles of Engineering Economics: Read More [+]
Rules & Requirements

Credit Restrictions: Students will receive 2 units for 120 after taking Civil Engineering 167. Students will not receive credit after taking 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: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Adler

Principles of Engineering Economics: Read Less [-]

IND ENG 130 Methods of Manufacturing Improvement 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Analytical techniques for the improvement of manufacturing performance along the dimensions of productivity, quality, customer service, and throughput. Techniques for yield analysis, process control, inspection sampling, equipment efficiency analysis, cycle time reduction, and on-time delivery improvement. Applications on semiconductor manufacturing or other industrial settings.
Methods of Manufacturing Improvement: Read More [+]
Rules & Requirements

Prerequisites: IND ENG 172, MATH 54, or STAT 134 (STAT 134 may be taken concurrently)

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Leachman

Methods of Manufacturing Improvement: Read Less [-]

IND ENG 135 Applied Data Science with Venture Applications 3 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021
This highly-applied course surveys a variety of key of concepts and tools that are useful for designing and building applications that process data signals of information. The course introduces modern open source, computer programming tools, libraries, and code samples that can be used to implement data applications. The mathematical concepts highlighted in this course include filtering, prediction, classification, decision-making, Markov chains, LTI systems, spectral analysis, and frameworks for learning from data. Each math concept is linked to implementation using Python using libraries for math array functions (NumPy), manipulation of tables (Pandas), long term storage (SQL, JSON, CSV files), natural language (NLTK), and ML frameworks.
Applied Data Science with Venture Applications: Read More [+]
Objectives & Outcomes

Student Learning Outcomes: Students will be able to design and build data sample application systems that can interpret and use data for a wide range of real life applications across many disciplines and industries;
implement these concepts within applications with modern open source CS tools.
understand relevant mathematical concepts that are used in systems that process data;

Rules & Requirements

Prerequisites: Prerequisites include the ability to write code in Python, and a probability or statistics course. This course is ideal for students who have taken COMPSCI C8 / DATA C8 / INFO C8 / STAT C8

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Sidhu

Applied Data Science with Venture Applications: Read Less [-]

IND ENG 142 Introduction to Machine Learning and Data Analytics 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
This course introduces students to key techniques in machine learning and data analytics through a diverse set of examples using real datasets from domains such as e-commerce, healthcare, social media, sports, the Internet, and more. Through these examples, exercises in R, and a comprehensive team project, students will gain experience understanding and applying techniques such as linear regression, logistic regression, classification and regression trees, random forests, boosting, text mining, data cleaning and manipulation, data visualization, network analysis, time series modeling, clustering, principal component analysis, regularization, and large-scale learning.
Introduction to Machine Learning and Data Analytics: Read More [+]
Objectives & Outcomes

Course Objectives: 1.
To expose students to a variety of statistical learning methods, all of which are relevant in useful in wide range of disciplines and applications.
2.
To carefully present the statistical and computational assumptions, trade-offs, and intuition underlying each method discussed so that students will be trained to determine which techniques are most appropriate for a given problem.
3.
Through a series of real-world examples, students will learn to identify opportunities to leverage the capabilities of data analytics and will see how data analytics can provide a competitive edge for companies.
4.
To train students in how to actually apply each method that is discussed in class, through a series of labs and programming exercises.
5.
For students to gain some project-based practical data science experience, which involves identifying a relevant problem to be solved or question to be answered, gathering and cleaning data, and applying analytical techniques.
6.
To introduce students to advanced topics that are important to the successful application of machine learning methods in practice, include how methods for prediction are integrated with optimization models and modern optimization techniques for large-scale learning problems.

Rules & Requirements

Prerequisites: IEOR 165 or equivalent course in statistics. Prior exposure to optimization is helpful but not strictly necessary. Some programming experience/literacy is expected

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructors: Grigas, Paul

Introduction to Machine Learning and Data Analytics: Read Less [-]

IND ENG 145 Fundamentals of Revenue Management 3 Units

Terms offered: Fall 2022
This course will introduce students to (i) Fundamental models that capture the key dynamics of these fundamental problems and (ii) Algorithms that turn these models into actionable decisions. The broad usefulness of concepts covered will be demonstrated through several applications such as in airline reservation systems, retail, advertising, e-commerce as well as applications beyond RM such as in hospital-resident matching and school-student assignments.
Fundamentals of Revenue Management: Read More [+]
Rules & Requirements

Prerequisites: IndEng 162, IndEng 169 and either IndEng 173 Or IndEng 172 (or equivalent introductory courses in mathematical programming and probability). Familiarity with algorithm design and mathematical maturity recommended

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Udwani

Fundamentals of Revenue Management: Read Less [-]

IND ENG 150 Production Systems Analysis 3 Units

Terms offered: Fall 2020, Fall 2019, Fall 2018
Quantitative models for operational and tactical decision making in production systems, including production planning, inventory control, forecasting, and scheduling.
Production Systems Analysis: Read More [+]
Rules & Requirements

Prerequisites: IND ENG 160, IND ENG 173, IND ENG 162, IND ENG 165, and ENGIN 120

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Yano

Production Systems Analysis: Read Less [-]

IND ENG 151 Service Operations Design and Analysis 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
This course is concerned with improving processes and designing facilities for service businesses such as banks, health care organizations, telephone call centers, restaurants, and transportation providers. Major topics in the course include design of service processes, layout and location of service facilities, demand forecasting, demand management, employee scheduling, service quality management, and capacity planning.
Service Operations Design and Analysis: Read More [+]

Rules & Requirements

Prerequisites: IND ENG 162, IND ENG 173, and a course in statistics

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Service Operations Design and Analysis: Read Less [-]

IND ENG 153 Logistics Network Design and Supply Chain Management 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
We will focus primarily on both quantitative and qualitative issues which arise in the integrated design and management of the entire logistics network. Models and solution techniques for facility location and logistics network design will be considered. In addition, qualitative issues in distribution network structuring, centralized versus decentralized network control, variability in the supply chain, strategic partnerships, and product design for logistics will be considered through discussions and cases.
Logistics Network Design and Supply Chain Management: Read More [+]

Rules & Requirements

Prerequisites: IND ENG 160, IND ENG 162 or senior standing

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Kaminsky

Logistics Network Design and Supply Chain Management: Read Less [-]

IND ENG 160 Nonlinear and Discrete Optimization 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
This course introduces unconstrained and constrained optimization with continuous and discrete domains. Convex sets and convex functions; local optimality; KKT conditions; Lagrangian duality; steepest descent and Newton's method. Modeling with integer variables; branch-and-bound method; cutting planes. Models on production/inventory planning, logistics, portfolio optimization, factor modeling, classification with support vector machines.
Nonlinear and Discrete Optimization: Read More [+]

Rules & Requirements

Prerequisites: MATH 53 and MATH 54

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Atamturk

Nonlinear and Discrete Optimization: Read Less [-]

IND ENG 162 Linear Programming and Network Flows 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
This course addresses modeling and algorithms for optimization of linear constrained optimization problems. The simplex method; theorems of duality; complementary slackness. Applications in production planning and resource allocation. Graph and network problems as linear programs with integer solutions. Algorithms for selected network flow problems. Transportation and logistics problems. Dynamic programming and its role in applications to shortest paths, project management and equipment replacement.
Linear Programming and Network Flows: Read More [+]

Rules & Requirements

Prerequisites: MATH 53 and MATH 54

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Hochbaum

Linear Programming and Network Flows: Read Less [-]

IND ENG 164 Introduction to Optimization Modeling 3 Units

Terms offered: Prior to 2007
Designed for students from any science/engineering major, this upper-division course will introduce students to optimization models, and train them to use software tools to model and solve optimization problems. The main goal is to develop proficiency in common optimization modeling languages, and learn how to integrate them with underlying optimization solvers. Students will work primarily on modeling exercises, which will develop confidence in modeling and solve optimization methods using software packages, and will require some programming.
Review of linear and nonlinear optimization models, including optimization problems with discrete decision variables. Applications to practical problems from engineering and data science.
Introduction to Optimization Modeling: Read More [+]
Objectives & Outcomes

Course Objectives: •
To introduce students to the core concepts of optimization

•
To train them in the art and science of using software tools to model and solve optimization problems.

Rules & Requirements

Prerequisites: No prerequisites except some Python programming skills, which can be met by COMPSCI C8 (or any other Python-based course)

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Introduction to Optimization Modeling: Read Less [-]

IND ENG 165 Engineering Statistics, Quality Control, and Forecasting 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This course will introduce students to basic statistical techniques such as parameter estimation, hypothesis testing, regression analysis, analysis of variance. Applications in forecasting and quality control.
Engineering Statistics, Quality Control, and Forecasting: Read More [+]
Rules & Requirements

Prerequisites: IND ENG 172, or STAT 134, or an equivalent course in probability theory

Credit Restrictions: Students will receive no credit for IND ENG 165 after completing STAT 135.

Hours & Format

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

Summer: 6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Engineering Statistics, Quality Control, and Forecasting: Read Less [-]

IND ENG 166 Decision Analytics 3 Units

Terms offered: Spring 2022, Spring 2021, Fall 2019
Introductory course on the theory and applications of decision analysis. Elective course that provides a systematic evaluation of decision-making problems under uncertainty. Emphasis on the formulation, analysis, and use of decision-making techniques in engineering, operations research and systems analysis. Includes formulation of risk problems and probabilistic risk assessments. Graphical methods and computer software using event trees, decision trees, and influence diagrams that focus on model design.
Decision Analytics: Read More [+]
Rules & Requirements

Prerequisites: IND ENG 172 or STAT 134

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructors: Oren, Righter

Decision Analytics: Read Less [-]

IND ENG 169 Integer Optimization 3 Units

Terms offered: Spring 2022, Spring 2021, Fall 2020
This course addresses modeling and algorithms for integer programming problems, which are constrained optimization problems with integer-valued variables. Flexibility of integer optimization formulations; if-then constraints, fixed-costs, etc. Branch and Bound; Cutting plane methods; polyhedral theory. Applications in production planning, resource allocation, power generation, network design. Alternate formulations for integer optimization: strength of Linear Programming relaxations. Algorithms for integer optimization problems. Specialized strategies by integer programming solvers.
Integer Optimization: Read More [+]
Objectives & Outcomes

Course Objectives: •
Enable the students to recognize when problems can be modeled as integer optimization problems.
•
Familiarize students in leading methodologies for solving integer optimization problems, and techniques in these methodologies.
•
To acquire skills in the best modeling approach that is suitable to the practical problem at hand.
•
To train students in modeling of integer optimization problems;
•
To train the students in the selection of appropriate techniques to be used for integer optimization problems.

Rules & Requirements

Prerequisites: MATH 53, MATH 54, and background in Python and programming

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Rajan

Integer Optimization: Read Less [-]

IND ENG 170 Industrial Design and Human Factors 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This course surveys topics related to the design of products and interfaces ranging from alarm clocks, cell phones, and dashboards to logos, presentations, and web sites. Design of such systems requires familiarity with human factors and ergonomics, including the physics and perception of color, sound, and touch, as well as familiarity with case studies and contemporary practices in interface design and usability testing. Students will solve a series of design problems individually and in teams.
Industrial Design and Human Factors: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Goldberg

Industrial Design and Human Factors: Read Less [-]

IND ENG 171 Technology Firm Leadership 3 Units

Terms offered: Spring 2022, Fall 2020, Spring 2020
This course explores key management and leadership concepts relevant to the high-technology world. Topics include the firm's key operations, strategic issues, and managerial leadership including personal leadership and talent management. This course prepares technical and business minded students for careers focused on professional and management track careers in high technology. Students undertake intensive study of actual business situations through rigorous case-study analysis.
Technology Firm Leadership: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing

Credit Restrictions: Students will receive no credit for Ind Eng 171 after taking UGBA 105.

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

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Technology Firm Leadership: Read Less [-]

IND ENG 172 Probability and Risk Analysis for Engineers 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
This is an introductory course in probability designed to develop a good understanding of uncertain phenomena and the mathematical tools used to model and analyze it. Applications will be given in such areas as reliability theory, risk theory, inventory theory, financial models, and computer science, among others. To complement the theory, the course also covers the basics of stochastic simulation. This course is a probability course and cannot be used to fulfill any engineering unit or elective requirements.
Probability and Risk Analysis for Engineers: Read More [+]

Objectives & Outcomes

Course Objectives: Students will learn how to model random phenomena and learn about a variety of areas where it is important to estimate the likelihood of uncertain events. Students will also learn how to use computer simulation to replicate and analyze these events.

Rules & Requirements

Prerequisites: Students should have a solid knowledge of calculus, including multiple variable integration, such as MATH 1A and MATH 1B or MATH 16A and MATH 16B, as well as programming experience in Matlab or Python

Credit Restrictions: Students will receive no credit for IND ENG 172 after completing STAT 134, or STAT 140. A deficient grade in IND ENG 172 may be removed by taking STAT 140.

Hours & Format

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

Summer: 6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Probability and Risk Analysis for Engineers: Read Less [-]

IND ENG 173 Introduction to Stochastic Processes 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This is an introductory course in stochastic models. It builds upon a basic course in probability theory and extends the concept of a single random variable into collections of random variables known as stochastic processes. The course focuses on discrete-time Markov chains, Poisson process, continuous-time Markov chains, and renewal theory. It also discusses applications to queueing theory, risk analysis and reliability theory. Along with the theory, the course covers stochastic simulation techniques that will allow students to go beyond the models and applications discussed in the course.
Introduction to Stochastic Processes: Read More [+]

Objectives & Outcomes

Course Objectives: Students will learn how to model random phenomena that evolves over time, as well as the simulation techniques that enable the replication of such problems using a computer. By discussing various applications in science and engineering, students will be able to model many real world problems where uncertainty plays an important role.

Rules & Requirements

Prerequisites: Students should have taken a probability course, such as STAT 134 or IND ENG 172, and should have programming experience in Matlab or Python

Credit Restrictions: Students will receive no credit for Ind Eng 173 after taking Ind Eng 161.

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Introduction to Stochastic Processes: Read Less [-]

IND ENG 174 Simulation for Enterprise-Scale Systems 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Introductory course on design, programming, and statistical analysis of simulation methods and tools for enterprise-scale systems such as traffic and computer networks, health-care and financial systems, and factories. Topics include the types of problems that can be solved by such methods. Programming material includes the theory behind random variable generation for a variety of common variables. Advanced techniques such as variance reduction, simulation optimization, or meta-modeling are considered. Student teams implement an enterprise-scale simulation in a semester-length design project.
Simulation for Enterprise-Scale Systems: Read More [+]
Objectives & Outcomes

Course Objectives: •
Exposure students to state-of-art advanced simulation techniques. • Note: the course is a mixture of modeling art, analytical science, and computational technology.
•
Have students communicate their ideas and solutions effectively in written reports.
•
Insure students become familiar with the fundamental similarities and differences among simulation software packages.
•
Introduce students to modern techniques for developing computer simulations of stochastic discrete-event models and experimenting with such models to better design and operate dynamic systems.
•
Introduce the different technologies used to develop simulation models and simulator products in order to become critical consumers of simulation study results.
•
Teach strengths and weaknesses of different approaches for a foundation for selecting methodologies.
•
Teach students how to model random processes and experiment with simulated systems.

Rules & Requirements

Prerequisites: IND ENG 165; IND ENG 173; IND ENG 172 or STAT 134

Credit Restrictions: Students will receive no credit for IND ENG 174 after completing IND ENG 131. A deficient grade in IND ENG 174 may be removed by taking IND ENG 131.

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Zheng

Simulation for Enterprise-Scale Systems: Read Less [-]

IND ENG 180 Senior Project 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
Application of systems analysis and industrial engineering to the analysis, planning, and/or design of industrial, service, and government systems. Consideration of technical and economic aspects of equipment and process design. Students work in teams under faculty supervision. Topics vary yearly.
Senior Project: Read More [+]
Rules & Requirements

Prerequisites: 160, 162, 165, 173, Engineering 120, and three other Industrial Engineering and Operations Research electives

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 6 hours of fieldwork per week

Summer: 10 weeks - 3 hours of lecture and 9 hours of fieldwork per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Senior Project: Read Less [-]

IND ENG 190A Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2018, Fall 2016, Spring 2016
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Read More [+]
Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Read Less [-]

IND ENG 190B Advanced Topics in Industrial Engineering and Operations Research: Entrepreneurial Marketing and Finance 1 - 4 Units

Terms offered: Fall 2017, Spring 2014, Fall 2013
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Entrepreneurial Marketing and Finance: Read More [+]

Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Entrepreneurial Marketing and Finance: Read Less [-]

IND ENG 190C Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2020, Fall 2019, Spring 2019
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Read More [+]

Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Read Less [-]

IND ENG 190D Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2017, Fall 2014, Spring 2014
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Read More [+]

Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Read Less [-]

IND ENG 190F Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2013, Spring 2012, Spring 2011
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Read More [+]

Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Read Less [-]

IND ENG 190G Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2020, Fall 2019, Spring 2019
The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).
Advanced Topics in Industrial Engineering and Operations Research: Read More [+]

Rules & Requirements

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

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of seminar per week
10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Advanced Topics in Industrial Engineering and Operations Research: Read Less [-]

IND ENG 190H Cases in Global Innovation 1 Unit

Terms offered: Fall 2021, Spring 2011
This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in globalizing a company, product, or service. Over the duration of this course, students will examines case studies of early, mid-stage, and large-scale enterprises as they seek to start a new venture, introduce a new product or service, or capitalize on global economic trends to enhance their existing business. The course content exposes students interested in internationally oriented careers to the strategic thinking involved in international engagement and expansion. Cases will include both U.S. companies seeking to enter emerging markets and emerging market companies looking to expand within their own nations or into markets in developed nations. The course is focused around intensive study of actual business situations through rigorous case-study analysis.
Cases in Global Innovation: Read More [+]

Rules & Requirements

Prerequisites: Junior or Senior standing

Hours & Format

Fall and/or spring: 8 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Cases in Global Innovation: Read Less [-]

IND ENG 190I Cases in Global Innovation: China 1 Unit

Terms offered: Prior to 2007

This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in globalizing a company product or service, with a focus on China. Over the duration of this course, students will examine case studies of foreign companies seeking to start a new venture, introduce a new product or service to the China market, or domestic Chinese companies seeking to adapt a U.S. or western business model to the China market. The course content exposes students interested in internationally oriented careers to the strategic thinking involved in international engagement and expansion and the particularities of the China market and their contrast with the U.S. market. The course is focused around intensive study of actual business situations through rigorous case-study analysis and the course size is limited to 30.

Cases in Global Innovation: China: Read More [+]

Rules & Requirements

Prerequisites: Junior or senior standing. Recommended, but not required to be taken after or along with Engineering 198

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Sidhu

Cases in Global Innovation: China: Read Less [-]

IND ENG 190K Cases in Global Innovation: South Asia 1 Unit

Terms offered: Prior to 2007

This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in conducting business, globalizing a company product or service, or investing in South Asia. Over the duration of this course, students will examine case studies of foreign companies seeking to start a new venture, introduce a new product or service to the South Asian market, or South Asian companies seeking to adapt a U.S or western business model. The course will put this into the larger context of the political, economic, and social climate in several South Asian countries and explore the constraints to doing business, as well as the policy changes that have allowed for a more conducive business environment.

Cases in Global Innovation: South Asia: Read More [+]

Rules & Requirements

Prerequisites: Junior or senior standing. Recommended but not required to be taken after or along with Engineering 198

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Instructor: Sidhu

Cases in Global Innovation: South Asia: Read Less [-]

IND ENG H196A Operations Research and Management Science Honors Thesis 3 Units

Terms offered: Prior to 2007
Individual study and research for at least one academic year on a special problem approved by a member of the faculty; preparation of the thesis on broader aspects of this work.
Operations Research and Management Science Honors Thesis: Read More [+]

Rules & Requirements

Prerequisites: Open only to students in the honors program

Credit Restrictions: Course may be repeated for credit with consent of instructor.

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

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Operations Research and Management Science Honors Thesis: Read Less [-]

IND ENG H196B Operations Research and Management Science Honors Thesis 3 Units

Terms offered: Prior to 2007
Individual study and research for at least one academic year on a special problem approved by a member of the faculty; preparation of the thesis on broader aspects of this work.
Operations Research and Management Science Honors Thesis: Read More [+]

Rules & Requirements

Prerequisites: Open only to students in the honors program

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

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Operations Research and Management Science Honors Thesis: Read Less [-]

IND ENG 197 Undergraduate Field Research in Industrial Engineering 1 - 12 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Students work on a field project under the supervision of a faculty member. Course does not satisfy unit or residence requirements for bachelor's degree.
Undergraduate Field Research in Industrial Engineering: Read More [+]

Rules & Requirements

Prerequisites: Completion of two semesters of coursework

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

Hours & Format

Fall and/or spring: 15 weeks - 1-12 hours of fieldwork per week

Summer:
6 weeks - 2.5-30 hours of fieldwork per week
8 weeks - 1.5-22.5 hours of fieldwork per week
10 weeks - 1.5-18 hours of fieldwork per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Undergraduate Field Research in Industrial Engineering: Read Less [-]

IND ENG 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021
Group studies of selected topics. Semester course unit value and contact hours will have a one-to-one ratio.
Directed Group Studies for Advanced Undergraduates: Read More [+]

Rules & Requirements

Prerequisites: Senior standing in Engineering

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

Hours & Format

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

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

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

IND ENG 199 Supervised Independent Study 1 - 4 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Supervised independent study. Enrollment restrictions apply.
Supervised Independent Study: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Course may be repeated for a maximum of four units per semester.

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

Hours & Format

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

Summer:
6 weeks - 2.5-10 hours of independent study per week
8 weeks - 2-7.5 hours of independent study per week
10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

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

Supervised Independent Study: Read Less [-]