



**USC** UNIVERSITY OF SOUTHERN CALIFORNIA  
*Daniel J. Epstein Department of  
Industrial and Systems Engineering*

[www.usc.edu/dept/ise](http://www.usc.edu/dept/ise)

# Master's Program Handbook 2016-2017

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## DISCLAIMER

This handbook is produced by the Daniel J. Epstein Department of Industrial and Systems Engineering as an unofficial guide to graduate studies in the department. The source for much of the information in this booklet is the *USC Catalogue*, the document of authority for all students of the University of Southern California. Degree requirements listed in the *USC Catalogue* supersede any information which may be contained in any bulletin of any school or department. The *USC Catalogue* is updated and published annually by the University of Southern California. Other sources for information contained in this booklet are the *School of Engineering Bulletin*, the *Schedule of Classes*, and the *SCampus*. The student is referred to these publications for the definitive answers to any questions whether or not they are covered in this booklet. Matters of department policy not covered in the above publications may be referred to the ISE Educational Services Coordinator or to the ISE Faculty.

Although the University of Southern California, the School of Engineering, and the Daniel J. Epstein Department of Industrial and Systems Engineering have many resources to help each student achieve his/her desired education and training goals, it is ultimately the student's responsibility to see that all requirements for graduation are satisfied.

"Students are expected to be familiar with university policies and to monitor their own academic progress. They should keep all records of official grades earned, degree requirements met, transfer credits accepted and actions taken on requests for substitutions or exceptions to university policies and regulations."

--*USC Catalogue*

**For additional information on USC or the Daniel J. Epstein Department of  
Industrial and Systems Engineering,  
go to [www.usc.edu/dept/ise/](http://www.usc.edu/dept/ise/)**

## DANIEL J. EPSTEIN DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

In today's economy, successful graduates need to be skilled in technology, computing and business. To get these skills, there is no better major than Industrial and Systems Engineering (ISE), and there is no better place to study Industrial and Systems Engineering than University of Southern California (USC). USC graduates

- Design and implement information systems to control supply chains, production equipment and business operations.
- Lead development projects for computers, software, communication equipment and bio-tech devices
- Manage technology workers in design firms, manufacturers, and service organizations, such as hospitals and airlines.
- Create human/computer interfaces and inventing technology to meet human needs.

A graduate degree from USC's Epstein Department enables students to enter careers in technology management, information systems, consulting, automation and optimization.

### WHY USC

Students come to USC because of our academics and innovative programs, but we also offer:

- Outstanding, well-paid career opportunities in California's high-tech economy.
- Personal contact with top-ranked faculty, who are both world-renowned researchers and experienced engineers.
- A modern and challenging curriculum emphasizing information technology
- Top students who are attracted to Los Angeles' international economy from around the world.
- For graduate students, a range of degree and course options, with choices for students coming from any engineering or technical major.

Students also choose USC because of its leadership in ISE research. Our faculty works with the National Science Foundation, the Integrated Media Systems Center (based at USC) and private companies, to stay at the forefront of innovation in software, control systems and engineering management.

USC's research leadership is reflected in our faculty's membership in the prestigious National Academy of Engineering, publications in leading journals and patents for innovative computer based technologies.

### GRADUATE DEGREES OFFERED

USC has choices for students with, and without, undergraduate ISE degrees. All choices give students the training they need within a short period of time. Full-time students can complete master degrees in three semesters or less; part-time students in five semesters or less.

#### Master of Science Degrees

**Master's in Analytics** is a multidisciplinary field that relates the application of engineering approaches and methods to the analytics and management of engineering and business processes based on data.

**Master's in Engineering Management** is a joint ISE/business program that prepares students to lead technology projects and manage technology companies. The degree is especially well suited for students who have several years of work experience and are preparing to move into engineering management. Engineering Management courses are offered at night and through Distance Education Network, so students can enroll while continuing employment (Open to grads from all engineering and technical majors.)

**Master's in Health Systems Management Engineering** is for students who are interested in operations management and health care applications, and whose career objectives lead to increasing technical management responsibilities in large health care organizations.

**Master's in Industrial and Systems Engineering** prepares students to become technical leaders in industrial engineering.

**Master's in Industrial and Systems Engineering/MBA** is for students who want an extended graduate program with depth in both business and engineering. (For students who have an undergrad degree in industrial engineering, production engineering or equivalent; other students may enroll while satisfying pre-requisites.)

**Master's in Manufacturing Engineering** educates students in modern manufacturing methods and control systems. (Primarily for students with undergrad degrees in industrial, manufacturing, mechanical, or production engineering.)

**Master's in Operations Research Engineering** trains students in solving business problems with computers and mathematics. (Open to graduates from all engineering and technical majors).

**Master's in Product Development Engineering** is a joint program with the Aerospace and Mechanical Engineering Department that prepares engineers to become leaders in engineering design and new product development.

## **ENGINEER DEGREE**

The Engineer degree is awarded under the jurisdiction of the School of Engineering, and is intended for students who wish to continue their coursework beyond the normal M.S. degree, but do not wish to complete the research requirements of the Ph.D.

## **DOCTOR OF PHILOSOPHY (Ph.D.)**

The Ph.D. program prepares students for leadership in Industrial and Systems Engineering research and university-level education. In addition to meeting course requirements, students spend one or more years on PhD dissertation research. Students must complete a master's degree before enrolling in the PhD program. Policies for the Ph.D. are described in a separate publication available from the department.

## **QUALIFICATIONS FOR ADMISSION**

Graduate applications are individually reviewed by faculty, who consider academic preparation, grade point average, test scores, work experience, statements of purpose and letters of recommendation. Admission is competitive. Applicants must generally meet the following minimum standards, though satisfaction of these standards does not guarantee admission. However, conditional admission is sometimes granted when students are deficient in one area, but compensate in others. Therefore, students are still encouraged to apply if some, but not all, qualifications are satisfied.

1. A Bachelor of Science degree in engineering, mathematics, sciences or related fields is required for master's degree programs. Applicants to the MS ISE or MS ISE/MBA are expected to hold an undergraduate degree in Industrial Engineering, Production Engineering, or equivalent. A Master of Science in engineering is required for the Engineer degree and the Ph.D. Other majors may be accepted on a case-by-case basis. Applicants who do not meet pre-requisite requirements may be conditionally admitted and must complete any and all course deficiencies prior to being admitted to regular student status.
2. Overall undergraduate GPA of 3.0 or better on a 4.0 scale, or "better than average" academic performance.
3. Satisfactory performance in any prior graduate work.

4. Satisfactory scores on the Graduate Record Examination (GRE). Minimum standards for students are:

GRE General Exam	NLTX	EMT	ISE	MFE	ORE	PDE	ENGR
<b>International students</b>							
Minimum Verbal	146	146	146	146	146	146	146
Minimum Quantitative	156	155	155	151	156	151	155
<b>Domestic Students</b>	NLTX	EMT	ISE	MFE	ORE	PDE	ENGR
Minimum Verbal	153	153	153	153	153	146	153
Minimum Quantitative	156	155	155	151	156	151	155

The GRE Subject Examination is not required for any Industrial and Systems Engineering Graduate program.

- International Students whose first language is not English are required to take the TOEFL exam or IELTS to be considered a candidate for admission. A minimum TOEFL (iBT) score of 90, with no less than 20 on each section or an IELTS scores of 6.5, with no less than 6 on each band score will be exempt from the ISE exam.
- Letters of recommendation are encouraged, but not required, for M.S. degrees. Letters should comment on the applicant's aptitude and capabilities for pursuing graduate studies, including an assessment of ability to conduct innovative research.

#### FINANCIAL AID AT USC

Financial assistance is administered on three levels at USC:

- University Level** (via The Graduate School). The Graduate School publishes the *Guide to Graduate Aid*. Fellowships are available. The completed Graduate Fellowship Application Form should be returned to the Department for processing. The Graduate School also accepts department nominations for scholarships.
- School Level** (via the School of Engineering). The Dean and the Director of Graduate Studies of the School of Engineering review information from University Admissions to make awards to qualified candidates.
- Department Level** (via the Industrial and Systems Engineering Department). A limited number of Teaching and Research Assistantships are available to highly qualified graduate students. Assistantships consist of a stipend (academic year only) plus a tuition award. Applications are available by writing to the Industrial and Systems Engineering Department. Teaching Assistantships require demonstrated English proficiency. Research Assistantships may be offered to qualified applicants whose research interests are compatible with research currently underway in the Department. Preference will be given to continuing students. To be considered for financial aid, all application materials (including letters of reference, statement of purpose and GRE scores) must be received by February 1. Teaching assistantships are awarded only in the fall.

All of the above are extremely competitive. Graduate School aid and School of Engineering aid are primarily awarded to American citizens. Applicants interested in financial assistance should have qualifications well beyond the minimum requirements for admission.

#### Other Sources of Financial Aid

Financial aid is offered by many privately- and publicly-funded organizations. A number of scholarships are available to specifically promote women in higher education.

The Institute of International Education publishes *Funding for U.S. Study: A Guide for Foreign Nationals*, which lists over 600 grants and scholarships for which foreign nationals may apply. Awards are sponsored by both private and public sources. Awards sponsored by individual colleges and universities, however, are not included. For further information, contact:

Educational Associate Member Services, Institute of International Education, 809 United Nations Plaza, New York, New York 10017, USA.

*A Selected List of Fellowship Opportunities and Aids to Advanced Education for U.S. Citizens and Foreign Nationals* is available from: The Publications Office, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230

## Employment

Many students are employed by the University while pursuing their graduate degrees. The USC Personnel Office and the Career Development Center have listings of full- and part-time on- and off-campus employment opportunities, which are widely available in Los Angeles (the second largest city in the United States). Many ISE students secure summer internships, which are frequently available to foreign students after completing a 9-month residency period in the United States.

## APPLICATION AND ADMISSION PROCESS

### Application Process

Applications to USC can be submitted online at <http://www.usc.edu/students/admission/>.

Application forms are also available from the Graduate and International Admissions Office. The forms must be filled out completely with all supporting documentation provided. Examination scores should be sent to USC by the testing agency. International students must provide an affidavit of financial support. Application fees may not be waived. Applicants who file incomplete applications will be notified in writing of any deficiencies.

Applications are reviewed by the Admissions Office and by the ISE Department. Complete applications are processed in three to six weeks. It is very important to ensure that all required documents are provided, as decisions cannot be made until all material is received.

### Graduate Application Package List

- Statement of Purpose
- Three Letters of Recommendation (not required, but highly recommended for MS applicants)
- Graduate application form
- Official transcript(s)
- GRE scores
- TOEFL scores (required for International Students)
- Financial Statement (required for International Students)

### Contact Information

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University of Southern California  
Office of Admission  
University Park Campus  
Los Angeles, CA 90089-0911  
PHONE: (213) 740-1111  
FAX: (213) 740-1556  
[gradadm@usc.edu](mailto:gradadm@usc.edu)

## **Limited Status Enrollment**

Students may take classes without being admitted to a degree program as a Limited Status Student. Students who have been denied admission to a USC degree program may not take classes in that degree program. A maximum of 12 units taken as a Limited Status Student may be applied toward a graduate degree. Successful completion of courses under limited status does not guarantee admission to ISE degree programs. Students who are interested in pursuing a graduate degree should not delay their application.

## **Admission**

Applicants will be notified in writing once a decision has been reached. Admitted applicants will receive further information on orientation programs, housing and campus life.

## **Conditional Admission**

Applicants who do not meet admission qualifications may be granted conditional admission. Conditionally admitted students will be notified in writing of their admission status and of the conditions which must be satisfied to gain regular student status. Students must typically satisfy the admission conditions in the first semester of study.

## **International Students**

USC provides excellent support for international students to assist in their transition to the United States. International students admitted to USC will be provided with either the I-20 or the IAP-66 Eligibility Certificates. After receiving this, the student must apply through a United States Embassy or Consulate for a visa to enter the United States. Students should plan on arriving in Los Angeles with ample time to arrange for housing and registration prior to the first day of classes.

## **COMMON REQUIREMENTS FOR MASTER'S DEGREES**

### **Advisement**

All graduate students in the Epstein Department are expected to see their advisors at least once per semester to plan courses and to ensure satisfactory degree progress.

### **Transfer Credit**

The maximum number of transfer credits which may be applied toward a master's degree, subject to departmental approval is four units in degree programs requiring 24-32 units; eight units in programs requiring 33-40 units; 12 units in programs requiring 41 or more units. The same limits apply if a student wishes to transfer credits from any advanced degree previously completed at USC toward a master's degree.

- A maximum of four units of transfer credit may be applied toward an approved dual degree program.
- A maximum of 12 units of credit may be applied from courses taken as a Limited Status Student.
- Students should arrange for any transfer of credits during the first semester of enrollment at USC.

### **Time Limit**

No course work that is older than seven years may be applied toward the master's degree. The master's degree must be completed within five calendar years of taking the first course applied to the program.

### **Undergraduate Deficiencies**

A student must satisfactorily complete all undergraduate prerequisites prior to enrolling in graduate level courses.

### **Directed Research**

No more than 12 units of directed research (590) may be applied toward the master's degree.

### **Residency**

Students must complete a minimum of 20 units at USC. The last four units of courses must be at USC.

### **Grade Point Average Requirement**



Students must maintain an overall 3.0 GPA on 400-level and above work attempted at USC beyond the bachelor's degree to graduate. A minimum grade of C (2.0) is required in a course to receive graduate credit. Transfer units count as credit (CR) and are not calculated in the GPA.

### **Graduation**

At the beginning of the last semester, students should file an Application for Master's Degree with the Epstein Department GER 247 ([isedept@usc.edu](mailto:isedept@usc.edu), FAX: (213) 740-1120). This will alert the School and the University that you are prepared to receive your degree and initiate the degree check process, verifying that all academic and administrative requirements are met.

### **Leave of Absence**

A student who must suspend his/her studies for a semester or more must file for a leave of absence with the Epstein Department GER 247 ([isedept@usc.edu](mailto:isedept@usc.edu), FAX: (213) 740-1120), and withdraw from classes before the last day to drop classes without a mark of W (published in the Schedule of Classes). Students who miss the deadline for a leave of absence may still withdraw from classes with a mark of W but must apply for readmission to the program.

## MASTER OF SCIENCE IN ANALYTICS (NLTX)

This program is designed to satisfy the growing demand for professionals equipped with significant technical and quantitative training in the fundamentals of analytics for solving engineering and business problems in today's data-extensive digital world.

The core of the M.S. in Analytics program consists of six foundational courses, and four elective courses, totaling 30 units. The foundational courses cover the basic topics of data science and management, statistical methods, optimization, simulation and other operations research tools. The elective courses allow students to deepen their technical skills and expose them to the applied domains where analytics is much needed; some of these domains include electricity markets, supply chains and logistics, health care systems and transportation.

### Required Courses: (18 units)

INF 551	Foundations of Data Management (3 units)
DSO 529	Advanced Regression Analysis (3 units)
ISE 529	Engineering Data Analytics (3 units)
ISE 530	Optimization Methods for Analytics (3 units)
ISE 580	Performance Modeling and Simulation (3 units)
ISE 515	Project Management (3 units)

### Electives:

ISE Elective	3 units
INF or CSCI Elective	3 units
Electives subject to advisor approval	6 units

**TOTAL**

**30 units**

## **MASTER OF SCIENCE IN ENGINEERING MANAGEMENT (MSEMT)**

This program is designed primarily, but not exclusively, for graduate engineers whose career objectives lead to increasing technical management responsibilities.

A total of 30 units is required for the degree. A minimum of 18 units must be taken in the Epstein Department of Industrial and Systems Engineering. A total of 21 units must be at the 500 level or above. The program is available via distance education.

### **Required Courses (6 units)**

ISE 500            Engineering Management Decisions and Statistics (3)  
ISE 561            Economic Analysis of Engineering Projects (3)

### **At least one course from the Accounting Area is required (3 units)**

CE 502            Construction Accounting and Finance (3)  
ISE 566            Financial Accounting Analysis for Engineering (3)

### **At least two courses from the engineering management area are required (6 units)**

ISE 515            Engineering Project Management (3)  
ISE 544            Management of Engineering Teams (3)  
ISE 564            Performance Analysis (3)  
ISE 565            Law and Finance for Engineering Innovation (3)

### **At least one course from the Quantitative Methods area is required (3)**

ISE 513            Inventory Systems  
ISE 514            Advanced Production Planning and Scheduling (3)  
ISE 525            Design of Experiments (3)  
ISE 527            Quality Management for Engineers  
ISE 530            Optimization Methods for Analytics

### **Electives (12 units)**

Four courses for at least 12 units chosen to form a coherent program with the consent of the Adviser.

**TOTAL**

**30 units**

## MASTER OF SCIENCE IN HEALTH SYSTEMS MANAGEMENT ENGINEERING (MSHSME)

This program is jointly sponsored by the Epstein Industrial and Systems Engineering Department and the School of Policy, Planning and Development, and is administered by the Epstein Industrial and Systems Engineering Department. This degree is designed for students with sufficiently quantitative bachelor's degrees in engineering, the sciences or applied social science who are interested in operations management and health care applications, and whose career objectives lead to increasing technical management responsibilities in large health care organizations, particularly hospitals. Students with less quantitative social science or other non-technical backgrounds interested in health administration objectives may also want to consider the Master of Health Administration program in the School of Policy, Planning and Development.

### Prerequisites:

Mathematical competence representative of that provided by an undergraduate degree in engineering  
Basic descriptive and inferential statistics  
Microeconomics  
Accounting

Admitted students who do not meet the course work requirements will be assigned courses to complete the deficiencies.

### Core: 14 units

ISE 507          Six-Sigma Methods and Applications (3)  
ISE 508          Health Care Operations Improvement (3)  
PPD 509          Problems and Issues in the Health Field (4)  
PPD 545          Human Behavior in Public Organizations (4)

### Economics and Finance: (select two courses) 6 units

ISE 561          Economic Analysis of Engineering Projects (3)  
ISE 562          Value and Decision Theory (3)  
ISE 563          Financial Engineering (3)  
PPD 510a        Financial Management of Health Services (4)  
PPD 514          Economic Concepts Applied to Health (4)

### Information Systems: (select one course) 2 units

BME 527          Integration of Medical Imaging Systems (3)  
BME 528          Medical Imaging Informatics (3)  
ISE 583          Enterprise Wide Information Systems (3)  
PM 538          Introduction to Biomedical Informatics (3)  
PPD 511          Health Information Systems (2)

### Management: (select two courses) 6 units

ISE 515          Engineering Project Management (3)  
ISE 544          Management of Engineering Teams (3)  
ISE 527          Quality Management for Engineers (3)  
ISE 564          Performance Analysis (3)  
PPD 513          Legal Issues in Health Care Delivery (4)  
PPD 517          Concepts and Practices in Managing Health Care Organizations (2)

### Quantitative Methods: (select two courses) 6 units

Select one course, at least 3 units:

ISE 530          Optimization Methods for Analytics (3)  
PPD 557          Modeling and Operations Research (4)

Select one course, at least 3 units:

ISE 525	Design of Experiments (3)
ISE 562	Value and Decision Theory (3)
ISE 570	Human Factors in Engineering (3)
ISE 580	Performance Modeling and Simulation (3)
PM 603	Structural Equation Modeling (4)
PPD 558	Multivariate Statistical Analysis (4)

**TOTAL**

**34 units**

Students may not simultaneously satisfy the Quantitative Methods and Economics and Finance requirement with only ISE 562.

## MASTER OF SCIENCE IN INDUSTRIAL AND SYSTEMS ENGINEERING (MSISE)

The MSISE program is for students who want to become technical leaders in the field of Industrial and Systems Engineering. The program consists of 30 units: two required courses, five courses chosen from a list of ISE electives, and two courses are electives chosen in conjunction with a faculty advisor. Eighteen units *must* be earned in the ISE Department. Twenty units *must* be at the 500 level or above. Entering students should possess a bachelor's degree in Industrial Engineering or equivalent (represented by the following pre-requisites).

### Prerequisites

- Computing
- Engineering Probability
- Engineering Statistics
- Engineering Economy

*400- and 500-level courses may be counted for credit toward the master's degree, subject to department approval and any other restricted courses noted in the USC Catalogue.*

*All 400- and 500-level courses are counted toward the overall GPA requirement.*

### Required Courses:

**6 Units**

- ISE 514 Advanced Production Planning and Scheduling (3)
- ISE 515 Engineering Project Management (3)

### At least one course from each of the 5 areas listed below:

**15 Units**

#### Systems Design:

- ISE 510 Advanced Computational Design and Manufacturing (3)
- ISE 525 Design of Experiments (3)
- ISE 527 Quality Management for Engineers (3)
- ISE 576 Industrial Ecology: Technology-Environment Interaction (3)
- SAE 541 Systems Engineering Theory and Practice (3)
- SAE 549 Systems Architecting (3)

#### Production:

- ISE 511L Mechatronic Systems Engineering (3)
- ISE 513 Inventory Systems (3)
- ISE 517 Modern Enterprise Systems (3)
- SAE 551 Lean Operations (3)

#### Systems Performance:

- ISE 544 Management of Engineering Teams (3)
- ISE 564 Performance Analysis (3)
- ISE 570 Human Factors in Engineering (3)

#### Information Systems:

- ISE 580 Performance Modeling and Simulation (3)
- ISE 582 Web Technology for Industrial Engineering (3)
- ISE 583 Enterprise Wide Information Systems (3)

#### Quantitative Methods:

- ISE 532 Network Flows (3)
- ISE 536 Linear Programming and Extensions (3) **or**
- ISE 530 Optimization Methods for Analytics (3, Fa)
- ISE 538 Elements of Stochastic Processes (3) **or**
- ISE 580 Performance Modeling and Simulation (3, Fa)
- ISE 563 Financial Engineering (3)

### Advisor-Approved Electives:

**9 units**

### TOTAL

**30 units**

## **MSISE/MASTER OF BUSINESS ADMINISTRATION (MSISE/MBA)**

The MSISE/MBA degree is for students who want an extended program that combines technical education in industrial engineering with an MBA degree. This 66-unit joint program with the Marshall School of Business requires 66 leads to both a Master of Science in Industrial and Systems Engineering and the Master of Business Administration. The program is especially well students who want to become managerial leaders within technically oriented companies.

### **Admission:**

To be admitted to the MSISE/MBA dual degree program, the applicant must satisfy admission criteria for both the Industrial and Systems Engineering Department and the Graduate School of Business Administration. Admission criteria for the ISE Department are outlined earlier in this publication. Admission criteria for the Graduate School of Business Administration may be obtained by calling MBA Admissions at (213) 740-7846 (also see <http://www.marshall.usc.edu>).

### **Marshall School of Business Required Courses:**

Required GSBA courses include all courses required in the M.B.A. core program and graduate business electives sufficient to bring the total units completed in the Marshall School of Business to at least 48 units.

### **Curriculum Prerequisites:**

Same as for the MSISE degree, plus any prerequisites required for the MBA.

### **School of Engineering Required Courses: (Minimum 18 units)**

ISE 514	Advanced Production Planning and Scheduling (3)
ISE 515	Engineering Project Management (3)

ISE Electives (Choose one from each group):

Systems Design:

ISE 525	Design of Experiments (3)
ISE 527	Quality Management for Engineers (3)
SAE 541	Systems Engineering Theory and Practice (3)

Information Systems:

ISE 580	Performance Modeling and Simulation (3)
ISE 582	Web Technology for Industrial Engineering (3)
ISE 583	Enterprise Wide Information Systems (3)

Quantitative Methods:

ISE 532	Network Flows (3)
ISE 536	Linear Programming and Extensions (3)
ISE 538	Elements of Stochastic Processes (3)

Advisor-Approved Engineering Elective(s): 3 units

**Marshall School of Business Required Units** 48 units

**Total Units for the Dual Degree Program (M.S./M.B.A.)** 66 units

## MANUFACTURING ENGINEERING (MSMFE)

The MSMFE degree is designed to educate students in the needs of modern, up-to-date manufacturing. MSMFE students learn how to design, install, and operate complex manufacturing systems composed of people, materials, automated machines and information systems. The Departments of Aerospace Engineering, Computer Science, Electrical Engineering, Industrial and Systems Engineering, Materials Science, Mechanical Engineering and Marshall School of Business participate in the Manufacturing Engineering Program. Entering students ordinarily possess undergraduate degrees in industrial engineering, manufacturing engineering, mechanical engineering or production engineering.

The Program consists of 30 units. A minimum of 21 units must be at the 500 level or above. A maximum of 6 units of electives may be taken from non-engineering departments. At least three courses must be taken in the student's selected area of specialization.

### Prerequisites:

- Calculus I
- Calculus II
- Calculus III
- Science
- Computer Engineering (Pascal, Fortran, C)
- Materials Science or General Chemistry

### Required Courses

**12 units**

- CSCI 585 Database Systems (3) or  
ISE 510 Advanced Computational Design and Manufacturing (3)
- ISE 511L Mechatronic Systems Engineering (3)
- ISE 517 Modern Enterprise System (3) or  
OR ISE 576 Industrial Ecology: Technology-Environment Interaction (3)
- ISE 525 Design of Experiments or  
AME 525 Engineering Analysis (3)

### Approved electives

**18 units**

### TOTAL

**30 units**



## APPROVED ELECTIVES IN SPECIALIZATION AREAS

### Business & Entrepreneurship

- BAEP 551: Introduction to New Ventures
- BAEP 557: Technology Transfer & Commercialization
- ISE 585: Strategic Management of Technology

### Aerospace Engineering

- AE 481 Aircraft Design
- AE 501 Spacecraft System Design
- AE 516ab Flight Vehicle Stability and Control
- AE 529 Aircraft Structures Analysis
- AE 546 Basic Aeroelasticity

### Computer Science

- CS 455x Intro to Programming Systems Design
- CS 460 Introduction to Artificial Intelligence
- CS 477L Design and Construction of Large Software Systems
- CS 480 Computer Graphics
- CS 482 Introduction to Geometric Modeling
- CS 485 File & Database Management
- EE 547 Software Methods in Robotics
- CS 551 Computer Communications
- EE 554 Real Time Computer Systems
- EE 559 Mathematical Pattern Recognition
- EE 560L Advanced Microcomputer-Based Design
- EE 561 Artificial Intelligence
- EE 574 Computer Vision
- CS 577ab Software Engineering
- CS 582 Geometric Modeling
- CS 583 Computational Geometry
- CS 584 Intelligent Systems for Design and Manufacture
- CS 585 Database Systems
- CS 598 Expert Systems
- CS 615 Robotic Motion Planning

### Electrical Engineering

- EE 454L Introduction to Systems Design Using Microprocessors
- EE 472 Intro to Lasers and Laser Systems
- EE 479 Intro to Integrated Circuit Design
- EE 482 Linear Control Systems
- EE 504L Solid State Processing & IC Laboratory
- EE 536 Integrated Circuit Analysis & Design
- EE 537 Survey of Modern Solid State Devices
- EE 543abL Digital Control
- EE 544 Optimal Control
- EE 545 Introduction to Robotics
- EE 546L Basic Robotics Laboratory
- EE 562a Random Processing in Engineering

- EE 569 Intro to Digital Image Processing
- EE 577 VLSI System Design
- EE 584 Chaotic Systems
- EE 585 Linear Systems Theory
- EE 587 Nonlinear Control Systems
- EE 588 Linear Quadratic Control
- EE 593 Multivariable Control
- EE 657 Parallel Processing
- EE 666 Data Communication
- EE 680 Computer Aided Design of Digital Systems
- EE 684 Optimum Stochastic Control
- EE 685 Parameter Identification & Adaptive Control

### Industrial & Systems Engineering

- ISE 410 Production Planning and Control
- ISE 411 Facilities Analysis and Design
- ISE 415 Industrial Automation
- ISE 426 Statistical Quality Control
- ISE 435 Discrete Systems Simulation
- ISE 511L Computer-Aided Manufacturing
- ISE 513 Inventory Systems
- ISE 514 Industrial Scheduling
- ISE 515 Engineering Project Management
- ISE 516 Facilities Location and Layout
- ISE 517 Modern Enterprise Systems
- ISE 527 Quality Management for Engineers
- ISE 528 Advanced Statistical Aspects of Engineering Reliability
- ISE 530 Optimization Methods for Analytics
- ISE 535 Continuous Systems Simulation
- ISE 538 Stochastic Processes
- ISE 540 Advanced Topics in Work Measurement & Methods Analysis
- ISE 561 Economic Analysis of Engineering Projects
- ISE 580 Performance Modeling and Simulation

### Materials Science

- MS 472 Polymer Science and Engineering
- MS 475 Physical Properties of Polymers
- MS 511 Materials Preparation
- MS 513 Multilayered Materials & Properties
- MS 518 Semiconductor Materials for Devices
- MS 560 Fatigue and Fracture
- MS 583 Materials Selection
- MS 584 Fracture Mechanics and Mechanisms

### Mechanical Engineering

- ME 403 Stress Analysis
- ME 407 Computer Graphics for Mechanical Engineers
- ME 408 Computer-Aided Design of Mechanical Systems

- ME 451 Linear Control Systems I
- ME 503 Advanced Mechanical Design
- ME 504 Metallurgical Design
- ME 541 Linear Control Systems II

- ME 542 Nonlinear Control Systems
- ME 544 Computer Control of Mechanical Systems
- ME 548 Analytical Methods in Robotics

## MASTER OF SCIENCE IN OPERATIONS RESEARCH ENGINEERING (MSORE)

The MSORE degree is for students who hold a bachelor's degree in engineering, mathematics, science or related fields, who would like to enter careers in the use of computers and mathematics in solving business problems. The 30-unit program must include at least 21 units of industrial and systems engineering courses related to operations research and 9 units of approved electives. Students will be required to make up deficiencies in mathematics and statistics. Additional courses or examinations may be required at the discretion of the department before full admission to the program

### Prerequisites:

- Calculus I
- Calculus II
- Calculus III
- Linear Algebra
- Programming Language (Pascal, Fortran, C)
- Engineering Probability
- Engineering Economy
- Engineering Statistics
- System Simulation

### Required Courses:

**15 units**

- ISE 532 Network Flows (3)
- ISE 536 Linear Programming and Extensions (3)
- ISE 538 Elements of Stochastic Processes (3)
- ISE 580 Performance Modeling and Simulation (3)
- ISE 582 Information Technology for Industrial Engineering (3) OR
- ISE 583 Enterprise Wide Information Systems (3)

### Select at least 2 of the following 10 courses:

**6 units**

- CE 645 Uncertainty Modeling and Stochastic Optimization (3)
- ISE 513 Inventory Systems (3)
- ISE 514 Advanced Production Planning and Scheduling (3)
- ISE 520 Optimization: Theory and Algorithms (3)
- ISE 525 Design of Experiments (3)
- ISE 539 Stochastic Elements of Stimulation (3)
- ISE 562 Value and Decision Theory (3)
- ISE 563 Financial Engineering (3)
- ISE 576 Industrial Ecology: Technology-Environment Interaction (3)
- SAE 541 Systems Engineering Theory and Practice (3)

### Advisor-Approved Electives:

**6 units**

### Advisor-Approved 400- or 500 Level Computer Science Course

**3 units**

### TOTAL

**30 units**

## MASTER OF SCIENCE IN PRODUCT DEVELOPMENT ENGINEERING (MSPDE)

The MSPDE is a joint program with the Aerospace and Mechanical Engineering (AME) Department that prepares engineers to become leaders in engineering design and new product development. The MSPDE program offers two Areas of Specialization (AOS), namely Product Development Technology (PDT) and Product Development Systems (PDS). The PDT specialization will prepare students for a career as product development chief engineer, while the PDS specialization will prepare students as future product development project managers. Student entering this program must declare their choice of an AOS at admission. The degree is also available for remote students through USC's Distance Education Network (DEN). For more information about DEN, go to <http://den.usc.edu>

Program is administered by the AME Department. Please check the MSPDE website at <http://mspde.usc.edu> for more details.

### Prerequisites:

A bachelor's degree in an area of engineering or science;  
Senior level coursework in either Engineering Design or Engineering Economy

### Required Courses

**6 units**

AME 503      Advanced Mechanical Design (3)  
ISE 545      Technology Development and Implementation (3)

### Product Development Systems (PDS) Specialization

Required courses for PDS specialization (6 units):

ISE 515      Engineering Project Management (3)  
ISE 544      Management of Engineering Teams (3)

Technical Elective courses for PDS specialization (6 units):

ISE415 – Industrial Automation (3)  
ISE460 – Engineering Economy (3)  
ISE470 – Human Computer Interface Design (3)  
ISE511 – Mechatronic Systems Engineering (3)  
ISE517 – Modern Enterprise Systems (3)  
ISE525 – Design of Experiments (3)  
ISE527 – Quality Management for Engineers (3)  
ISE528 – Advanced Statistical Aspects of Engineering Reliability (3)  
ISE555 – Invention and Technology Development (3)  
ISE561 – Economic Analysis of Engineering Projects (3)  
ISE567 – Collaborative Engineering Principles and Practice (3)  
ISE576 – Industrial Ecology: Technology-Environment Interaction (3)  
ISE580 – Advanced Concepts in Computer Simulation (3)  
ISE585 – Strategic Management of Technology (3)  
SAE541 – System Engineering Theory and Practice (3)

### Approved electives

**9 units**

Departmental approval is required for courses not listed.

### TOTAL

**27 units**

## **ENGINEER IN INDUSTRIAL AND SYSTEMS ENGINEERING**

The Engineer degree is designed for students who want to extend their coursework, but do not want to complete the research requirements of the Ph.D.

### **Prerequisites**

A Master of Science degree in engineering, or completion of a minimum of 27 units of graduate engineering courses, plus all prerequisite courses for the Master of Science in Industrial and Systems Engineering.

### **Course Requirements**

The Engineer degree requires a minimum of 30 units of graduate course work beyond the Master of Science degree; up to six units at the 400 level may be counted at the discretion of the student's guidance committee if the committee finds them necessary for the student's program. The course work must form a balanced program of study leading to a definite concentration in two fields of engineering: a minimum of 12 units in one field, nine in another; nine units are elective and may be taken outside the School of Engineering, but must be acceptable for graduate credit. The distribution of course work will be governed by the student's guidance committee and should be considered in conjunction with the course work done for the Master of Science degree. A candidate for the Engineer degree may substitute a project under the supervision of a faculty member for six units of course work. In order to have the project credited toward the degree, the student must register in 690 during the course of the project; total 690 registration should be six units. A student wishing to work on a project must make arrangements with a member of the faculty to supervise and evaluate the work, and obtain the approval of the committee chair prior to completing more than 15 units of coursework. In many cases, the project may be related to the candidate's work outside the university, but must still be supervised by a faculty member. Distribution of the course work should take into account the nature of the project.

Course work for the EISE is distributed as follows:

- 12 units in an ISE area of concentration  
Technical Economic Planning, Human Factors Engineering,  
Production Engineering, Systems Engineering, or Operations Research
- 9 units in an ISE area of concentration not already chosen, or in another engineering department
- 9 units in an ISE area of concentration not already chosen, in another engineering department, or in a non-engineering department
- 6 units of ISE 690 to satisfactorily complete a professional engineering project (optional)

### **Grade Point Average Requirement**

Students must maintain an overall 3.0 GPA on all 400-level and above work attempted at USC beyond the bachelor's degree to graduate. A minimum grade of C (2.0) is required in a course to receive graduate credit. Transfer units count as credit (CR) and are not calculated in the GPA.

### **Residence Requirement**

A candidate must complete the last four units of course work at USC. At least 26 units must be taken in residency at USC.

### **Guidance Committee**

After being granted graduate standing the student must form a guidance committee. The committee is made up of three full-time faculty members who are specialists in the student's areas of concentration, with at least two from the major department. Forms for appointment of the committee are available from the Graduate Study Office. The student is responsible for finding a faculty member from one area of concentration who will act as the chair of the guidance committee. The chair will assist in selection of the other members. Advisement of the student after formation of the committee will be by the committee chair. Students must meet with their committees at least once per year.

The guidance committee chair and members equally share advisement responsibilities and together maintain the quality of the program. The chair is responsible for maintaining the student's advisement file, keeping it up-to-date and complete with all documentation.

### **Study Plan**

With the advice of the guidance committee, the student should lay out a study plan listing all courses to be taken toward the degree and when the courses will be taken. The study plan should form a coherent body of course work fulfilling the student's academic and professional objectives. Changes in the study plan must be approved by the guidance committee.

### **Qualifying Examination**

The student must satisfactorily complete an engineer's qualifying examination administered by his or her guidance committee. This examination will cover both areas of concentration and will consist of at least one written and one oral examination. This examination is normally taken during the last semester of course work toward the degree. Students who choose to take the examination in the semester following the completion of course requirements may do so until the end of the third week of classes without registering. After that date students must register for GRSC 800 to maintain continuous enrollment in the program. Results of the examination are reported to the Graduate Study Office and forwarded to the Office of Academic Records and Registrar.

The qualifying examination is given strictly on a pass/fail basis. Students must be unanimously passed by the guidance committee. Students may not be conditionally passed. Students who fail the examination may, at the guidance committee's discretion, retake the examination not sooner than six months following the first exam. The exam may only be taken twice.

### **Transfer Credit**

Four units of graduate course work may be transferred from an accredited institution toward the Engineer degree. Transfer work must have been done after receiving the M.S. degree and must be approved by the guidance committee.

### **Reserving Course Credit**

A student who receives the Master of Science degree at USC may reserve a limited number of units taken prior to the receipt of the Master of Science degree for credit toward the Engineer degree. To reserve credit, the course must have been taken during the last semester as a Master of Science candidate, not used toward the Master of Science degree, be acceptable to the guidance committee, and approved by petition to the graduate study committee of the School of Engineering.

### **Time Limit**

The student must complete all requirements within five calendar years.

### **Admission to Candidacy**

After satisfactorily completing the qualifying examination, and no later than the beginning of the last semester of course work, the student must file for candidacy. This is a separate and distinct step which sets forth the entire academic program fulfilling the degree requirements and is used as a working basis for awarding the degree.

### **Changes to the Academic Program**

After admission to candidacy, any changes in the proposed academic program must be approved by the Graduate Study Committee. Petition forms are available from the Graduate Study Office and must be endorsed by the guidance committee.

### **Graduation**

At the beginning of the last semester, students should file an Application for Engineer's Degree with the Graduate Study Office. This will alert the School and the University that you are prepared to receive your degree and initiate the degree check process, verifying that all academic and administrative requirements are met.

### **Transfer to the Doctor of Philosophy Program**

Students registered for the Engineer degree may still elect to undertake a Doctor of Philosophy program. A supplemental Application for Graduate Admission must be filed with the Office of Admission.

## **ACADEMIC HONORS**

### **Academic Awards**

The Department and the School of Engineering may, from time to time, nominate students for awards and scholarships. If you feel you may qualify for any award or recognition based on academic performance, leadership, extra-curricular activities, or any combination of the above, please let the Department know. We are always happy to give you the recognition you deserve.

## **STUDENT ORGANIZATIONS**

To build character and leadership skills, and to acknowledge academic achievement, the ISE Department supports the activities of three student organizations: the Student Chapter of Institute of Industrial Engineers; Alpha Pi Mu; and Omega Rho. These organizations are run by ISE students to further academic and professional goals. Each organization has an ISE faculty member as an advisor. The quality of each of these organizations is directly affected by the quality of its student members, and particularly its officers. Your active participation is, therefore, encouraged. Interested students should contact the Educational Services Coordinator for details.

### **Student Chapter of the Institute of Industrial Engineers**

The Institute of Industrial Engineers is the professional organization for industrial engineers. Its mission is to promote and foster industrial engineering as a profession. Reduced membership dues are available to student members.

### **Alpha Pi Mu**

Alpha Pi Mu is the industrial engineering honors society. Its purpose is to recognize high academic achievement by juniors, seniors, and graduate students in industrial engineering. Membership is by invitation only.

### **Omega Rho**

Omega Rho is the operations research honors society. Its purpose is to recognize high academic achievement by undergraduate and graduate students in operations research. Membership is by invitation only.