USC Viterbi

School of Engineering
*Daniel J. Epstein Department of
Industrial and Systems Engineering*

www.ise.usc.edu

Master's Program Handbook
2021-2022

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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 Viterbi 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 Viterbi 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 https://ise.usc.edu/

DANIEL J. EPSTEIN DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEEERING

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

5. 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.

6. 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:

1. **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.

2. **School Level** (via the Viterbi 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.

3. **Department Level** (via the Epstein Department Industrial and Systems Engineering). A limited number of Grader and Course Producer positions are available to highly qualified graduate students. To apply login to myViterbi at https://myviterbi.usc.edu/.

All of the above are extremely competitive. Graduate School aid and Viterbi 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://gradadm.usc.edu. Examination scores should be sent to USC by the testing agency. International students must provide an affidavit of financial support.

Applications are reviewed by the Admissions Office and by the Viterbi Graduate Admissions Office. 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
  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

University of Southern California
Daniel J. Epstein Department of
Industrial & Systems Engineering
3715 McClintock Ave. GER 240
Los Angeles, CA 90089-0193
PHONE: (213) 740-4893
FAX: (213) 740-1120
isedept@usc.edu

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

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 faculty of a degree program may establish limits on the number of transfer credits stricter than those of the university, which follow:

Courses used toward a degree completed elsewhere may not be applied toward a master's degree at USC. If courses were not used toward a completed degree, the maximum number of transfer credits that may be applied towards a 30 unit master's degree, subject to departmental approval, is four units.

- 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, 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, 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 MS in Analytics program consists of seven foundational courses, and three elective courses, totaling 30 units. The foundational courses cover the fundamentals of optimization, Data Management, Data Mining and Predictive Analytics modeling and the computational tools needed to implement them. The elective courses expose the students to different business domains such as data analytics consulting, analytics of web data, predictive modeling with big data, among others.

Required Courses: (12 units)

DSCI 559	Introduction to Data Management (3)
ISE 529	Predictive Analytics (3)
ISE 530	Optimization Methods for Analytics (3)
ISE 535	Data Mining

Group A (3 units are required)

ISE 533	Integrative Analytics (3)*
ISE 534	Data Analytics Consulting (3)
ISE 580	Performance Analysis with Simulation (3)*

Group B (6 units are required)

ISE 533	Integrative Analytics (3)*
ISE 537	Financial Analytics (3)
ISE 538	Performances Analysis Using Markov Models
ISE 540	Text Analytics (3)
ISE 562	Decision Analysis (3)
ISE 580	Performance Analysis with Simulation (3)*

*May count towards Group A or Group B but not both.

Adviser-Approved Electives: (9 units)
ISE Elective (3)
Additional electives (6)

TOTAL: 30 units

Approved Electives for Analytics Program

Industrial & Systems Engineering Courses

ISE 501	Innovative Conceptual Design for New Product Development
ISE 505	Modeling for Health Policy & Medical Decision Making
ISE 506	Lean Operations
ISE 508	Health Care Operations Improvement
ISE 509	Practicum in Health Care Systems
ISE 510	Advanced Computational Design & Manufacturing
ISE 511	Mechatronic Systems Engineering
ISE 513	Inventory Systems
ISE 514	Advanced Production Planning & Scheduling
ISE 515	Engineering Project Management
ISE 525	Design of Experiments
ISE 527	Quality Management for Engineers
ISE 529	Predictive Analytics
ISE 530	Optimization Methods for Analytics
ISE 533	Integrative Analytics
ISE 534	Data Analytics Consulting
ISE 535	Data Mining
ISE 536	Linear Programming & Extensions
ISE 537	Financial Analytics
ISE 538	Performance Analysis Using Markov Models
ISE 539	Stochastic Elements of Simulation
ISE 540	Text Analytics
ISE 543	Enterprise Business Intelligence & Systems Analytics
ISE 544	Leading & Managing Engineering Teams
ISE 545	Technology Development & Implementation
ISE 561	Economic Analysis of Engineering Projects
ISE 562	Decision Analysis
ISE 563	Financial Engineering
ISE 580	Performance Analysis with Simulation
ISE 583	Enterprise Wide Information Systems
ISE 585	Strategic Management of Technology
ISE 610	Advance Design of Experiments & Quality Engineering
ISE 620	Foundations of Stochastic Processes
ISE 630	Foundations of Optimization
ISE 631	Linear Programming
ISE 632	Network Flows & Combinatorial Optimization
ISE 633	Large Scale Optimization & Machine Learning
ISE 637	Equilibrium Programming
*ISE-651 NO	
ISE 662	Advanced Decision Theory

Computer Science Courses

CSCI 455X	Introduction to Programming Systems Design
CSCI 485	File & Database Management
CSCI 510	Software Management & Economics
CSCI 521	Optimization: Theory & Algorithms
CSCI 544	Applied Natural Language Processing
CSCI 561	Foundations of Artificial Intelligence
CSCI 570	Analysis of Algorithms
CSCI 577A	Software Engineering
CSCI 578	Software Architectures
CSCI 585	Database Systems

Data Science Courses

DSCI 519	Foundations & Policy for Information Security
DSCI 551	Foundations of Data Management
DSCI 552	Machine Learning for Data Science
DSCI 553	Foundations & Applications of Data Mining
DSCI 554	Data Visualization
DSCI 559	Introduction to Data Management

Data Science & Operations (Marshall)

DSO 528	Data Warehousing, Business Intelligence, & Data Mining
DSO 547	Designing Spreadsheet-Based Business Models
DSO 562	Fraud Analytics

Marketing (Marshall)

MKT 566	Marketing Analytics

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.

Applicants to the program are expected to have a degree in engineering or the equivalent.

Required Courses (18-19 units)

ISE 500	Statistics for Engineering Managers (3)	
ISE 515	Engineering Project Management (3)	
ISE 544	Leading and Managing Engineering Teams (3)	
ISE 561	Economic Analysis of Engineering Projects (3) (*prerequisite* **ISE 500)**	

Analytics Course – Select one

DSCI 552	Machine Learning for Data Science (4)
ISE 529	Predictive Analytics (3)
ISE 530	Optimization Methods for Analytics (3)
ISE 562	Decision Analysis (3)

Technology Course – Select one

ISE 545	Technology Development and Implementation (3)
CE 576	Invention and Technology Development (3)
ISE 585	Strategic Management of Technology (3)

Select One of the Following Tracks (9-10 units)

Management Track – Select three courses

CE 502	Construction Accounting, Finance and Strategy (4)
ISE 506	Lean Operations (3)
ISE 527	Quality Management for Engineers (3)
ISE 585	Strategic Management of Technology (3)
MOR 557	Strategy and Organization Consulting (3)

Analytics Track – select three courses

DSCI 552	Machine Learning for Data Science (4)
ISE 529	Predictive Analytics (3)
ISE 530	Optimization Methods for Analytics (3)
ISE 533	Integrative Analysis (3)
ISE 562	Decision Analysis (3)

Innovation and Technology Commercialization Track – Select three courses

BAEP 556	Technology Feasibility (3)
BAEP 557	Technology Commercialization (3)
ISE 545	Technology Development and Implementation (3)
CE 576	Invention and Technology Development (3)
ISE 585	Strategic Management of Technology (3)

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

Supply Chain and Operations Track – Select three courses
      DSO 581   Supply Chain Management (3)
      DSO 583   Operations Consulting (3)
      ISE 513   Inventory Systems (3)
      ISE 514   Advanced Production Planning and Scheduling (3)
      ISE 583   Enterprise Wide Information Systems (3)

Custom Track (9 units) – Select Three Courses from Industrial and Systems Engineering or Business in consultation with an advisor.

Electives (3 units)

TOTAL　　　　　**30-32 units**

MASTER OF SCIENCE IN HEALTH SYSTEMS MANAGEMENT ENGINEERING (MSHSME)

At least 31 units are required for the degree. Some combinations of courses may require students to complete more than 31 units. Admitted students may count courses taken for completion of the Graduate Certificate in Health Systems Operations toward this degree. This program is available via distance education.

Applicants to the program are expected to have mathematical competence representative of that provided by an undergraduate degree in engineering; competence in basic descriptive and inferential statistics; competence in microeconomics. Admitted students who do not meet the course work requirements will be assigned courses to complete the deficiencies.

Required Courses – (22 Units)

ISE 508	Health Care Operations Improvement (3)	
ISE 509	Practicum in Health Care Systems (3)	
ISE 515	Engineering Project Management (3)	
PM 508	Health Service Delivery in the U.S. (4)	
PPD 511	Health Information Systems (2)	

Health Care – Select One Option (4 Units)

PM 504   Quality in Health Care (4) **or**

PPD 518   Quality of Care Concepts (2) **and**
PPDE 610   Population Health Management (2)

Data Analytics – Select One Course (3 Units)

ISE 500   Statistics for Engineering Management (3)
ISE 529   Predictive Analytics (3)

Advisor Approval Electives (9 units)

TOTAL   31 units

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. Entering students should possess a bachelor's degree in Industrial Engineering or equivalent (represented by the following pre-requisites). Admitted students who do not meet prerequisites will be assigned courses to complete the deficiencies.

A total of 30 units is required for the degree, of which at least 18 units must be completed in the Epstein Department of Industrial and Systems Engineering. Of the 30 units, 20 must be at the 500 level or above.

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 (12 units)
>   ISE 513   Inventory Systems (3)
>   ISE 514   Advanced Production Planning and Scheduling (3)
>   ISE 515   Engineering Project Management (3)
>   ISE 583   Enterprise Wide Information Systems (3)

Group A (3 units) Select one course

>   ISE 530   Optimization Methods for Analytics (3)
>   ISE 536   Linear Programming and Extensions **(*prerequisite* MATH 225 or EE 441)** (3)

Group B (3units) Select one course
>   ISE 525   Design of Experiments (3)
>   ISE 527   Quality Management for Engineers (3)

Group C (3 units) Select of course
>   ISE 538   Performances Analysis Using Markov Models (3)
>   ISE 580   Performance Analysis with Simulation (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)

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

(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 Analysis with Simulation (3)	
ISE 582	Web Technology for Industrial Engineering (*prerequisite* **ISE 382**) (3)	
ISE 583	Enterprise Wide Information Systems (3)	

Quantitative Methods:
ISE 532	Network Flows (*prerequisite* **ISE 330 or ISE 536**) (3)	
ISE 536	Linear Programming and Extensions (*prerequisite* **MATH 225 or EE 441**) (3)	
ISE 538	Performance Analysis Using Markov Models (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 (4) **or**	
ISE 510	Advanced Computational Design and Manufacturing (3)	
ISE 511L	Mechatronic Systems Engineering (3)	
ISE 517	Modern Enterprise System (3) **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 Performance Analysis Using Markov Models
- ISE 540 Advanced Topics in Work Measurement & Methods Analysis
- ISE 561 Economic Analysis of Engineering Projects
- ISE 580 Performance Analysis with 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

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
• E44 Optimal Control
• EE 545 Introduction to Robotics
• EE 546L Basic Robotics Laborator
• 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 Performance Analysis Using Markov Models
• ISE 540 Advanced Topics in Work Measurement & Methods Analysis
• ISE 561 Economic Analysis of Engineering Projects
• ISE 580 Performance Analysis with 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) (*prerequisite* **ISE 330 or ISE 536)**	
ISE 536	Linear Programming and Extensions (3) (*prerequisite* **MATH 225 or EE 441)**	
ISE 538	Performance Analysis Using Markov Models (3)	
ISE 580	Performance Analysis with Simulation (3)	
ISE 582	Web Technology for Industrial Engineering (3) (*prerequisite* **ISE 382) 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) (*corequisite* **ISE 538)**	
ISE 562	Decision Analysis (3)	
ISE 563	Financial Engineering (3)	
ISE 576	Industrial Ecology: Technology-Environment Interaction (3)	
SAE 541	Systems Engineering Theory and Practice (3)	

Advisor-Approved 400- or 500 Level Computer Science Course   **3 units**

Advisor-Approved Electives: **6 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 MSPED 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 Epstein ISE Department.

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**)

ISE 501	Innovative Conceptual Design for New Product Development (3)
ISE 545	Technology Development and Implementation (3)

Product Development Systems (PDS) Specialization (12-13 units)

Required courses for PDS specialization (6 units):
ISE 515	Engineering Project Management (3)
ISE 544	Leading and Managing of Engineering Teams (3)

Technical Elective courses for PDS specialization (6 units):
BAEP 557	Technology Commercialization (3)
DSCI 552	Machine Learning for Data Science (4)
ISE 510	Advanced Computational Design and Manufacturing (3)
ISE 511L	Mechatronic Systems Engineering (3)
ISE 514	Advanced Production (3_
ISE 525	Design of Experiments (3)
ISE 527	Quality Management for Engineers (3)
CE 576	Invention and Technology Development (3)
ISE 561	Economic Analysis of Engineering Projects (*prerequisite ISE 500*) (3)
ISE 562	Decision Analysis (3)
ISE 567	Collaborative Engineering Principles and Practice (3)
ISE 580	Performances Analysis with Simulation (3)
ISE 583	Enterprise Wide Information Systems (3)
ISE 585	Strategic Management of Technology (3)
ISE 610	Advance Design of Experiments and Quality Engineering (3)
SAE 541	System Engineering Theory and Practice (3)
SAE 549	Systems Architecting (3)

General Electives (9 Units)
Advisor approved electives must be upper-division 400- or 500-level courses.

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 Viterbi 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.

Progressive Degree Options

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

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 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.

The Master of Science in Analytics 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 management problems in today's data-extensive digital world.

Analytics is a multidisciplinary field that relates the application of engineering approaches and methods to the analysis and management of engineering and enterprise processes based on data. Learning objectives of this program involve data collection, cleansing, fusing and curating, for the purpose of analyzing trends, discovering patterns and building decision models for well-reasoned decision support. Rigorous mathematical modeling and computational methods tools are at the heart of the program.

Graduates of this program will be prepared to convert data into meaningful information, embedded in decision support systems that can help organizations make important operational decisions and help set strategic direction and policy.

Required Courses **(12 units)**
DSCI 559 Introduction to Data Management Units: 3 (Sp)
ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
ISE 535 Data Mining Units: 3 (Fa, Sp)

Project **(3 units)** Select one course.
ISE 533 Integrative Analytics Units: 3 (Sp)
ISE 534 Data Analytics Consulting Units: 3 (Fa)
ISE 580 Performance Analysis with Simulation Units: 3 (Fa, Sp)

Methodology **(6 units)** Select two courses.
ISE 533 Integrative Analytics Units: 3 (Sp)
ISE 537 Financial Analytics Units: 3 (Fa)
ISE 538 Performance Analysis Using Markov Models Units: 3 (Fa)
ISE 540 Text Analytics Units: 3 (Fa)
ISE 543 Enterprise Business Intelligence & Systems Analytics
ISE 562 Decision Analysis Units: 3 (Fa, Sp)
ISE 580 Performance Analysis with Simulation Units: 3 (Fa, Sp)

*Total Units Required for the PDP degree: 21

<h1 style="color:red; text-align:center">Masters Degree – Engineering Management
Progressive Degree Option</h1>

The MS in Engineering Management program (MSEMT) is designed for students with undergraduate degrees in engineering or related sciences to prepare them for management responsibilities. As an MSEMT student, you will learn how to lead technology projects as well as manage teams, engineering functions, and companies. In addition, you will gain an understanding of the economic decision making processes. More than just theory, the MSEMT program offers real-world examples provided by instructors who have years of relevant industry experience, covering topics such as technology creation, management of invention, information systems, managerial accounting, and quantitative methods.
This is also a suitable program to help prospective technical entrepreneurs understand the enterprise creation process.

Required Courses (18-20 Units)

- ISE 500 Statistics for Engineering Managers Units: 3 (Fa, Sp)
- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- ISE 544 Leading and Managing Engineering Teams Units: 3 (Fa, Sp, Su)
- ISE 561 Economic Analysis of Engineering Projects Units: 3 (Fa, Sp, Su)

Analytics Course Select one.
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 534 Data Analytics Consulting Units: 3 (Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Technology Course Select one.
- CE 576 Invention & Technology Development Units: 4
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Select One Course from One of the Following Tracks (3-4 units)

Management Track
- CE 502 Construction Accounting, Finance and Strategy Units: 4 (Fa, Sp)
- ISE 506 Lean Operations Units: 3 (Fa, Sp)
- ISE 527 Quality Management for Engineers Units: 3 (Fa, Sp)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)
- MOR 557 Strategy and Organization Consulting Units: 3 (Fa, Sp)

Analytics Track
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 533 Integrative Analytics Units: 3 (Sp)
- ISE 534 Data Analytics Consulting Units: 3 (Fa)
- ISE 543 Enterprise Business Intelligence & Systems Analytics Units: 3
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Innovation and Technology Commercialization Track
- BAEP 556 Technology Feasibility Units: 3 (Fa)
- BAEP 557 Technology Commercialization Units: 3 (Sp)
- CE 576 Invention & Technology Development Units: 4
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Supply Chain and Operations Track
- DSO 581 Supply Chain Management Units: 3 (Fa, Sp)
- DSO 583 Operations Consulting Units: 3 (Sp)
- ISE 513 Inventory Systems Units: 3 (Sp)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)

Custom Track

Select one course from Industrial and Systems Engineering or Business in consultation with an adviser.

Total units required for the degree: 21-23

Courses cannot be double counted

(term offerings in parenthesis are expected but not guaranteed)

The Master of Science in Health Systems Management Engineering prepares students for leadership positions in the healthcare industry. Hospitals and the healthcare system are in desperate need of redesign from a cost, quality and productivity standpoint. Employers are seeking the skills offered in this degree. Jobs are often in management, consulting, performance improvement or technology. Healthcare is the largest industry and needs people able to help improve operations. You will learn how healthcare works and how to make it better for everyone by doing projects at hospitals and clinics. Courses are from three schools; the Daniel J. Epstein Department of Industrial and Systems Engineering, the Keck School of Medicine of USC and the USC Sol Price School of Public Policy.

Required Courses – (15 units)
- ISE 508 Health Care Operations Improvement Units: 3 (Fa)
- ISE 509 Practicum in Health Care Systems Units: 3 (Sp)
- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- PM 508 Health Service Delivery in the U.S. Units: 4 (Fa)
- PPD 511 Health Information Systems Units: 2 (Fa)

Health Care – (4 Units)
- PM 504 Quality in Health Care Units: 4 **or** (Fa, Sp)

- PPD 518 Quality of Care Concepts Units: 2 **and** (Fa, Sp)
- PPDE 610 Population Health Management Units: 2 (Fa)

Data Analytics – Select One Course (3 Units)
- ISE 500 Statistics for Engineering Management Units: 3 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)

*Total Units Required for the Health Systems Management Engineering PDP degree: 22
(term offerings in parenthesis are expected but not guaranteed)

The MS in Industrial & Systems Engineering (MSISE) program is designed for engineers and related technical professionals aspiring to achieve the highest levels of responsibility and leadership in the workplace. As an MSISE student, you will be broadly educated in all aspects of technical enterprises.

The MSISE program is excellent preparation for industrial engineering program graduates who want to acquire substantial depth with respect to industrial engineering methods and the theory of the firm. This degree is also relevant if you are a graduate from another technical area and intend to leverage your existing skills toward the pursuit of responsibility for the profitability and growth of your organization.

Required Courses (12 units)

- ISE 513 Inventory Systems Units: 3 (Sp)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)

Group A (3 units)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 536 Linear Programming and Extensions Units: 3 (Fa, Sp)

Group B (3 units)
- ISE 525 Design of Experiments Units: 3 (Sp)
- ISE 527 Quality Management for Engineers Units: 3 (Fa, Sp)

Group C (3 units)
- ISE 538 Performance Analysis Using Markov Models Units: 3 (Fa)
- ISE 580 Performance Analysis with Simulation Units: 3 (Fa, Sp)

*Total Units Required for the PDP degree: 21
(term offerings in parenthesis are expected but not guaranteed)

Manufacturing engineering at USC is a multidisciplinary program that confers the degree of Master of Science and is designed to produce graduates capable of responding to the needs of modern, up-to-date manufacturing. These graduates should be able to design, install and operate complex manufacturing systems made up of people, materials, automated machines and information systems. The Departments of Computer Science, Electrical Engineering, Industrial and Systems Engineering, Materials Science, Mechanical Engineering, and Entrepreneurship participate in the Manufacturing Engineering Program. Course work in the program will train students in traditional manufacturing engineering topics, such as materials selection and process design. Additional courses will include the more modern, system-level concepts of integrated product and process design, applications of modern information technology to design and manufacturing, hands-on laboratories using advanced manufacturing equipment and commercial software, and entrepreneurship.

Required Courses (12-14 units)

- CSCI 585 Database Systems Units: 4 or (Fa, Sp)
- ISE 510 Advanced Computational Design and Manufacturing Units: 3 (Sp)

- ISE 511L Mechatronic Systems Engineering Units: 3 (Fa)

- ISE 517 Modern Enterprise Systems Units: 3 or
- ISE 576 Industrial Ecology: Technology-Environment Interaction Units: 3 (Sp)

- ISE 525 Design of Experiments Units: 3 or (Sp)
- AME 525 Engineering Analysis Units: 4 (Fa, Sp)

Approved electives at 500 level or higher (7-9 units)

*Total Units Required for the Manufacturing Engineering PDP degree: 21
(term offerings in parenthesis are expected but not guaranteed)

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.

Required Courses (15 units)

- ISE 532 Network Flows Units: 3 (will substitute with ISE-632) (Sp)
- ISE 536 Linear Programming and Extensions Units: 3 (Fa, Sp)
- ISE 538 Performance Analysis Using Markov Models Units: 3 (Fa)
- ISE 580 Performance Analysis with Simulation Units: 3 (Fa, Sp)

- ISE 582 Web Technology for Industrial Engineering Units: 3 or
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)

Select at least two of the following 10 courses: (6 units)
- CE 645 Uncertainty Modeling and Stochastic Optimization Units: 3
- ISE 513 Inventory Systems Units: 3 (Sp)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 520 Optimization Theory and Algorithms: Numerical Optimization Units: 3
- ISE 525 Design of Experiments Units: 3 (Sp)
- ISE 539 Stochastic Elements of Simulation Units: 3 (Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)
- ISE 563 Financial Engineering Units: 3 (Fa, Sp)
- ISE 576 Industrial Ecology: Technology-Environment Interaction Units: 3 (Sp)
- SAE 541 Systems Engineering Theory and Practice Units: 3 (Fa, Sp)

Computer Science Course (3-4 units)
- 400- or 500-level computer science course, approved by faculty adviser

*Total Units Required for the Operations Research Engineering PDP degree: 24-25
(term offerings in parenthesis are expected but not guaranteed)

The MS in Product Development Engineering is an interdisciplinary degree program jointly offered by the Aerospace and Mechanical Engineering and the Daniel J. Epstein Industrial and Systems Engineering Departments. The Aerospace and Mechanical Engineering Department will manage this joint degree program.

Developing new products is the essence of human intelligence in general, and engineering professions in particular. The growth of our economy has been largely determined by the engineer's performance and effectiveness in new product developments. The ever-increasing demands for product functions, coupled with low cost, high quality, and short lead-time requirements have made product development a very complex and inter-disciplinary activity. The recent high-tech revolutions and stringent environmental concerns have further contributed to the complexity of modern product development. There exists a great human resource need in the areas of new product developments.

There are three interrelated disciplines in product development: art, management, and engineering. The MS in Product Development Engineering program focuses on the engineering discipline, ranging from technology to systems. From the engineering viewpoint, product development can be seen as a process from invention, design, planning, production, to service phases. Three types of knowledge are needed for an engineer to go through these phases:

- knowledge to generate new product ideas

- knowledge to evaluate these ideas

- knowledge to structure and manage the development process

This innovative degree program provides students with an integrated education experience, including modern theories and practical experiences, to acquire this knowledge systematically so that they can accomplish these phases efficiently.

All students are required to take the (2) core courses. Then you will choose which Specialization and complete those requirements.

Core Courses (6 units)
- ISE 501 Innovative Conceptual Design for New Product Development Units: 3
- ISE 545 Technology Development and Implementation Units: 3

Product Development Systems Specialization **(12-14 units)**

- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- ISE 544 Leading and Managing Engineering Teams Units: 3 (Fa, Sp, Su)

Product Development Systems Electives Select two courses.

- BAEP 557 Technology Commercialization Units: 3 (Sp)
- CE 576 Invention and Technology Development Units: 4
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 510 Advanced Computational Design and Manufacturing Units: 3 (Sp)
- ISE 511L Mechatronic Systems Engineering Units: 3 (Fa)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 525 Design of Experiments Units: 3 (Sp)
- ISE 527 Quality Management for Engineers Units: 3 (Fa, Sp)
- ISE 561 Economic Analysis of Engineering Projects Units: 3 (Fa, Sp, Su)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)
- ISE 567 Collaborative Engineering Principles and Practice Units: 3
- ISE 580 Performance Analysis with Simulation Units: 3 (Fa, Sp)
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)
- ISE 610 Advance Design of Experiments and Quality Engineering Units: 3 (Fa)
- SAE 541 Systems Engineering Theory and Practice Units: 3 (Fa, Sp)
- SAE 549 Systems Architecting Units: 3 (Fa, Sp)

*Total Units Required for the Systems Specialization PDP degree: 18-20

(term offerings in parenthesis are expected but not guaranteed)

AME Required Courses: (18 units)

Approved graduate-level course work in AME

ISE Required Courses: (24 units)

Required Courses (18-19 Units)

- ISE 500 Statistics for Engineering Managers Units: 3 (Fa, Sp)
- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- ISE 544 Leading and Managing Engineering Teams Units: 3 (Fa, Sp, Su)
- ISE 561 Economic Analysis of Engineering Projects Units: 3 (Fa, Sp, Su)

Analytics Course Select one.
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Technology Course Select one.
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- CE-576 Invention and Technology Development Units: 3
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Select One Course from One of the Following Tracks (3-4 units)

Management Track
- CE 502 Construction Accounting, Finance and Strategy Units: 4 (Fa, Sp)
- ISE 506 Lean Operations Units: 3 (Fa, Sp)
- ISE 527 Quality Management for Engineers Units: 3 (Fa, Sp)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)
- MOR 557 Strategy and Organization Consulting Units: 3 (Fa, Sp)

Analytics Track
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 533 Integrative Analytics Units: 3 (Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Innovation and Technology Commercialization Track
- BAEP 556 Technology Feasibility Units: 3 (Fa)
- BAEP 557 Technology Commercialization Units: 3 (Sp)
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- CE-576 Invention and Technology Development Units: 3
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Supply Chain and Operations Track
- DSO 581 Supply Chain Management Units: 3 (Fa, Sp)

- DSO 583 Operations Consulting Units: 3 (Sp)
- ISE 513 Inventory Systems Units: 3 (Sp)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)

Custom Track

Select one course from Industrial and Systems Engineering or Business in consultation with an adviser.

Select One ISE Elective

Total ISE units required for the degree: 24

Courses cannot be double counted
(term offerings in parenthesis are expected but not guaranteed)

Total Units Required for the Dual PDP degree: 42

Aerospace Engineering/ Mechanical Engineering & Engineering Management (POST 1577) 42 units total with 3.0 GPA: approved graduate coursework in AME (18); approved graduate level coursework in ISE (18); approved elective courses approved by ISE (6).

Masters Degree – Mechanical Engineering/Engineering Management Progressive Degree Option

AME Required Courses: (18 units)

Approved graduate-level course work in AME

ISE Required Courses: (24 units)

Required Courses (18-19 Units)

- ISE 500 Statistics for Engineering Managers Units: 3 (Fa, Sp)
- ISE 515 Engineering Project Management Units: 3 (Fa, Sp, Su)
- ISE 544 Leading and Managing Engineering Teams Units: 3 (Fa, Sp, Su)
- ISE 561 Economic Analysis of Engineering Projects Units: 3 (Fa, Sp, Su)

Analytics Course Select one.
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Technology Course Select one.
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- ISE 555 Invention and Technology Development Units: 3
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Select One Course from One of the Following Tracks (3-4 units)

Management Track
- CE 502 Construction Accounting, Finance and Strategy Units: 4 (Fa, Sp)
- ISE 506 Lean Operations Units: 3 (Fa, Sp)
- ISE 527 Quality Management for Engineers Units: 3 (Fa, Sp)
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)
- MOR 557 Strategy and Organization Consulting Units: 3 (Fa, Sp)

Analytics Track
- DSCI 552 Machine Learning for Data Science Units: 4 (Fa, Sp)
- ISE 529 Predictive Analytics Units: 3 (Fa, Sp)
- ISE 530 Optimization Methods for Analytics Units: 3 (Fa, Sp)
- ISE 533 Integrative Analytics Units: 3 (Sp)
- ISE 562 Decision Analysis Units: 3 (Fa, Sp)

Innovation and Technology Commercialization Track
- BAEP 556 Technology Feasibility Units: 3 (Fa)
- BAEP 557 Technology Commercialization Units: 3 (Sp_
- ISE 545 Technology Development and Implementation Units: 3 (Fa)
- CE-576 Invention and Technology Development Units: 3
- ISE 585 Strategic Management of Technology Units: 3 (Fa, Sp)

Supply Chain and Operations Track
- DSO 581 Supply Chain Management Units: 3 (Fa, Sp)
- DSO 583 Operations Consulting Units: 3 (Sp)
- ISE 513 Inventory Systems Units: 3 (Sp)
- ISE 514 Advanced Production Planning and Scheduling Units: 3 (Fa, Sp)
- ISE 583 Enterprise Wide Information Systems Units: 3 (Fa, Sp, Su)

Custom Track

Select one course from Industrial and Systems Engineering or Business in consultation with an adviser.

Select One ISE Elective

Total ISE units required for the degree: 24

Courses cannot be double counted
(term offerings in parenthesis are expected but not guaranteed)

Total Units Required for the Dual PDP degree: 42