



USC Viterbi

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

www.ise.usc.edu

**ISE
Master's Program Handbook
2024 – 2025**

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Disclaimer

This handbook is produced by the Daniel J. Epstein Department of Industrial and Systems Engineering (ISE) 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 at 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 Catalog

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 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 biotech 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

Master of Science in Analytics is a program designed to satisfy the growing demand for professionals equipped with significant training in the fundamentals of analytics for solving engineering and management problems in today's data-driven world. Analytics is a multidisciplinary field that applies data analysis to engineering management and enterprise processes.

Master of Science in Engineering Management is a program that prepares students to lead technology projects and manage technology-driven organizations and companies delivering a wide array of goods and services. The degree is especially well suited for students who have several years of work experience and are preparing to move into engineering management.

Master of Science 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, particularly hospitals.

Master of Science in Industrial and Systems Engineering prepares students to become technical leaders in industrial engineering by using qualitative and quantitative techniques to improve systems. The ISE program prepares students to become skilled experts, managers, decision makers and researchers for design and optimization in complex and uncertain environments. The Epstein Department's research and education benefit society through novel systems for healthcare, manufacturing, transportation and logistics, security, e-commerce, and the environment.

Master of Science in Industrial and Systems Engineering/MBA is a joint ISE/business program that 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 of Science in Operations Research Engineering trains students in solving business problems with computers and mathematics. This program prepares students to build mathematical models and algorithms to make decisions.

Master of Science 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. Students will choose either the Management Specialization or Technology specialization.

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 Ph.D. dissertation research. Policies for the Ph.D. are described in a separate publication available from the department.

Ph.D. 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 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.

For more information, please go to <https://gradadm.usc.edu/our-programs/viterbi-school-of-engineering/>

FINANCIAL AID

Financial assistance is administered on various 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 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.

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.

ACADEMIC POLICIES

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.

Course Requirements

All students should refer to the USC Catalog for their course requirements. Please make sure you are looking at the Catalog for the year you were admitted to the program. Past catalog years may have different requirements which do not apply to your catalog year.

Condition of Admission

Students should take the condition of admissions classes as soon as possible in their course of study to prevent registration holds and progress delays.

Transfer Credit

The faculty of a degree program may establish limits on the number of transfer credits that are stricter than those of the university, which are as follows:

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 28-unit master's degree, subject to departmental approval, is 4 units. Students should arrange for any transfer of credits during the first semester of enrollment at USC.

Limited Status Enrollment

A maximum of 12 units of credit may be applied from courses taken as a Limited Status Student.

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.

Residency

Students must complete a minimum of 20 units at USC. The last four units of courses must be taken 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 to Graduate in MyViterbi. The department will email the instructions each semester. 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. Students should contact their advisor 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.

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 students the recognition they 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; Engineering Management Student Association, 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.

Engineering Management Student Association EMSA

EMSA was established in 2012 to increase the interaction between industry, alumni, students, and the professors. The organization is free to all USC students.

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.

MS ANALYTICS DEGREE REQUIREMENTS

Core Courses (12 units)

ISE 529 Predictive Analytics Units: 4

ISE 530 Optimization Methods for Analytics Units: 4

ISE 558 Data Management for Analytics Units: 4

Group A (4 units)

Select one course.

ISE 533 Integrative Analytics Units: 4

ISE 534 Data Analytics Consulting Units: 4

ISE 580 Performance Analysis with Simulation Units: 4 *

Group B (4 units)

Select one course.

ISE 525 Design of Experiments Units: 4

ISE 535 Data Mining Units: 4

ISE 537 Financial Analytics Units: 4

ISE 538 Markov Models for Performance Analysis Units: 4

ISE 540 Text Analytics Units: 4

ISE 543 Enterprise Business Intelligence and Systems Analytics Units: 4

ISE 562 Decision Analysis Units: 4

ISE 580 Performance Analysis with Simulation Units: 4 *

Note

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

Advisor-approved Electives (8 units)

Total units required for the degree: 28

Advisor-Approved Electives for Analytics

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 Data Science Courses

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 Marketing (Marshall)

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 662 Advanced Decision Theory

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 567 Machine Learning
CSCI 570 Analysis of Algorithms
CSCI 571 Web Technologies
CSCI 577A Software Engineering
CSCI 578 Software Architectures
CSCI 585 Database Systems

DSCI 519 Foundations & Policy for Information Security
DSCI 552 Machine Learning for Data Science
DSCI 553 Foundations & Applications of Data Mining
DSCI 554 Data Visualization

DSO 510 Business Analytics
DSO 522 Applied Time Series Analysis for Forecasting
DSO 528 Data Warehousing, Business Intelligence, & Data Mining
DSO 531 Digital Foundations for Business Innovation
DSO 545 Statistical Computing and Data Visualization
DSO 547 Designing Spreadsheet-Based Business Models
DSO 559 Introduction to Python for Business Analytics
DSO 562 Fraud Analytics

EE 541 A Computational Introduction to Deep Learning

FBE 523 Forecasting and Risk Analysis

GERO 502 Marketing and Shifts in Consumer Decision Making
GERO 504 Current Issues in Aging Services Management

GSBA 548 The Firm in the National and International Economy
GSBA 561 Evaluating Market Performance
GSBA 562 Management of Operations
GSBA 563 Technology and Information Systems Management

ITP 449 Applications of Machine Learning

MATH 502a Numerical Analysis
MATH 547 Mathematical Foundations of Statistical Learning Theory

MKT 530 New Product Development
MKT 543 Market Demand and Sales Forecasting
MKT 566 Marketing Analytics

MOR 569 Negotiation and Deal-Making

MS ENGINEERING MANAGEMENT DEGREE REQUIREMENTS

Required Courses

- ISE 500 Statistics for Engineering Managers Units: 4
- ISE 515 Engineering Project Management Units: 4
- ISE 544 Leading and Managing Engineering Teams Units: 4
- ISE 561 Economic Analysis of Engineering Projects Units: 4

Technology Course

Select one:

- CE 576 Invention and Technology Development Units: 3
- ISE 445 Principles and Practices of Global Innovation Units: 4
- ISE 501 Innovative Conceptual Design for New Product Development Units: 4
- ISE 585 Strategic Management of Technology and Innovation Units: 4

Advisor-Approved electives (8 units)

Total units required for the degree: 28

Advisor Approved Electives for Engineering Management

*Is listed as a Required or Elective course in one or more of the following Marshall Graduate Certificates: Business Analytics, Optimization and Supply Chain Management, Technology Commercialization

BAEP 450 Fundamentals of Entrepreneurship
BAEP-553 Cases in New Venture Management *
BAEP 554 Venture Initiation*
BAEP-555 Founders Dilemmas: Anticipate and Avoid Startup Pitfalls *
BAEP 556 Technology Feasibility *
BAEP 557 Technology Commercialization *
BAEP 559 Investing in New Ventures*
BAEP 562 Entrepreneurship in eCommerce*
BAEP 563 Corporate Entrepreneurship *
BAEP 565 Digital Playbook for Entrepreneurs: Creating a Tech Startup
BAEP 577 The Entrepreneurial CEP: The Real World of Leading Startups

CE 469 Sustainable Design and Construction
CE 502 Construction Accounting, Finance and Strategy
CE 576 Invention and Technology Development
CE 589 Port Engineering: Planning and Operational Analysis *

DSCI 552 Machine Learning for Data Science

DSO 505 Sustainable Supply Chains *
DSO 506 Sourcing and Supplier Management *
DSO 510 Business Analytics Units*
DSO 581 Supply Chain Management
DSO 583 Operations Consulting

DSO 516 Probability and Data Modeling *
DSO 520 Logistics Management *
DSO 522 Applied Time Series Analysis for Forecasting *
DSO 528 Blended Data Business Analytics for Efficient Decisions *
DSO 529 Advanced Regression Analysis *
DSO 530 Applied Modern Statistical Learning Methods *
DSO 531 Digital Foundations for Business Innovation *
DSO 534 Discrete-Event Simulation for Process Management *
DSO 536 Monte Carlo Simulation and Decision Models *
DSO 545 Statistical Computing and Data Visualization *
DSO 547 Spreadsheet Modeling for Business Insights *
DSO 548 Emerging Technologies in Supply Chain Management *
DSO 549 Application of Lean Six Sigma *
DSO 551 Digital Transformation in the Global Enterprise *

DSO 552 SQL Databases for Business Analysts *
DSO 554 Digital Strategies for Sustainability in Global Markets *
DSO 556 Business Models for Digital Platforms *
DSO 559 Introduction to Python for Business Analytics *
DSO 562 Fraud Analytics *
DSO 565 Supply Chain Analytics *
DSO 570 The Analytics Edge: Data, Models, and Effective Decisions *
DSO 572 Strategies for Digital Analytics *
DSO 573 Data Analytics Driven Dynamic Strategy and Execution *
DSO 574 Using Big Data: Challenges and Opportunities *
DSO 580 Project Management *
DSO 581 Supply Chain Management *
DSO 582 Service Management: Economics and Operations *
DSO 583 Operations Consulting *

ENE 502 Environmental and Regulatory Compliance

GSBA 504a Operations Management *
GSBA 504b Operations Management *
GSBA 506a Applied Managerial Statistics *
GSBA 506b Applied Managerial Statistics *
GSBA 545 Data Driven Decision Making *
GSBA 524 Data Science for Business *
GSBA 534 Operations Management *
ISE 445 Principles and Practices of Global Innovation,
ISE 506 Lean Operations *
ISE 513 Inventory Systems *
ISE 514 Advanced Production Planning and Scheduling *
ISE 527 Quality Management for Engineers
ISE 529 Predictive Analytics
ISE 530 Optimization Methods for Analytics *
ISE 534 Data Analytics Consulting
ISE 543 Enterprise Business Intelligence and Systems Analytics
ISE 562 Decision Analysis
ISE 580 Performance Analysis with Simulation *
ISE 583 Enterprise-Wide Information Systems *
ISE 585 Strategic Management of Technology

ITP 466 Building the High-Tech Startup

MKT 530 New Product Development
MKT 566 Internet Marketing

MOR 543 Leading with Mindfulness and Compassion

MOR 544 Fundamentals of Crisis Management
MOR 557 Strategy and Organization Consulting
MOR-561 Strategies in High-Tech Businesses *
MOR-564 Strategic Innovation: Creating New Markets, Business Models and Growth *
MOR 566 Environmental Sustainability and Competitive Advantage
MOR 569 Negotiation and Deal-Making
MOR 571 Leadership and Executive Development

SAE 541 Systems Engineering Theory and Practice
SAE 548 System/System-of-Systems Integration and Communication
SAE 549 Systems Architecting

MS HEALTH SYSTEMS MANAGEMENT ENGINEERING DEGREE REQUIREMENTS

Required Courses (24 Units)

ISE 504 Management of Change in Health Care Systems Units: 4

or

ISE 564 Organizational Performance Analysis Units: 4

ISE 505 Modeling for Health Policy and Medical Decision Making Units: 4

ISE 508 Health Care Operations Improvement Units: 4

ISE 509 Practicum in Health Care Systems Units: 4

PM 504 Quality in Health Care Units: 4

PM 508 Health Service Delivery in the U.S. Units: 4

Advisor-Approved Electives (4 Units)

Total Units: 28

Advisor-Approved Electives for Health Systems Management Engineering

BME 527 Integration of Medical Imaging Systems

BME 528 Medical Diagnostics, Therapeutics and Informatics Applications

DSO 506 Sourcing and Supplier Management

DSO 581 Supply Chain Management

ISE 460 Engineering Economy

ISE 470 Human Factors in Work Design

ISE 435 Discrete Systems Simulation

ISE 506 Lean Operations

ISE 515 Engineering Project Management

ISE 527 Quality Management for Engineers

ISE 535 Data Mining

ISE 544 Leading and Managing Engineering Teams

ISE 562 Decision Analysis

PM 500 Foundations of Health Behavior

PM 502 Foundations of Public Health

PM 519 Health Disparities in the U.S.

PM 526 Communications in Public Health

PM 547 Public Health Policy and Politics

PPD 506 Introduction to Microeconomics Applications in Health

PPD 509 Problems and Issues in the Health Field

PPD 516 Financial Accounting for Health Care Organizations

PPD 518 Quality of Care Concepts

MS INDUSTRIAL AND SYSTEMS ENGINEERING DEGREE REQUIREMENTS

Required Courses (12 units)

ISE 513 Logistics and Inventory Systems Units: 4

ISE 514 Advanced Production Planning and Scheduling Units: 4

ISE 515 Engineering Project Management Units: 4

Group A Quantitative Techniques (4 units required)

Select one course

ISE 530 Optimization Methods for Analytics Units: 4

ISE 536 Linear Programming and Extensions Units: 4

ISE 538 Markov Models for Performance Analysis Units: 4

ISE 580 Performance Analysis with Simulation Units: 4

ISE 539 Stochastic Elements of Simulation Units: 4

Group B Quality and Operations (4 units required)

Select one course

ISE 506 Lean Operations Units: 4

ISE 525 Design of Experiments Units: 4

ISE 527 Quality Management for Engineers Units: 4

ISE 583 Enterprise Wide Information Systems Units: 4

Group C Engineering Management (4 units required)

Select one course

ISE 561 Economic Analysis of Engineering Projects Units: 4

ISE 562 Decision Analysis Units: 4

ISE 564 Organizational Performance Analysis Units: 4

ISE 570 Human Factors in Engineering Units: 4

Advisor approved electives (4 units)

Total Units 28

Advisor- Approved Electives for MS Industrial and Systems Engineering

ACCT 509 Concepts of Financial and Management Accounting

BAEP 553 Cases in New Venture Management

BAEP 557 Technology Commercialization

CE 404 Business and Intellectual Property Law for Engineers

CE 412 Construction Contracts and Law

CE 460 Construction Engineering

CE 461 Construction Estimating

CE 462 Construction Methods and Equipment

CE 471 Principles of Transportation Engineering

CE 501 Construction Practices

CE 502 Construction Accounting, Finance and Strategy

CE 506 Heavy Construction Estimating

CE 550 Computer-Aided Engineering

CE 551 Computer-Aided Engineering Project

CE 552 Managing and Financing Public Engineering Works

CE 554 Risk and Reliability Analysis for Civil Infrastructure Systems

CE 558 International Construction and Engineering

CE 569 Project Controls

CE 579 Introduction to Transportation Planning Law

CE 585 Traffic Engineering and Control

CE 589 Port Engineering: Planning and Operational Analysis

CE 633 Urban Transportation Planning and Management

CE 634 Institutional and Policy Issues in Transportation

CSCI 455x Introduction to Programming Systems Design

CSCI 485 File and Database Management

CSCI 510 Software Management and Economics

CSCI 530 Security Systems

CSCI 561 Foundations of Artificial Intelligence

CSCI 570 Analysis of Algorithms

CSCI 571 Web Technologies

CSCI 576 Multimedia Systems Design

CSCI 577a Software Engineering

CSCI 577b Software Engineering

CSCI 578 Software Architectures

CSCI 585 Database Systems

DSO 427 Spreadsheet Modeling for Business Insights

DSO 431 Digital Innovation as Competitive Advantage

DSO 433 Designing Digital Processes and User Experiences

DSO 482 Supply Chain Management

DSO 528 Blended Data Business Analytics for Efficient Decisions
DSO 531 Digital Foundations for Business Innovation
DSO 547 Spreadsheet Modeling for Business Insights
DSO 548 Emerging Technologies in Supply Chain Management
DSO 570 The Analytics Edge: Data, Models, and Effective Decisions
DSO 581 Supply Chain Management
DSO 583 Operations Consulting

ENE 505 Energy and the Environment
ENE 506 Ecology for Environmental Engineers
ENE 510 Water Quality Management and Practice

ENGR 501x Engineering Writing and Communication for Master's Students

FBE 437 Entrepreneurial Finance: Financial Management for Developing Firms

GSBA 520 Business Fundamentals for Non-Business professionals
GSBA 534 Operations Management

ITP 404 Advanced Front-End Web Development
ITP 422 Configuring Enterprise Resource Planning Systems
ITP 454x Enterprise Resource Planning, Design, and Implementation
ITP 457 Network Security
ITP 460 Web Application Project
ITP 482 Engineering Database Applications
ITP 486 Securing and Auditing Enterprise Resource Planning Systems
ITP 487 Enterprise Data Analytics

MKT 526 Advertising and Social Media: Strategy and Analytics

MOR 548 Competitive Advantage Through People
MOR 555 Designing High Performance Organizations
MOR 557 Strategy and Organization Consulting
MOR 564 Strategic Innovation: Creating New Markets
MOR 566 Environmental Sustainability and Competitive Advantage
MOR 572 Leadership and Self-Management

PPD 501a Economics for Policy, Planning and Development
PPD 501b Economics for Policy, Planning and Development
PPD 558 Multivariate Statistical Analysis
PPD 587 Risk Analysis
PPD 634 Institutional and Policy Issues in Transportation

SAE 541 Systems Engineering Theory and Practice
SAE 549 Systems Architecting

MS OPERATIONS RESEARCH ENGINEERING DEGREE REQUIREMENTS

Required Courses: 20 units

- ISE 536 Linear Programming and Extensions Units: 4
- ISE 538 Markov Models for Performance Analysis Units: 4
- ISE 580 Performance Analysis with Simulation Units: 4
- ISE 583 Enterprise Wide Information Systems Units: 4
- ISE 632 Network Flows and Combinatorial Optimization Units: 4

Select one from the following: 4 units

- ISE 513 Logistics and Inventory Systems Units: 4
- ISE 514 Advanced Production Planning and Scheduling Units: 4
- ISE 520 Optimization Theory and Algorithms: Numerical Optimization Units: 4
- ISE 525 Design of Experiments Units: 4
- ISE 539 Stochastic Elements of Simulation Units: 4
- ISE 562 Decision Analysis Units: 4
- ISE 563 Financial Engineering Units: 4
- ISE 576 Industrial Ecology Units: 4

Advisor-Approved Elective: 4 units

Total units: 28

Advisor Approved Electives for Operations Research Engineering

ISE 535 Data Mining

ISE 543 Enterprise Business Intelligence and Systems Analytics

CSCI 545 Robotics

CSCI 561 Foundations of Artificial Intelligence

CSCI 567 Machine Learning

CSCI 570 Analysis of Algorithms

CSCI 571 Web Technologies

CSCI 585 Database Systems

MS PRODUCT DEVELOPMENT ENGINEERING DEGREE REQUIREMENTS

Core courses for both Management and Technology Specializations (8 units)

ISE 445 Principles and Practices of Global Innovation Units: 4

ISE 501 Innovative Conceptual Design for New Product Development Units: 4

Management Specialization Required Courses (8 units)

ISE 515 Engineering Project Management Units: 4

ISE 544 Leading and Managing Engineering Teams Units: 4 or

ISE 585 Strategic Management of Technology and Innovation Units: 4

Management Specialization Technical Electives (8 units)

Select two courses from the list

AME 504 Mechatronics Systems Engineering Units: 4

AME 510 Advanced Computational Design and Manufacturing Units: 4

ISE 514 Advanced Production Planning and Scheduling Units: 4

ISE 525 Design of Experiments Units: 4

ISE 527 Quality Management for Engineers Units: 4

ISE 544 Leading and Managing Engineering Teams Units: 4 *

ISE 561 Economic Analysis of Engineering Projects Units: 4

ISE 562 Decision Analysis Units: 4

ISE 580 Performance Analysis with Simulation Units: 4

ISE 583 Enterprise Wide Information Systems Units: 4

ISE 585 Strategic Management of Technology and Innovation Units: 4 *

ISE 610 Advanced Design of Experiments and Quality Engineering Units: 4

Note: *Choose one that is not included as a specialization required course.

Management Specialization General Electives Suggested (4 units)

Advisor approved electives must be upper-division 400- or 500-level courses. Up to 4 units can be transferred from other institutions.

CSCI 567 Machine Learning Units: 4

DSCI 552 Machine Learning for Data Science Units: 4

ISE 460 Engineering Decisions, Economics and Ethics Units: 4

ISE 470 Human/Computer Interface Design Units: 4

ISE 506 Lean Operations Units: 4

ISE 520 Optimization Theory and Algorithms: Numerical Optimization Units: 4

ISE 529 Predictive Analytics Units: 4

ISE 530 Optimization Methods for Analytics Units: 4

ISE 633 Large Scale Optimization and Machine Learning Units: 4

PPD 587 Risk Analysis Units: 4

Technology Specialization Required Courses (7-8 units)

AME 503 Advanced Mechanical Design Units: 3

AME 525 Engineering Analysis Units: 4 **or**

AME 526 Introduction to Mathematical Methods in Engineering II Units: 4

Technology Specialization Technical Electives (6-8 units)

AME 408 Computer-Aided Design of Mechanical Systems Units: 3

AME 410 Engineering Design Theory and Methodology Units: 3

AME 502 Modern Topics in Aerospace Design Units: 3

AME 505 Engineering Information Modeling Units: 3

AME 510 Advanced Computational Design and Manufacturing Units: 4

AME 525 Engineering Analysis Units: 4 *

AME 526 Introduction to Mathematical Methods in Engineering II Units: 4 *

AME 527 Elements of Vehicle and Energy Systems Design Units: 3

AME 544 Computer Control of Mechanical Systems Units: 3

AME 546 Design for Manufacturing Assembly Units: 4

AME 547 Foundations for Manufacturing Automation Units: 4

ASTE 523 Design of Low Cost Space Missions Units: 3

CE 576 Invention and Technology Development Units: 3

ISE 567 Collaborative Engineering Principles and Practice Units: 3

ISE 576 Industrial Ecology Units: 4

ISE 585 Strategic Management of Technology and Innovation Units: 4

MASC 551 Mechanical Behavior of Engineering Materials Units: 4

MASC 583 Materials Selection Units: 4

SAE 549 Systems Architecting Units: 3

Note: *Choose one that is not included as a specialization required course.

Technology Specialization General Electives Suggested (4-7 units)

Advisor approved electives must be upper-division 400- or 500-level courses. Up to 4 units can be transferred from other institutions.

AME 481 Aircraft Design Units: 4

AME 577 Survey of Energy and Power for a Sustainable Future Units: 4

AME 578 Modern Alternative Energy Conversion Devices Units: 3

ASTE 520 Spacecraft System Design Units: 3

CE 529 Finite Element Analysis Units: 4

CE 543 Structural Instability and Failure Units: 4

CE 550 Computer-Aided Engineering Units: 3

CE 551 Computer-Aided Engineering Project Units: 3

Minimum units required for degree: 28

Advisor-Approved Electives for Product Development Engineering

AME 403 Stress Analysis
AME 407 Computer Graphics for Mechanical Engineers
AME 408 Computer-Aided Design of Mechanical Systems
AME 451 Linear Control Systems I
AME 481 Aircraft Design
AME 501 Spacecraft System Design
AME 503 Advanced Mechanical Design
AME 504 Metallurgical Design
AME 510 Advanced Computational Design and Manufacturing
AME 514 Applications of Combustion and Reacting Flows
AME 516ab Flight Vehicle Stability and Control
AME 528a Finite Element Analysis
AME 528b Finite Element Analysis
AME 529 Aircraft Structures Analysis
AME 541 Linear Control Systems II
AME 542 Nonlinear Control Systems
AME 543 Stability of Structures
AME 544 Computer Control of Mechanical Systems
AME 546 Basic Aeroelasticity
AME 548 Analytical Methods in Robotics
AME 577 Survey of Energy and Power for a Sustainable Future
AME 578 Modern Alternative Energy Conversion Device

ASTE 520 Spacecraft System Design

BAEP 551 Introduction to New Ventures (No DEN)
BAEP 556 Technology Feasibility (No DEN)
BAEP 557 Technology Transfer & Commercialization

CE 550 Computer-Aided Engineering
CE 551 Computer-Aided Engineering Project

CSCI 455x Intro to Programming Systems Design
CSCI 460 Introduction to Artificial Intelligence
CSCI 467 Introduction to Machine Learning
CSCI 477L Design and Construction of Large Software Systems
CSCI 480 Computer Graphics
CSCI 482 Introduction to Geometric Modeling
CSCI 485 File & Database Management
CSCI 551 Computer Communications
CSCI 567 Machine Learning
CSCI 571 Web Technologies
CSCI 577ab Software Engineering

CSCI 582 Geometric Modeling
CSCI 583 Computational Geometry
CSCI 584 Intelligent Systems for Design and Manufacture
CSCI 585 Database Systems
CSCI 598 Expert Systems
CSCI 615 Robotic Motion Planning

CTIN 583 Game Development for Designers

DSO 531 Digital Foundations for Business Innovation (no DEN)
DSO 551 Digital Transformation in the Global Enterprise (no DEN)
DSO 581 Supply Chain Management (no DEN)

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 547 Software Methods in Robotics
EE 554 Real Time Computer Systems
EE 559 Mathematical Pattern Recognition
EE 560L Advanced Microcomputer-Based Design
EE 561 Artificial Intelligence
EE 562a Random Processing in Engineering
EE 569 Intro to Digital Image Processing
EE 574 Computer Vision
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

GBSA 545 Data Driven Decision Making (No DEN)

GBSA 548 Corporate Finance (No DEN)

INF 552 Machine Learning for Data Informatics

ISE 410 Production Planning and Control

ISE 426 Statistical Quality Control

ISE 435 Discrete Systems Simulation

ISE 460 Engineering Economy

ISE 470 Human/Computer Interface Design

ISE 506 Lean Operations

ISE 511L Computer-Aided Manufacturing

ISE 513 Inventory Systems

ISE 514 Industrial Scheduling

ISE 515 Engineering Project Management

ISE 517 Modern Enterprise Systems

ISE 520 Optimization: Theory and Algorithms

ISE 527 Quality Management for Engineers

ISE 528 Advanced Statistical Aspects of Engineering Reliability

ISE 529 Predictive Analytics

ISE 530 Optimization Methods for Analytics

ISE 535 Data Mining

ISE 538 Performance Analysis Using Markov Models

ISE 540 Text Analytics

ISE 543 Enterprise Business Intelligence and Systems Analytics

ISE 559 Introduction to Data Management

ISE 561 Economic Analysis of Engineering Projects

ISE 580 Performance Analysis with Simulation

ISE 585: Strategic Management of Technology

ISE 633 Large Scale Optimization and Machine Learning

ISDN 523 User Experience Design

MASC 472 Polymer Science and Engineering

MASC 475 Physical Properties of Polymers

MASC 511 Materials Preparation

MASC 513 Multilayered Materials & Properties

MASC 518 Semiconductor Materials for Devices

MASC 560 Fatigue and Fracture

MASC 583 Materials Selection

MASC 584 Fracture Mechanics and Mechanisms

ME 403 Stress Analysis

ME 407 Computer Graphics for Mechanical Engineers

ME 408 Computer-Aided Design of Mechanical Systems

MOR 554 Leading Innovation and Change

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

PPD 587 Risk Analysis

SAE 541 Systems Engineering Theory and Practice

SAE 546 Engineering Resilient Systems and System-of Systems

SAE 547 Model Based Systems Architecting and Engineering

SAE 549 Systems Architecting

SAE 550 Systems Architecting and Political Process