MANUFACTURING SYSTEMS ENGINEERING

The program may be completed entirely on campus, entirely online, or through a combination of on-campus and online courses.

Admission

Admission to the program requires a Bachelor of Science degree in engineering or a physical science from an accredited program with an average of B or better (GPA of 3.0 on a 4-point scale).

Students who do not meet BS degree requirements of the program should speak to the program advisor regarding the additional requirements to be met.

Course Prerequisites

- Course in probability and statistics (IMSE 510, Probability and Statistical Models or equivalent). The IMSE 510 requirements can be completed after admission into the program and will count as an elective toward the 30-credit degree requirement.
- Course in engineering materials (ENGR 250 or equivalent). No credit will be given for the ENGR 250.

Degree Requirements

The MSE in Manufacturing Systems Engineering requires a minimum of 30 credit hours.

Minimum Grade Requirement in addition to maintaining a minimum cumulative GPA of 3.0 or higher every semester:

- Courses in which grades of C- or below are earned cannot be used to fulfill degree requirements.
- A minimum of a 3.0 cumulative GPA or higher is required at the time of graduation.

Advanced Standing

Up to six graduate credit hours (grade of *B* or better) may be transferred from another accredited institution.Students may transfer up to one-half (1/2) the minimum number of credit hours required for their master's or professional degree from another University of Michigan program.

Graduate Academic Policies can be found below:

http://catalog.umd.umich.edu/academic-policies-graduate/

Course Requirements

Code	Title	Credit Hours
Core Courses		
The following courses are required:		
AENG 587	Automotive Manuf Processes	3
IMSE 5215	Program Budget, Cost Est & Con	3
IMSE 561	Tot Qual Mgmt and Six Sigma	3
IMSE 580	Prod & Oper Engineering I	3
EMGT 580	Mgt of Prod and Proc Design	3
Electives		
Select any five courses from the list below:		15
ACC 505	Devel & Interp Financial Info	
AENG 584	Lightweight Automotive Alloys	
AENG 586	Design & Mfg: Ltwt Auto Mat	
AENG 588	Design&Manufac for Environment	
AENG 589	Auto Assembly Systems	
ECE 516	Electronic Materials & IC Proc	
IMSE 502	Computer-Integrated Mfg	
IMSE 504	Metal Forming Processes	
IMSE 510	Probability & Statistical Mod	
IMSE 511	Design and Analysis of Exp	
IMSE 515	Fundamentals of Program Mgt	
IMSE 516	Project Management and Control	
IMSE 517	Managing Global Programs	
IMSE 5205	Eng Risk-Benefit Analysis	
IMSE 538	Intelligent Manufacturing	
IMSE 5655	Supply Chain Management	
IMSE 570	Enterprise Information Systems	
IMSE 581	Prod & Oper Engineering II	
IMSE 5825	Industrial Controls	
ME 580	Advanced Engineering Materials	
ME 582	Injection Molding	
ME 585	Cast Metals in Engineering Design	
ME 586	Materials Consideration in Manufacturing	
ME 587	Automotive Composites	
HRM 561	Human Resource Management	
OB 510	Organization Behavior	
OB 610	Intrnatl Dimensions of Managmt	
Total Credit Hours		**30**

A thesis may be submitted in lieu for six hours of electives, on approval by the program director. The thesis work may be a company project if it meets certain requirements.

Learning Goals

1. Students will be able to demonstrate knowledge in process engineering, system design and management aspects of manufacturing.
2. Students will be able to demonstrate knowledge in product quality and process control.

IMSE 500   Models of Oper Research   3 Credit Hours
The method of mathematical modeling and its application to decision-making problems in organizations. Some widely used models and techniques: linear programming, queuing, inventory, and simulation.
Restriction(s):
Can enroll if Class is Graduate

IMSE 501   Human Factors & Ergonomics   3 Credit Hours
The analysis and prediction of human performance in industrial and other man-machine systems using work sampling, time-motion analysis, synthetic and standard time study, and learning curves, in the design of such systems. Lecture and laboratory. Cannot receive credit for both IMSE 442, and IMSE 501. This class may be scheduled at the same time as the undergraduate course IMSE 442. Graduate students will be required to do additional research paper and/or project.
Prerequisite(s): IMSE 317* or IMSE 510*
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 5010   Fundamentals of Program Mgt   3 Credit Hours
An overview of the project/program management framework and knowledge areas including plan development and execution; management of scope, time, cost, quality, human resource, communications, risk, and procurement. Typical program phases and life cycles observed in defense, construction, automobile, and software industries. Program organizational structures, program management processes, international project management, role of software tools for program management, product development, applications of Lean Product Development techniques, cutting waste and lead time in program management.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate
Can enroll if College is Business

IMSE 502   Computer-Integrated Mfg   3 Credit Hours
This course provides basic knowledge of elements in Computer-Integrated Manufacturing Systems, with particular emphasis on Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Computer-Aided Process Planning (CAPP), materials handling, and information flow in manufacturing systems. Hands-on experiments and course projects are required. Two lecture hours and three laboratory hours. Credit cannot be given for both IMSE 483 and IMSE 502. This class may be scheduled at the same time as the undergraduate course IMSE 483. Graduate students will be required to do additional research paper and/or project.
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 503   Computer-Aided M/C & Tool Desg   3 Credit Hours
Study of the fundamentals of machine tool design, cutting tools, metal forming dies, and jig fixtures for practical applications in machining and assembly. Principles of design for manufacture and assembly as applied to tool and machine design. Laboratory exercise and projects are required using computer-aided design software. Two lecture hours and three laboratory hours. Credit cannot be given for both IMSE 484 and IMSE 503. This class may be scheduled at the same time as the undergraduate course IMSE 484. Graduate students will be required to do additional research paper and/or project.
Prerequisite(s): IMSE 382 or ME 381
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 504   Metal Forming Processes   3 Credit Hours
This course focus is on fundamentals of metal forming processes; mechanics of metal forming; formability of manufacture; and economic aspect of the process. Emphasis is placed on analysis of bulk and sheet metal forming processes as applied to practical cases such as automobile manufacturing. Laboratory and course project are required. Credit cannot be given for both IMSE 488 and IMSE 504. This class may be scheduled at the same time as the undergraduate course IMSE 488. Graduate students will be required to do additional research paper and/or project.
Prerequisite(s): IMSE 382 or IMSE 381
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 505   Optimization   3 Credit Hours
Theory of linear and nonlinear programming. Language multipliers and Kuhn-Tucker conditions. Convex programming. Combinatorial and integer programming. Dynamics programming. Heuristic and search optimization techniques. Theory and emphasis on applications using various computer codes.
Prerequisite(s): IMSE 300 or IMSE 500

IMSE 510   Probability & Statistical Mod   3 Credit Hours
Review of basic concepts in probability and statistics. Multivariate distributions. Estimation and order statistics. General hypothesis testing, and non-parametric tests. Linear, multiple-linear, and nonlinear regression models. Analysis of variance.Introduction to the design of experiments.
Prerequisite(s): IMSE 317

IMSE 511   Design and Analysis of Exp   3 Credit Hours
One factor, two factor, and multifactor experiments. Fixed random and mixed models. Blocked confounding, incomplete blocks, factorial experiments, fractional factorial experiments. Introduction to response surface analysis.
Prerequisite(s): IMSE 510

IMSE 512   Taguchi Method of Quality Eng   3 Credit Hours
Quality engineering methodology developed by Genichi Taguchi. Design and analysis of experiments using orthogonal arrays and linear graphs. Accumulation analysis for categorized data. Signal-to-noise ratio as a measure of quality characteristics. Simulation using orthogonal arrays. Parameter design for reducing variability around the target without cost increase. Tolerance design for reducing variability with minimum cost increase. Evaluation and improvement of measurement.
Prerequisite(s): IMSE 510

IMSE 513   Robust Design   3 Credit Hours
Students will learn models and methods in the context of overall strategies to empirically study the design of products and manufacturing processes to reduce variability and to reduce sensitivity to parameter variation. Topics include: process capability studies and measures, basic DOE concepts, factorial experiments, evaluating sources of variation, evolutionary operation and adaptive statistical process control.
Prerequisite(s): IMSE 510

IMSE 514   Multivariate Statistics   3 Credit Hours
Linear statistical models used in simple and multiple regression, and analysis of variation. Principles and techniques of principle component analysis are studied and applied to business and engineering problems using statistical computer software. (YR)
Prerequisite(s): IMSE 510

IMSE 515 Fundamentals of Program Mgt 3 Credit Hours
An overview of the project/program management framework and knowledge areas including plan development and execution, scope management, time management, cost management, quality management, human resource management, communications management, risk management, and procurement management. Typical Program Phases and Life Cycles observed in Defense, Construction, Automobile, and Software Industries. Program Organizational Structures, Program Management Processes, and International Project Management are covered. Role of software tools for Program Management and Product Development are discussed. Applications of Lean Product Development Techniques are considered. Cutting waste and lead time in program management are covered. Case studies are used extensively throughout the course.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Professional Development or Graduate

IMSE 516 Project Management and Control 3 Credit Hours
Project Planning, Scheduling, and Controlling functions are discussed in detail including work breakdown structure, CPM and PERT methods, resource allocation and leveling techniques, cost control and minimization, trade-off analysis, learning curves overlapping relationships and concurrent engineering, multiple project execution and optimization. Applications of Lean Techniques in program management are discussed as well as the role of IT in accelerating the product development and reducing the program time. The importance of integrating the Supply Chain in the Product Development is also considered. Case studies and project management software are used throughout the course.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Professional Development or Graduate

IMSE 517 Managing Global Programs 3 Credit Hours
This course focuses on some of the central strategic and organizational problems that arise in managing global programs, including cultural conflicts, developing and managing international managers, global and local brands, and organizing to resolve global-local conflicts. The course uses a combination of case studies, problems, lectures and discussion, over a wide variety of companies and countries.
Prerequisite(s): IMSE 515
Restriction(s):
Can enroll if Level is Rackham or Professional Development or Graduate

IMSE 519 Quan Meth in Quality Engin 3 Credit Hours
This course introduces the advanced quantitative and analytical methods used in quality measurement, prediction, control and improvement. The topics include sampling design and plan, control charts, statistical quality control, time series, process capability analysis and quality cost analysis. Quality related topics in robust and tolerance design are also included.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Doctorate or Rackham or Graduate or

IMSE 520 Managerial Decision Analysis 3 Credit Hours
Normative decision analysis, decisions, structures, and trees. Utility theory, game theory, and statistical decision theory are introduced. Applications of the theories to management studies in capital investment, bidding, purchasing, and risk analysis are discussed.
Prerequisite(s): IMSE 510

IMSE 5205 Eng Risk-Benefit Analysis 3 Credit Hours
Analysis risk assessment, decision and cost-benefit analysis, and fault-tree methods for describing and making decisions about societal risks associated with large engineering projects. Balancing risks and benefits in situations involving human safety, environmental risks, and financial uncertainties. Presentations of major risk assessment and the public decision processed associated with them.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate
Can enroll if College is Business

IMSE 521 Mfg Cost Estimation & Control 3 Credit Hours
In this course, concepts of strategic costing in product development and manufacturing are introduced. Engineering economy techniques are used in the study of life cycle cost elements. Equipment acquisition and replacement justification methods under risk and uncertainty are presented.
Restriction(s):
Can enroll if Class is Graduate

IMSE 5215 Program Budget, Cost Est & Con 3 Credit Hours
This course focuses on cost estimation and control for program managers and engineers. The course introduces a systematic approach for applying engineering economy techniques in cost estimating, resource planning, cost planning, cost management and control, and the study of life cycle cost elements. An introduction to decisions under risk and uncertainty as well as an introduction to project crashing are also presented.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate
Can enroll if Level is Doctorate or Rackham or Graduate or Professional Development
Can enroll if College is Engineering and Computer Science or Business

IMSE 533 Manufacturing Systems 3 Credit Hours
This course introduces methodologies and tools for modeling, design and operations planning of manufacturing systems. Topics include introduction to integrated manufacturing systems, manufacturing system and data modeling methodologies, process planning, group technology, manufacturing system layout, scheduling, push and pull production systems. Industrial case studies are presented and discussed.
Restriction(s):
Can enroll if Class is Graduate

IMSE 536 Machinery Diagnostics 3 Credit Hours
Introduction to diagnostic system design. Fundamentals of mechanical vibration and noise. Vibration-generating sources in machinery. Sensing and data acquisition methods. Data interpretation by statistical and spectral analysis methods. Fault classifications methods. Computer implementation.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Graduate

IMSE 537 Metal Machining Processes 3 Credit Hours
Detailed study of the principles of conventional and non-traditional metal removing processes, machine tools accuracy, cutting fluids, and cutting tools. The course emphasis will be on the mechanics of metal cutting, machining processes, cutting tool materials and tool geometry, selection of cutting conditions, planning for machining and optimization of manufacturing process. Role of numerical control in improving machining process and productivity of manufacturing system.
Prerequisite(s): ME 381 or IMSE 382 or AENG 587

IMSE 538   Intelligent Manufacturing   3 Credit Hours
A comprehensive and integrated approach to topics associated with the science of artificial intelligence and their role in today's manufacturing environments. Design and management issues including information systems in an automated and integrated manufacturing environment.
Prerequisite(s): IMSE 317
Restriction(s):
Can enroll if Class is Graduate

IMSE 543   Industrial Ergonomics   3 Credit Hours
Effective ergonomic interventions in industrial environment enhance productivity, safety and job satisfaction. This course introduces engineers and engineering students how to apply ergonomic principles in designing industrial and manufacturing operations in which people play a significant role, so that human capabilities are maximized, physical fatigue is minimized, and performance is optimized. Case studies and topics emphasize industrial applications. (OC).
Prerequisite(s): IMSE 4425
Restriction(s):
Can enroll if Class is Graduate

IMSE 544   Industrial Biomechanics   3 Credit Hours
This course introduces the mechanical behavior of the musculoskeletal systems as related to physical work activities. Fundamentals of human body mechanics (Kinetic and Kinematic aspects of locomotion, body link systems, muscle strength and performance), muscle fatigue and musculoskeletal injury mechanism are covered with application to design of physical work activities and equipment. (OC).
Prerequisite(s): IMSE 4425
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 545   Vehicle Ergonomics I   3 Credit Hours
Overview of drive characteristics, capabilities, and limitations. Human variability and driver demographics, driver performance measurements. Driver information processing models, driver errors and response time. Driver sensory capabilities: vision, audition, and other inputs. Vehicle controls and displays. Driver anthropometry, biomechanical considerations.
Restriction(s):
Cannot enroll if Class is
Can enroll if Level is Rackham or Graduate
Can enroll if College is Engineering and Computer Science

IMSE 546   Safety Engineering   3 Credit Hours
Safety requirements for production processes, equipment, and plants; organization and administration of safety programs, current safety laws, current occupational safety research.
Restriction(s):
Can enroll if Level is Graduate

IMSE 548   Res.Meth.Human Fctrs/Ergonomic   3 Credit Hours
Full Course Titile: Research Methods in Human Factors and Erogonomics -This course covers principals and guidelines of Human Factors and Ergonomics (HFE) practices applied to complex human machine systems. The emphasis is on understanding advanced HFE assessment and surveillance methods in describing and quantifying human-machine-environment interaction. Key topics include, human modeling and simulation, information processing and related motor behavior, and egronomics design and evaluation tools. (W).
Prerequisite(s): IMSE 4425 or IMSE 501

IMSE 549   Product Design and Evaluation   3 Credit Hours
Design approaches and processes used in developing customer/user-oriented products. Study of widely used product evaluation techniques: methods of observation, communication and experimentation; subjective (e.g., psychological scaling) and objective measurement methods. Review of product design and evaluation case studies. Laboratory projects to evaluate several products. (OC).
Restriction(s):
Can enroll if Level is Graduate

IMSE 550   Data Management   3 Credit Hours
Topics in computer organization; principle data structures (stacks, trees, linked lists) and their use; searching and sorting; algorithm specification, and recursion. Programming assignments will deal with applications of these subjects.

IMSE 551   Compiler Construction   3 Credit Hours
The design and construction of compilers and programming systems. Lexical scan; parsing techniques; code generation and optimization; storage allocation. Applications of formal language theory in compiler design. Translator writing systems; XPL.
Prerequisite(s): IMSE 550

IMSE 552   Design/Analysis of Algorithms   3 Credit Hours
Design, evaluation, and communication of algorithms for solving problems using a digital computer. Topics include problem-solving approaches, algorithm notation, determination of algorithm correctness, measures of efficiency, improvement of algorithms. Examples and homework in designing algorithms for data processing, scheduling, combinatorial optimization, and elementary computer graphics, and numerical analysis.
Prerequisite(s): IMSE 550

IMSE 553   Software Engineering   3 Credit Hours
Program design methodologies; control flow and data flow in programs; program measurement. Software life cycle; large program design, development, testing, and maintenance. Software reliability and fault tolerance. Evolution dynamics of software.
Restriction(s):
Can enroll if Level is Rackham or Graduate or Doctorate or
Can enroll if College is Engineering and Computer Science
Can enroll if Major is Software Engineering, Computer & Information Science, Info Systems and Technology,

IMSE 555   Decision Support/Expert Sys   3 Credit Hours
Decision support process and decision support systems, development tools, executive support systems, expert systems and their development processes, expert shells, integration of decision support and expert systems.
Prerequisite(s): IMSE 350

IMSE 556   Database Systems   3 Credit Hours
Introduction to database system concepts and techniques. Topics covered include: database environment, ER model, relational data model, object-oriented databases, object-relational databases, database design theory and methodology, database languages, query processing and optimization, concurrency control, database recovery, and database security. No credit given to both CIS 421 and CIS 556.
Restriction(s):
Cannot enroll if Class is
Can enroll if Level is Rackham or Graduate or Doctorate or
Can enroll if Major is Software Engineering, Info Systems and Technology, , Computer & Information Science

IMSE 5585   Electronic Commerce   3 Credit Hours
This course examines how new information technologies and networks affect the exchange of goods and services between buyers and sellers in firms. What are economics of different electronic commerce models for firms? The course combines critical evaluation of business strategies with hands-on experience in building supporting electronic commerce systems utilizing electronic data interchange (EDI) software. (YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 559   System Simulation   3 Credit Hours
The modeling and simulation of discrete-change, continuous-change and combined-change stochastic systems. Conducting simulation studies using contemporary software such as SLAM II or random number generation, distribution sampling, and output analysis. Comparisons with analytical queuing models.
Prerequisite(s): IMSE 510

IMSE 561   Tot Qual Mgmt and Six Sigma   3 Credit Hours
This course covers implementing Total Quality Management (TQM), undertaking Six Sigma Projects, and applying Baldrige National Quality Award criteria and ISO 9000 principles to improve quality performances in an organization. Topics include Definitions and Importance of Quality, Quality Costs, Quality Function Deployment (QFD), Product Specification and Critical-to-quality Measures (CQM), Statistical Quality Control (SQC), Robustness Concepts, Quality System Design and Evaluation. Six Sigma and DMAIC Methodologies, Design for Six Sigma (DFSS) process, IDOV (Identity requirements, Design alternatives, Optimize the design and Verify process capability) Methodology, and several other concepts and tools related to quality are also covered.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Graduate

IMSE 564   Applied Data Analytics and Modeling for Enterprise Systems   3 Credit Hours
This course explores the theory, practice and application of data analytics to consolidate, arrange, analyze and model vast amount of data for organizations which supports forecasting and prediction of future events. In-depth studies and hands on exercises will be covered in Data Warehousing, Business Intelligence for ERP systems, Data Mining, Predictive Analysis, Provisioning and Modeling of In-memory Analytics system. Various software tools, such as SAP HANA Cloud Analytics, Lumira and Modeling Software, will be introduced and used in this class. (W).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5655   Supply Chain Management   3 Credit Hours
This course will address theories, concepts, models, methodologies and techniques for managing a supply chain. Topics include supply chain strategy, drivers and metrics of performance, designing global and regional supply chain networks using optimization models, planning demand and supply in a supply chain using forecasting, aggregate planning, and inventory optimization models, designing the transportation systems, pricing, and employing IT systems effectively in supply chains.
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 567   Reliability Analysis   3 Credit Hours
Statistics of reliability and life testing. Application of stochastic models for failure based on Poisson and related processes. Use of exponential and extreme value distribution in reliability. Use of Markov process in the areas of equipment reliability, maintenance and availability.
Prerequisite(s): IMSE 510

IMSE 569   Sys Simulation in Auto Engin   3 Credit Hours
The modeling and simulation of discrete, continuous and combined change stochastic systems. Conducting simulation studies using contemporary software such as ARENA and WITNESS. Topics in simulation methodology include random number generation, distribution sampling, input and output analysis. Integration techniques for continuous simulation, application to design of manufacturing and automotive systems.
Prerequisite(s): IMSE 510

IMSE 570   Enterprise Information Systems   3 Credit Hours
The purpose of this course is to provide a foundation for the analysis, design and implementation of enterprise information systems. Topics include systems and organization theories, and information systems planning and evaluation. Students will be also introduced to various systems development life cycle phases of an enterprise information system. Students will acquire an understanding of the flow of information (forecasts, financial, accounting and operational data) within an enterprise and the factors that should be considered in designing an integrated enterprise information system. This includes all systems in the business cycle from revenue forecasts, production planning, inventory management, logistics, manufacturing, accounts payable, sales, accounts receivable, payroll, general ledger and report generation. Specifications for some of these systems will be developed utilizing ERP software such as SAP R/3 application development software suite. (F, W).
Restriction(s):
Cannot enroll if Class is

IMSE 5715   Modeling of Int Info Syst   3 Credit Hours
A review of approaches for modeling of integrated information systems. ARIS architecture. Data, control, function, and organization views of an information system.Requirements definition, design specification, and implementation definition of the different views. Process chain diagrams. Management of ERP projects. (YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5725   Object Oriented System Design   3 Credit Hours
Students will be introduced to fundamental concepts and methods of object oriented design and development. Topics that will be covered include object oriented database concepts, data models, schema design (conceptual schemas and physical schemas), query languages, physical storage of objects and indexes on objects, version management, schema evolution and systems issues such as concurrent control and recovery from failure. For application programming, a programming language such as C++ will be used for database design and query language. (YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5755   Bus Proc Int using Entrpr Tech   3 Credit Hours
Full Title: Business Process Integration using Enterprise Technology
This course introduces the concept of integration, optimization and
configuration of strategic business processes across the enterprise using
ERP software technology. Use cases and specifications for some of these
systems are introduced in different functional areas, such as Finance,
Human Capital Management, Logistics, and Project Systems utilizing
ERP software. (F)
Restriction(s):
Can enroll if Level is Rackham or Graduate

IMSE 577   Human-Computer Interaction   3 Credit Hours
Full Course Title: Human-Computer Interaction for UI and UX Design -This
course introduces current theory and design techniques concerning how
user interfaces (UI) and user experience (UX) should be designed and
assessed to be easy to learn and use. Course includes flowing general
modules introduction of HCI & UX; Interface/Interaction design strategy;
Advanced Issues in HCI; and Evaluation methods. (W).
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Doctorate or Rackham or Graduate or

IMSE 580   Prod & Oper Engineering I   3 Credit Hours
Production and operations management techniques including
forecasting, inventory control, MRP, detailed scheduling, aggregate
planning, process variability and its effects on throughput and inventory,
factory physics principles, and lean methods.
Prerequisite(s): EMGT 505
Restriction(s):
Can enroll if Level is Rackham or Graduate

IMSE 581   Prod & Oper Engineering II   3 Credit Hours
This course addresses the advanced theory and techniques of production
and inventory systems. Topics include advanced forecasting methods,
production scheduling and lot-sizing, stochastic single-and multi-item
inventory systems, and service operations. This course also includes
discussions of research articles on production and inventory systems.
Prerequisite(s): IMSE 580 or EMGT 520

IMSE 5825   Industrial Controls   3 Credit Hours
This course introduces the principle aspects of computers and their
applications in systems control, principles of automation, with emphasis
on manufacturing industries. Discussion on the hardware and software
associated with this task and other topics such as integrated systems
modeling, sensor technologies, digital and analog signal processing and
control, and information communication are also included. Laboratory
exercises and projects are required. Credit cannot be given for both IMSE
482 and IMSE 5825. This class may be scheduled at the same time as the
undergraduate course IMSE 482. Graduate students will be required to do
additional research paper and/or project.
Prerequisite(s): ECE 305
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 584   Logistical Systems   3 Credit Hours
Introduction to concepts of physical distribution and logistics
management. Quantitative treatment of topics in materials management,
transportation, forecasting, warehouse location. Logistical system
design techniques which synthesize the above topics in order to design a
fundamental system.
Prerequisite(s): IMSE 580

IMSE 585   Material Handling Systems   3 Credit Hours
Studies of material handling methods and equipment, study of
techniques used in the analysis and design of material handling systems,
study of storage and warehousing systems.
Prerequisite(s): IMSE 500

IMSE 586   Big Data Aanal & Visuliztn   3 Credit Hours
Introduction to big data analytics and visualization. This course provides
students with hands-on experience of using analytical and predictive
modeling techniques and software for practical applications. Topics
include data visualization principles and techniques, data processing and
manipulation, and statistical learning methods such as linear regression,
classification, model selection, clustering, principal components analysis,
and time-series analysis. (F).
Prerequisite(s): IMSE 510
Corequisite(s): IMSE 510

IMSE 587   Facilities Planning   3 Credit Hours
Analysis, planning and design of physical facilities utilizing operations
research, engineering and economic principles. Synthesis of physical
plant equipment and man into an integrated system for either service or
manufacturing activities. Design of material handling systems. Students
are required to select problems of interest and present design project
reports. Credit may not be given for both IMSE 474 and IMSE 587. This
class may be scheduled at the same time as the undergraduate course
IMSE 474. Graduate students will be required to do additional research
paper and/or project.
Prerequisite(s): IMSE 500

IMSE 588   Bldg High Perf Learning Org   3 Credit Hours
The purpose of this course is to develop students' knowledge and skills to
explore and experience how the disciplines of systems thinking, personal
mastery, mental models, team learning and shared vision impact on
organizational learning and influence management practices for building
highly performing organizations.

IMSE 590   Grad Study in Sel Topics I   1 to 3 Credit Hours
Individual or group of selected topics in industrial and systems
engineering.
Restriction(s):
Can enroll if Class is Graduate

IMSE 591   Grad Study in Sel Topics II   1 to 3 Credit Hours
Continuation of IMSE 590.
Restriction(s):
Can enroll if Class is Graduate

IMSE 593   Vehicle Package Engineering   3 Credit Hours
Vehicle package specifications related to exterior and interior design
reference points, dimensions and curb loadings. Benchmarking package
studies, ergonomic tools and design practices used in the automobile
industry. Driver positioning considerations; seat height, heel points,
hip points, steering wheel location, seat pan, and back angles. Pedal
design issues, gear shift positioning. Visibility of instrument panel
space. Armrest and console design considerations. Principles and
considerations in selecting and location types and characteristics
of controls and displays on instrument panels, doors, consoles, and
headers. Engine compartment packaging issues. Perception of interior
spaciousness and visibility of the road over cowl and hood. (F).
Restriction(s):
Can enroll if Class is Graduate

IMSE 600   Research in IMSE   1 to 3 Credit Hours
Individual or group study or research in a field of interest to the student. Topics may be chosen from any of the areas of industrial and systems engineering. The student will submit a project report and give an oral presentation at the close of the term.
Restriction(s):
Can enroll if Class is Graduate

IMSE 605   Advanced Optimization   3 Credit Hours
This course will cover selected advanced optimization methods for engineering disciplines and information systems. Topics include nonlinear programming, network optimization, dynamic programming and optimal control. Theories related to optimality and convergence, population-based optimization, etc. will be covered. Students will be expected to write computer program code to implement optimization methodologies.
Prerequisite(s): IMSE 500
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Doctorate or Rackham or Graduate or

IMSE 606   Advanced Stochastic Processes   3 Credit Hours
This course introduces the theory and applications of discrete and continuous stochastic processes and models. The topics include Poisson process, renewal theory, discrete-time and continuous-time Markov chains, martingales, random walks, and Brownian motion. Other Markov processes with applications to queuing, simulation, and operations research in manufacturing and service systems will also be covered.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Doctorate or Rackham or Graduate or
Can enroll if College is Engineering and Computer Science

IMSE 610   Adv Top Enterprise Info Sys   3 Credit Hours
This course introduces advanced topics in the development, management and improvement of information systems in the context of supporting large enterprises. It covers emerging issues and solutions in modeling, IT infrastructure and technologies, critical enterprise functions, knowledge engineering, security and governance of enterprise information systems. It focuses on the changing requirements posed by the dynamics of their residing environment and information technology.
Prerequisite(s): IMSE 5715
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Doctorate or Rackham or Graduate or

IMSE 699   Master's Thesis Project   1 to 6 Credit Hours
Graduate students electing this course, while working under the general supervision of a member of the department faculty, are expected to plan and conduct the work themselves, to submit a thesis for review and approval, and to present an oral defense of the thesis.
Restriction(s):
Can enroll if Class is Graduate

IMSE 791   Advanced Guided Study for Doctoral Students   1 to 6 Credit Hours
Independent study and research work on the material related to the doctoral research project under the guidance of the faculty advisor. The course is for doctoral students who have not completed the PhD program's coursework requirements. A report and an oral presentation are required. (F, W, S).

IMSE 980   Ph.D. diss research precand   1 to 9 Credit Hours
Full Title: Ph.D. dissertation research pre-candidate Dissertation research by a pre-candidate student of the Ph.D. in Industrial and Systems Engineering (I&SE) Program conducted under guidance of the faculty advisor. The credits earned in this dissertation research course count towards (fulfil) 24 credit hours of dissertation research requirements of the Ph.D. I&SE program. (F,W,S)
Restriction(s):
Can enroll if Level is Doctorate or
Can enroll if Major is Industrial & Systems Engin

IMSE 990   PHD Dis Research Cand   1 to 12 Credit Hours
Full Title: Ph.D. dissertation research candidate Dissertation research by a candidate student of the Ph.D. in Industrial and Systems Engineering Program conducted under guidance of the faculty advisor. (F,W,S)
Restriction(s):
Can enroll if Level is Doctorate or
Can enroll if Major is Industrial & Systems Engin

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally