Industrial & Manufacturing Engineering (IME)

Courses numbered 100 to 299 = lower-division; 300 to 499 = upper-division; 500 to 799 = undergraduate/graduate.

IME 150. Workshop in Industrial and Manufacturing Engineering 1-3 credit hours
Offered from time to time on various topics in industrial or manufacturing engineering.

IME 222. Engineering Graphics 2 credit hours
Provides an opportunity for the undergraduate student to learn the basics of engineering graphics using a suitable CAD software. Includes the practice of using a CAD software to understand and produce basic spatial relationships involving orthographic projections, auxiliary views, sectional views, pictorial projections, dimensioning, tolerancing, working drawings are also included. Prerequisite: MATH 123. Corequisite: IME 222L or equivalent.

IME 222L. Graphics Lab 1 credit hour
3 Lab hours. Provides an opportunity for students to reinforce the basics of engineering graphics using a suitable CAD software. Includes the practice of using a CAD software to understand and produce basic spatial relationships involving orthographic projections, auxiliary views, sectional views, pictorial projections, dimensioning, tolerancing, working drawings, 3D assembly and implementing these on a suitable CAD software. Prerequisite: MATH 123. Corequisite: IME 222 or equivalent.

IME 250. Topics in Engineering Graphics 2 credit hours
The application of engineering graphics to the study of special problems and to methods of conveying information. Prerequisite: IME 222.

IME 254. Engineering Probability and Statistics I 3 credit hours
Studies the concepts of probability theory, random variables, distributions, moments, sample statistics and hypothesis testing. Prerequisite: MATH 243 or 252.

IME 255. Engineering Economy 3 credit hours
Economic comparisons of engineering alternatives considering the time value of money, taxes and depreciation; accounting and its relationship to economic analysis; replacement decisions. Corequisite: MATH 242 or 251.

IME 258. Manufacturing Methods and Materials I 3 credit hours
2 Classroom hours; 2 Lab hours. Provides a basic understanding of materials and processes used to manufacture products. Some of the major manufacturing processes covered include metal machining, metal forming, extrusion, casting, joining and plastics forming. Emphasizes the use of materials, sciences and mathematics to understand the behavior of materials undergoing the manufacturing process. Includes an introduction to process planning. Students gain an extensive hands-on experience in different manufacturing processes and in teamwork. Prerequisite: MATH 123.

IME 281P. Cooperative Education 1 credit hour
Introduces the student to engineering practice by working in industry in an engineering-related job and provides a planned professional experience designed to complement and enhance the student's academic program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Students must enroll concurrently in a minimum of 6 hours of coursework including this course in addition to a minimum of 20 hours per week at their co-op assignment. May be repeated. Graded Cr/NCr. Prerequisites: successful completion of 20 hours toward an engineering degree and approval by appropriate faculty sponsor.

IME 361. Industrial Controls and Instrumentation 4 credit hours
3 Classroom hours; 2 Lab hours. Cross-listed as ENGT 361. Introduces the principles of measurement and data acquisition, transmission and application in industrial and commercial systems. The theory and application of electronic programmable devices such as programmable logic controllers, temperature controllers, counters, etc., Ladder logic and input/output devices are emphasized. Laboratory exercises include loop wiring, calibration, controller configuration and troubleshooting. Prerequisite: ENGT 320 or EE 282.

IME 410. Robotics Technology 3 credit hours
2 Classroom hours; 3 Lab hours. Cross-listed as ENGT 410. Examines systems using robotics in technology. Provides the fundamentals of manipulators, sensors, actuator, end-effectors, and product design for automation. Includes kinematics, controls, programming of manipulator, and simulation. Also covers artificial intelligence. Prerequisite: IME 361 or ENGT 361, or instructor's consent.

IME 411. Microcomputer-Based Mechanical Systems Technologies 3 credit hours
2 Classroom hours; 3 Lab hours. Cross-listed as ENGT 411. Focuses on microcomputer-based real-time control of mechanical systems technologies. Familiarizes students with software methodologies used for real-time control. Includes laboratory sessions involving interfacing microcomputers to mechanical systems. Prerequisites: both ENGT 361 and 410; or instructor's approval.

IME 452. Work Systems 3 credit hours
The documentation, measurement and design of work systems. Includes work measurement systems, methods engineering, work sampling, predetermined time systems and economic justification. Prerequisite: IME 254. Corequisite: IME 255.

IME 480. Selected Topics in Industrial Engineering 1-3 credit hours
New or special course material presented upon sufficient student demand. Repeatable for credit. Prerequisite: departmental consent.

IME 481A. Cooperative Education 1 credit hour
Introduces the student to professional practice by working in industry in an academically-related job and provides a planned professional experience designed to complement and enhance the student's academic program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Intended for students who will be working full time on their co-op assignment and need not be enrolled in any other course. Graded Cr/NCr unless student has received permission before enrolling for course to be used as an elective. May be repeated. Prerequisites: junior standing and approval by the appropriate faculty sponsor.

IME 481I. Noncredit Internship 0 credit hours
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite: departmental consent.

IME 481N. Internship 1 credit hour
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Graded Cr/NCr. Prerequisite: departmental consent.

IME 481P. Cooperative Education 1 credit hour
Introduces the student to engineering practice by working in industry in an engineering-related job and provides a planned professional experience designed to complement and enhance the student's academic program.
program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Students must enroll concurrently in a minimum of 6 hours of coursework including this course in addition to a minimum of 20 hours per week at their co-op assignment. May be repeated. Graded Cr/NCr. Prerequisites: junior standing and approval by appropriate faculty sponsor.

**IME 490. Independent Study 1-3 credit hours**
Arranged individual independent study in specialized areas of industrial engineering under the supervision of a faculty member. May be repeated for credit. Prerequisite: instructor's consent.

**IME 524. Engineering Probability and Statistics II 3 credit hours**
A study of confidence interval, regression analysis, analysis of variance, correlation analysis and design of experiments emphasizing applications to engineering. Prerequisite: IME 254.

**IME 549. Industrial Ergonomics 3 credit hours**
A systematic approach to the optimization of the human-task-environment system. Includes work space design, manual materials handling, work related musculoskeletal disorders and environmental factors. Emphasizes applications in industry. Prerequisite: IME 254 or departmental consent.

**IME 550. Operations Research 3 credit hours**
Models and methods in operations research. Linear and quadratic programming. Network models and algorithms. Integer, dynamic and nonlinear programming. Unconstrained and constrained optimization. Prerequisite: IME 254 or departmental consent.

**IME 553. Production Systems 3 credit hours**
Quantitative techniques used in the analysis and control of production systems. Includes forecasting, inventory models, operation planning and scheduling. Prerequisite: IME 254. Corequisite: IME 255.

**IME 554. Statistical Quality Control 3 credit hours**
A study of the measurement and control of product quality using statistical methods. Includes acceptance sampling, statistical process control and total quality management. Corequisite: IME 524.

**IME 556. Information Systems 3 credit hours**
Provides a basic understanding of information systems in a modern enterprise, including database design, information technology and ethics using hands-on activities and directed classroom discussion. Prerequisite: CS 211 or MIS 310.

**IME 557. Safety Engineering 3 credit hours**

**IME 558. Manufacturing Methods and Materials II 4 credit hours**
3 Classroom hours; 2 Lab hours. Covers theoretical and practical aspects of manufacturing processes, including material properties and behavior as influenced by the manufacturing process. In-depth study of such manufacturing processes as casting heat treatment, bulk forming, sheet metal forming, metal cutting, nontraditional machining and process monitoring through measurement of manufacturing process variables. Also includes laboratory experience and plant tours. Prerequisites: IME 258, ME 250.

**IME 563. Facilities Planning and Design 3 credit hours**
Quantitative and qualitative approaches to problems in facilities planning and design, emphasizing activity relationships, space requirements, materials handling and storage, and plant layout. Quantitative and qualitative approaches to selection of material handling devices and design of storage systems, and introduction to concepts of supply chain. Prerequisites: IME 452, 550, 553.

**IME 565. Systems Simulation 3 credit hours**
The design of simulation models and techniques for use in designing and evaluating discrete systems, including manufacturing systems too complex to be solved analytically. Emphasizes general purpose computer simulation languages. Prerequisite: computer programming competency. Corequisites: IME 553, 524.

**IME 590. Industrial Engineering Design I 3 credit hours**
An industry-based team design project using industrial engineering and manufacturing engineering principles; performed under faculty supervision. May not be counted toward graduate credit. Prerequisites: IME 553; must be within two semesters of graduation or departmental consent.

**IME 658. Forming Processes 3 credit hours**
Introduction to the fundamentals of deformation and techniques for analysis of forming processes. Application to various bulk forming and sheet metal forming processes. Introduction to applied nonlinear finite element analysis and its application for analysis and design of forming processes. Prerequisite: AE 333.

**IME 664. Engineering Management 3 credit hours**
Cross-listed as ENGT 664. Introduction to the design and control of technologically-based projects. Considers both the theoretical and practical aspects of systems models, organizational development, project planning and control, resource allocation, team development and personal skill assessment. Prerequisites: IME 254, 255.

**IME 676. Aircraft Manufacturing and Assembly 3 credit hours**
Covers key aspects of assembly design for aircraft structures. First module covers design of jigs and fixtures to locate parts and machine features to tolerance, and the effect of part and tool stiffness on the tolerances. Second module covers gage design and gage studies, and geometric dimensioning and tolerancing. Third module covers assembly planning and best practices for aircraft assembly. Laboratory experiments and case studies are used to understand issues related to aircraft assembly. Prerequisite: IME 258.

**IME 690. Industrial Engineering Design II 3 credit hours**
Continuation of the design project initiated in IME 590 or the performance of a second industrial engineering design project; an industry-based team design project using industrial and manufacturing engineering principles; performed under faculty supervision. May not be counted toward graduate credit. Prerequisites: IME 590 and departmental consent.

**IME 724. Statistical Methods for Engineers 3 credit hours**
For graduate students majoring in engineering. Students study and model real-life engineering problems and draw reliable conclusions through applications of probability theory and statistical techniques. Not available for undergraduate credit. Prerequisite: MATH 243.

**IME 731. Foundations of Optimization 3 credit hours**
An extensive treatment of the theories and concepts of linear, nonlinear, constrained and unconstrained optimization techniques. Prerequisite: IME 550.

**IME 740. Analysis of Decision Processes 3 credit hours**
Decision analysis as it applies to capital equipment selection and replacement, process design and policy development. Explicit consideration of risk, uncertainty and multiple attributes is developed and applied using modern computer-aided analysis techniques. Prerequisites: IME 254, 255.

**IME 749. Ergonomic Assessment Methods 3 credit hours**
Covers current and commonly used risk and exposure assessment methods used for musculoskeletal disorders in the workplace. Students develop an understanding and working knowledge of how to evaluate and control the risk of work-related musculoskeletal disorders in the
design of workplaces. Critical assessments and discussions of risk and exposure assessment techniques are performed relative to the strengths and weaknesses of each technique as well as the evidence for risk control and validity of the various methods. Prerequisite: IME 549 or instructor's consent.

IME 753. Advanced Linear Programming 3 credit hours
Linear and integer programming formulations, simplex method, geometry of the simplex method, sensitivity and duality, interior point methods. Prerequisite: IME 550 or instructor's consent.

IME 754. Reliability and Maintainability Engineering 3 credit hours
Studies problems of quantifying, assessing and verifying reliability. Presents various factors that determine the capabilities of components emphasizing practical applications. Examples and problems cover a broad range of engineering fields. Prerequisite: IME 524 or 724.

IME 755. Design of Experiments 3 credit hours
Application of analysis of variance and experimental design for engineering studies. Includes general design methodology, single-factor designs, randomized blocks, factorial designs, fractional replication and confounding. Prerequisite: IME 524 or 724.

IME 758. Analysis of Manufacturing Processes 3 credit hours
Introduces students to plasticity and builds upon their knowledge of mechanics and heat transfer in order to analyze various manufacturing processes. Numerical techniques (mainly finite element analysis) as well as theoretical methods are introduced and applied to analysis of processes such as open and closed die forging, superplastic forming, machining, grinding, laser welding, etc. The effect of friction, material properties and process parameters on the mechanics of the processes and process outputs is the main focus of study. Prerequisite: IME 524 or 724.

IME 759. Ergonomic Interventions 3 credit hours
Provides an understanding and working knowledge of how to evaluate and control the risk of musculoskeletal disorders in the design of workplaces and processes. Scientific aspects of intervention design and effectiveness assessment are discussed, including an assessment of the strengths and weaknesses of the intervention research literature. Prerequisite: IME 549 or instructor's consent.

IME 760. Ergonomics Topics 3 credit hours
New or special courses on topics in ergonomics and human factors engineering. May be repeated for different topics. Prerequisite: departmental consent.

IME 764. Systems Engineering and Analysis 3 credit hours
Presentation of system design process from the identification of a need through conceptual design, preliminary design, detail design and development, and system test and evaluation. Studies operational feasibility, reliability, maintainability, supportability and economic feasibility. Prerequisites: IME 254, 255.

IME 767. Lean Manufacturing 3 credit hours
Introduces lean concepts as applied to the manufacturing environment. Deals with the concepts of value, value stream, flow, pull and perfection. Includes waste identification, value stream mapping, visual controls and lean metrics. Prerequisite: IME 553.

IME 768. Metal Machining: Theory and Applications 3 credit hours
Provides basic understanding of the various conventional metal machining processes and the nature of various phenomena that occur in it. Includes fundamental treatments of the mechanics of chip formation under orthogonal and oblique conditions, temperatures in machining, tool materials, tool wear, surface roughness, numerical and mechanistic modeling methods, and discusses current research trends and possible future developments. Prerequisite: AE 333 or ME 250.

IME 775. Computer Integrated Manufacturing 3 credit hours
A study of the concepts, components and technologies of CIM systems; enterprise modeling for CIM, local area networks, CAD/CAM interfaces, information flow for CIM, shop floor control and justification of CIM systems. Prerequisites: knowledge of a programming language, IME 558.

IME 777. IME Colloquium 0 credit hours
Presentations and discussions of industrial engineering problems, research methods, and case analyses for graduate students. Repeatable for credit. Graded S/U.

IME 778. Machining of Composites 3 credit hours
Introduction to a wide range of machining processes used in the secondary manufacturing of composites, focusing on scientific and engineering developments affecting the present and future of composites manufacturing. Major traditional and nontraditional machining processes are discussed. The effect of process parameters, material parameters and system parameters on the material removal rate and the quality of the machined part are also discussed. Emphasis is given to the application of nontraditional machining processes in the manufacture of fiber-reinforced polymers used in the aerospace and aviation industries. Students learn the advantages and disadvantages of each machining process and how to select the most appropriate process for different materials and geometries. Prerequisite: AE 333 or instructor's approval.

IME 780. Topics in Industrial Engineering 3 credit hours
New or special courses are presented under this listing. Repeatable for credit when subject matter warrants.

IME 781. Cooperative Education 1-8 credit hours
A work-related placement with a supervised professional experience to complement and enhance the student's academic program. Intended for master's level or doctoral students in IME. Repeatable for credit. May not be used to satisfy degree requirements. Graded Cr/NCr. Prerequisites: departmental consent, graduate GPA of 3.000 or above.

IME 781P. Cooperative Education 1 credit hour
Introduces the student to professional practice by working in industry in an academically-related job and provides a planned professional experience designed to complement and enhance the student's academic program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Students must enroll concurrently in a minimum of 6 hours of coursework including this course in addition to a minimum of 20 hours per week at their co-op assignment. Graded Cr/NCr unless student has received permission before enrolling for course to be used as an elective. May be repeated. For graduate students.

IME 783. Supply Chain Management 3 credit hours
Quantitative and qualitative techniques used in the design and management of the supply chain. Includes distribution management, multi-plant coordination, optimal design of the logistics network, adequate safety stock levels and the risk pooling concept, and integrating decision support systems (DDS) in the management of the supply chain. Prerequisite: IME 553.