

## Industrial and Manufacturing Engineering (IME) Courses for Graduate/Undergraduate Credit

IME 524. Engineering Probability and Statistics II (3). A study of hypothesis testing, regression analysis, analysis of variance, correlation analysis, and design of experiments emphasizing applications to engineering. Prerequisite: IME 254.

IME 549. Industrial Ergonomics (3). A systematic approach to the optimization of the human-task-environment system. Includes work space design, manual materials handling, cumulative trauma disorders, and environmental factors. Emphasizes applications in industry. Corequisite: IME 524 or departmental consent.

IME 550. Operations Research (3). Models and methods in operations research. Linear and quadratic programming. Network models and algorithms. Integer, dynamic, and nonlinear programming. Unconstrained and constrained optimization. Prerequisite: MATH 511. Corequisite: IME 254.

IME 553. Production Systems (3). 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). 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). 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. Prerequisites: IME 452 and CS 211 or MIS 310.

IME 557. Safety Engineering (3). Environmental aspects of accident prevention, industrial compensation, and safety legislation. Fundamental concepts of occupational health and hygiene. Prerequisite: IME 254

IME 558. Manufacturing Methods and Materials II (4). 3R; 3L. 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 and ME 250.

IME 563. Facilities Planning and Design (2). Quantitative and qualitative approaches to problems in facilities planning and design, emphasizing activity relationships, space requirements, materials handling and storage, and plant layout. Prerequisites: IME 258, 452, 550.

IME 565. Systems Simulation (3). 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. Prerequisites: IME 553 and CS 211 or MIS 310. Corequisite: IME 524.

IME 576. Composites Manufacturing (3). 2R, 3L. Introduction to composite materials, the various manufacturing methods used in the aerospace industry and prevalent quality assurance methods. Students are introduced to inspection, damage control and repair techniques as well as material handling, safety and environmental requirements. Course contains laboratory modules designed to provide hands-on experience to emphasize the practical aspects of the topics covered. Prerequisites: AE 333 or instructor's consent.

IME 590. Industrial Engineering Design I (3). 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: must be within one year of graduation and departmental consent.

IME 658. Forming Processes (3). 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). 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 and 255.

IME 676. Aircraft Manufacturing and Assembly (3). 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). Continuation of the design experience of IME 590 in the performance of a second industry-based design project. May not be counted toward a graduate industrial engineering major. Prerequisites: IME 590 and departmental consent.

IME 724. Statistical Methods for Engineers (3). 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). 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). 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 and 255.

IME 749. Advanced Ergonomics (3). A continuation of IME 549. Includes principles and application of human factors to the design of the workplace, displays, control systems, hand tools, and video display terminals. Prerequisite: IME 549.

IME 750. Industrial Engineering Workshops (1–4). Various topics in industrial engineering. Prerequisite: departmental consent.

IME 754. Reliability and Maintainability Engineering (3). 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). 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). 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: AE 333.

IME 760. Ergonomics Topics (3). 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). 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). 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). 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, and 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). 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 778. Machining of Composites. (3). 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 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 materials and geometries. Prerequisites: AE 333, IME 578, or instructor's approval.

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

IME 781. Cooperative Education (1–8). 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. Prerequisite: departmental consent and graduate GPA of 3.000 or above. *Cr/NCr* only.

IME 783. Supply Chain Management (3). 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.

IME 785. Tolerancing in Design and Manufacturing (3). Provides a basic understanding of the theory and application of tolerancing in design, manufacturing, and inspection. Reviews current literature in the area of tolerancing and inspection. Includes detailed discussion of the ASME standards on geometric dimensioning and tolerancing (GD&T), GD&T verification procedures, tolerance analysis and allocation, statistical tolerancing, and Taguchi's approach to tolerancing. Prerequisite: IME 254 or instructor's consent.

## **Courses for Graduate Students Only**

IME 825. Enterprise Engineering (3). How to design and improve all elements associated with the total enterprise through the use of engineering and analysis methods and tools to more effectively achieve its goals and objectives. Deals with the analysis, design, implementation and operation of all elements associated with an enterprise. Includes business process re-engineering, graphical enterprise modeling tools and architectures, and enterprise transformation. Prerequisite: IME 553.

IME 835. Applied Forecasting Methods (3). A study of forecasting methods, including smoothing techniques, time series analysis, and Box-Jenkins models. Prerequisite: IME 524.

IME 854. Quality Engineering (3). A broad view of quality tools and their integration into a comprehensive quality management and improvement system. Covers the theory and approaches of the major quality leaders such as Deming, Juran, and Crosby. Explores off-line and online quality engineering techniques, including cost of quality, the seven "old" and seven "new" tools, Quality Function Deployment, and statistical process control methods. Explores design of engineering experiments, including Taguchi's methods. Prerequisite: IME 524.

IME 858. Nonlinear Finite Element Analysis of Metal Forming (3). Introduces the use of an LS-DYNA software package for metal forming simulations and discusses the theoretical foundation necessary to understand the physics and mechanics behind some of the options that need to be used to ensure solution accuracy in FEA of metal forming. Prerequisite: AE 722 or ME 650K or IME 780K.

IME 864. Risk Analysis (3). Provides a set of methods that have been widely used to evaluate and void the risk of technological systems and devices in engineering applications. The methods introduced are multidisciplinary in terms of the scope of the methodology and the concepts that are being applied in many industries. Students are expected to have an engineering background and the capability of using statistics and operations research tools. Prerequisites: IME 724, or 754, or instructor's consent

IME 865. Modeling and Analysis of Discrete Systems (3). Discusses analytical and experimental techniques for the modeling and analysis of discrete systems in general and manufacturing systems in particular. Students use techniques such as simulation, Markov Chains, Queuing Theory, and Petri Nets to model manufacturing systems problems. Students investigate issues related to the modeling and analysis of manufacturing systems through readings, lectures and projects. Prerequisite: IME 553 or instructor's consent.

IME 875. System Dynamics (3). Introduction to, and overview of, system dynamics, using business and engineering examples. Topics include: systems thinking, structure and behaviors of dynamic systems, causal loop diagrams, stocks and flows, dynamics of stocks and flows, dynamics of growth, modeling dynamic systems including

instability and oscillations, model testing, and use of software for model development and testing. Prerequisite: instructor's consent.

IME 876. Thesis (1–6). Repeatable for credit. Graded *S/U* only. Prerequisite: consent of thesis adviser.

IME 877. Foundations of Neural Networks (3). For students from a variety of disciplines. Introduces the theory and practical applications of artificial neural networks. Covers several network paradigms, emphasizing the use of neural networks as a solution tool for industrial problems which require pattern recognition, predictive and interpretive models, pattern classification, optimization, and clustering. Presents examples and discusses them from a variety of areas including quality control, process monitoring and control, robotics control, simulation/metamodeling, economic analysis models, diagnostic models, combinatorial optimization, and machine vision.

IME 878. MS Directed Project (1–3). A project conducted under the supervision of an academic adviser for the directed project option. Requires a written report and an oral presentation on the project. Graded *S/U* only. Prerequisite: consent of academic adviser.

IME 880. Topics in Industrial Engineering (3). New or special courses are presented under this listing on sufficient demand. Repeatable for credit when subject matter warrants.

IME 890. Independent Study in Industrial Engineering (3). Analysis, research, and solution of a selected problem. Prerequisite: instructor's consent.

IME 930. Multiple Criteria Decision Making (3). An extensive treatment of techniques for decision making where the multiple criteria nature of the problem must be recognized explicitly. Prerequisite: IME 550.

IME 950. Occupational Biomechanics (3). Theoretical fundamentals of the link system of the body and kinetic aspects of body movement. Includes application of biomechanics to work systems. Prerequisites: IME 549 and AE 223.

IME 960. Advanced Selected Topics (1–3). New or special courses on advanced topics presented under this listing on sufficient demand. Prerequisite: instructor's consent.

IME 976. PhD Dissertation (1–6). Repeatable for credit. Graded *S/U* only. Prerequisite: admission to doctoral aspirant status

IME 990. Advanced Independent Study (1–3). Arranged individual, independent study in specialized content areas. Repeatable toward the PhD degree. Prerequisites: advanced standing and departmental consent.