

2011-13 Cal Poly Catalog

[Industrial & Manufacturing Engineering Department](#)

IME–INDUSTRIAL and MANUFACTURING ENGINEERING

IME 101 Introduction to Industrial and Manufacturing Engineering (1)

Introduction of major topics in industrial and manufacturing engineering. Time management, study skills and class scheduling necessary for academic success. University services. Professional ethics. Career opportunities review. 1 laboratory.

IME 130 Technical Foundations (2) (CR/NC)

Introduction to visualization, sketching, and drafting. Basic hand-tools, shop practices, and materials. Clearances and fits, threads and fasteners. Safety. Open to all majors. Credit/No Credit grading only. 1 lecture, 1 laboratory.

IME 140 Graphics Communication and Modeling (2)

Introduction to computer-aided drafting and modeling of solid objects. Visualization and sketching for engineers. Communication of design information to manufacturing using pictorials, orthographic projection, section views, and auxiliary views. Manufacturing tolerances. 1 lecture, 1 laboratory.

IME 141 Manufacturing Processes: Net Shape (1)

Metal casting as a net shape process in manufacturing. Properties of molding materials and methods of casting. Introduction to rapid prototyping. Pattern and casting design principles. 1 laboratory.

IME 142 Manufacturing Processes: Materials Joining (2)

Theory and application of metal cutting and welding processes. Includes shielded metal arc, flux cored arc, submerged arc, gas metal arc, gas tungsten arc, brazing, resistance, and oxy-acetylene processes. Bonding theory, joint design, codes and testing. Introduction to adhesive bonding. Open to all majors. 1 lecture, 1 laboratory.

IME 143 Manufacturing Processes: Material Removal (2)

Uses, capabilities, and theoretical and operational characteristics of lathe and milling machine tools, including conventional, automatic and numerical control. Cutting tool characteristics, machining parameters, quality control, and production methods. Design considerations for manufacturing. Introduction to robotics and automation. Open to all majors. 1 lecture, 1 laboratory.

IME 144 Introduction to Design and Manufacturing (4)

Supplemental review of visualization, sketching, and drafting fundamentals. Computer-aided solid modeling of parts and assemblies. Introduction to conventional machining processes on lathes and mills, computer numerical control, quality control, production methods, and design for manufacturing. Open to all majors. 2 lectures, 2 laboratories. **Prerequisite: IME 130 or IME 140 or consent of instructor. Recommended: IME 140, ME 151, or equivalent. Change effective Spring 2012**

IME 156 Basic Electronics Manufacturing (2)

Practical electronics manufacturing knowledge expanded through concepts such as CAD/CAM design, Design for Manufacture (DFM), documentation requirements, prototyping and production planning. Hands-on techniques learned for project planning, soldering, automation, hand tool usage and production methods. 1 lecture, 1 laboratory.

IME 157 Electronics Manufacturing (4)

Printed circuit board assembly; printed circuit board fabrication process; electronics packaging; overview of semiconductor manufacturing; design, documentation and fabrication of electronic units with emphasis on CAD/CAM. Open to all majors. 2 lectures, 2 laboratories.

IME 200 Special Problems for Undergraduates (1–2)

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department chair.

IME 223 Process Improvement Fundamentals (4)

Principles of work simplification and motion analysis. Recording of work flow and methods. Process improvement through work measurement and standards, time study, synthetic data, predetermined time systems and work sampling. Allowances and performance rating, productivity measures. Introduction to lean manufacturing principles. Client based project. 3 lectures, 1 laboratory. Prerequisite: MATH 141. Recommended: IME 101.

IME 239 Industrial Costs and Controls (3)

Estimation of manufacturing costs for production planning, cost analysis, and cost control. Planning, budgeting and control processes. Costs, accounting data and analysis of variances for managerial control, inventory valuation and decision making. Techniques of forecasting, pricing, cost estimating and cost reduction. 3 lectures. Prerequisite: IME 223.

IME 240 Additional Engineering Laboratory (1–2)

Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 or 2 laboratories.

IME 241 Manufacturing Process Design I (4)

Economic and engineering analysis of manufacturing processes. Cost estimation for production planning, analysis, and control. Analysis of machining process inputs and mechanisms as an example process. Test report writing, documentation, and inspection methods. Field trips to manufacturing centers. 3 lectures, 1 laboratory. Prerequisite: IME 143 or IME 144, PHYS 141.

IME 251 Introduction to Manufacturing Engineering Analysis (4)

State of the art methods and processes in mechanical and electronic manufacturing. Selection of materials for manufacturing. Product design and manufacturability. Specifications and metrology in manufacturing. Continuous improvement strategies, such as automation, group technology, value analysis, and flexible system design. 2 lectures, 2 laboratories. Prerequisite: IME 143 or IME 144, PHYS 131, CHEM 124.

IME 270 Selected Topics (1–4)

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Open to undergraduate students and consent of instructor.

IME 301 Operations Research I (4)

Systems modeling methodology, mathematical model formulations, linear programming, graphical and simplex methods. Duality and sensitivity analysis. Transportation, transshipment and assignment models. Introduction to goal programming and elastic constraints. Computer applications. 3 lectures, 1 activity. Prerequisite: MATH 244.

IME 303 Project Organization and Management (4)

Design and implementation of a major industrial/business systems project. Project planning considerations. Motivational and influence techniques used in project management. Scheduling techniques with risk assessment. Resource leveling and management under constraints. Reducing project duration. Monitoring progress with earned value analysis. Project audit and closure. Planning and implementation of a project. Application of project management software. 3 lectures, 1 laboratory. Prerequisite: Junior standing, IME 314 or equivalent.

IME 312 Data Management and System Design (4)

Design and management of industrial databases and reporting systems. Relationships of financial accounting databases and production systems. Efficient data entry and reports, queries, macro function, and Internet based database applications. 3 lectures, 1 laboratory. Prerequisite: CSC 232.

IME 313 Introduction to Information Systems Engineering (4) Practical approach to use of modern information technologies related to industrial and manufacturing engineering. Use of networking and application software, including theory and practice. 3 lectures, 1 laboratory. Prerequisite: CSC 232.

IME 314 Engineering Economics (3)

Economic analysis of engineering decisions. Determining rates of return on investments. Effects of inflation, depreciation and income taxes. Sensitivity, uncertainty, and risk analysis. Application of basic principles and tools of analysis using case studies. 3 lectures. Prerequisite: MATH 241.

IME 319 Human Factors Engineering (3)

Analysis of factors influencing the efficiency of human work. Data on the physical and mental capacities of persons, the physical environment, work organization, and the problem of aging. Design of machines, operations, human computer interface and work environment to match human capacities and limitations, including the handicapped. Multidisciplinary team project. 3 lectures. Prerequisite: PSY 201 or PSY 202 or consent of instructor, and junior standing.

IME 320 Human Factors and Technology (4)**GE Area F**

Analysis of cognitive, sensory and physical limitations and capabilities of operators and users of technology, both hardware and software, in working and living environments. Analysis of pertinent databases for a proactive approach to designing user-centered industrial products /systems, consumer products, and work environment. 4 lectures. Prerequisite: Junior standing and completion of GE Area B requirements. Fulfills GE Area F.

IME 322 Leadership and Project Management (2)

Theory and practice in leadership and project management skills for engineering design teams. Basic issues related to, and tools used for, managing projects and concepts comprising project management. Emphasis on situations requiring resolutions and management decisions by groups representing various elements of an enterprise. 2 lectures. Prerequisite: Junior standing in an engineering program or consent of instructor. *Crosslisted as HNRS/IME/MATE 322.*

IME 326 Engineering Test Design and Analysis (4)

Data gathering and statistical testing applied to industrial engineering and manufacturing fields. Experimental methods for product and process evaluation and comparisons; interpretation of engineering data. Engineering experimental design, linear and nonlinear regression, ANOVA, and multifactor ANOVA. Utilization of existing computer software. 4 lectures. Prerequisite: STAT 321 with a grade of C- or better, or consent of instructor.

IME 334 CAD/CAM (3)

Identification and study of the individual techniques of CAD/CAM as being practiced in modern industry. Total credit limited to 6 units. 2 lectures, 1 laboratory. Prerequisite: IME 144 or consent of instructor.

IME 335 Computer-Aided Manufacturing I (4)

Use of the computer to communicate design information to manufacturing. Computer Numerical Control (CNC) programming. Use of CAD/CAM software. Overview of manufacturing systems in an automated environment, including cellular manufacturing and computer-aided process planning. 3 lectures, 1 laboratory. Prerequisite: IME 144, CSC 232, or consent of instructor.

IME 336 Computer-Aided Manufacturing II (4)

Advanced Computer Numerical Control (CNC) programming and machine tool control. Machining center operation. Parametric representation of curves and surfaces. Computation of tool paths. Product and process design for CNC machining. CNC machine tool dynamics. Introduction to flexible manufacturing systems and robotics. Design and fabrication projects. 3 lectures, 1 laboratory. Prerequisite: IME 335, ME 212, MATH 244, or consent of instructor.

IME 341 Tool Engineering (4)

Engineering design of fixtures and tools for manufacturing processes. Interpretation of engineering design specifications. Material selection. Analysis of cost, quality, productivity, and safety in tool design. The role of tooling in manufacturing competitiveness. Design projects. 3 lectures, 1 laboratory. Prerequisite: IME 241, CE 204, MATH 244, MATE 210, or consent of instructor.

IME 342 Manufacturing Systems Integration (4)

Analysis and design tools for production planning, control, and simulation of manufacturing systems. Use of systems modeling software. Overview of ergo-nomics and facilities design. 3 lectures, 1 laboratory. Prerequisite: MATH 241 and IME 223 or consent of instructor. Recommended: STAT 321.

IME 351 Advanced Material Removal Process Design (4)

Advanced turning and milling processes; grinding and non-traditional processes. Thread and gear manufacturing, producibility, machinability, part and tool materials, cutting fluids, and tool life testing. Finishes and measurement of surface roughness. Process design projects. 2 lectures, 2 laboratories. Prerequisite: IME 241, MATE 210 and MATE 215, and CE 204.

IME 352 Manufacturing Process Design II (4)

Advanced engineering analysis of material shaping processes, surface processing and assembly operations with emphasis on optimizing process parameters, equipment, and operational sequence. Process design projects. 2 lectures, 2 laboratories. Prerequisite: IME 141, IME 142, IME 241, MATE 210/215, CE 204.

IME 356 Manufacturing Automation (4)

Computers in the factory automation environment. Basic control theory including feedback. Programming and use of programmable logic controllers (PLC), human-machine interface (HMI), and industrial control systems. Interfacing of electro-mechanical systems; analog and digital inputs, output; programmable controllers. Computer process control. 3 lectures, 1 laboratory. Prerequisite: EE 321.

IME 400 Special Problems for Advanced Undergraduates (1-4)

Individual investigation, research, studies, or surveys of selected problems. Total credit limit to 4 units. Prerequisite: Consent of instructor.

IME 401 Sales Engineering (2)

Concepts and principles of engineering in sales. Role of the professional engineer in the analysis, design, development, production, and final application of a product or system required by the buyer. 2 seminars. Prerequisite: Senior standing in engineering, or consent of instructor.

IME 404 Engineering Economic Decision Management (3)

Quantitative approaches to engineering and management problems. Time value concepts, breakeven and replacement analysis, optimization techniques for scheduling. Project cost estimation, resource management and risk analysis. Use of computer software packages. For non-majors only. 3 lectures. Prerequisite: Junior standing.

IME 405 Operations Research II (4)

Stochastic decision analysis. Queuing models, inventory models and analysis. Markov processes. Computer aided modeling and case studies. 3 lectures, 1 activity. Prerequisite: IME 301, ~~IME-326 STAT 321~~ or consent of instructor. *Change effective Spring 2012.*

IME 407 Operations Research III (4)

Systems modeling and solution of large scale problems using advanced operations research methods. Integer and goal programming. Application of nonlinear, quadratic, dynamic programming concepts. Case studies of systems modeling including software aided analysis. 3 lectures, 1 activity. Prerequisite: IME 301 or consent of instructor.

IME 408 Systems Engineering (3)

Systems, subsystems, static, dynamic, closed and open systems. Systems design requirements. Performance measures. Process control modeling and analysis, transform methods, linear systems analysis, digital, adaptive and steady state optimal control. Optimal search strategies. Manufacturing, maintenance, replacement and engineering applications. 3 lectures. Prerequisite: IME 326, IME 405, CSC 232.

IME 409 Economic Decision Systems (3)

Economic evaluation of information for complex decisions. Analysis of risks and uncertainties. Bayes theory and models. Decision theory, sequential decisions, and value of information applied to financial evaluation and control. Major project justification procedures. 3 lectures. Prerequisite: IME 239, IME 314, and IME 405, or consent of instructor.

IME 410 Production Planning and Control Systems (4)

Building blocks of manufacturing resource planning (MRP II). Demand forecasting, production planning, master scheduling development. BOM and inventory files. MRP computations and operational challenges. Capacity analysis and production control in push and pull systems.

Enterprise Resource Planning (ERP). Principles of JIT and lean manufacturing. 3 lectures, 1 laboratory. Prerequisite: IME 405 or IME 342.

IME 411 Production Systems Analysis (3)

Systems analysis for production control. Design of computer integrated planning and control systems for scheduling manufacturing orders, monitoring operating costs and control system performance evaluation. Development of computer-aided decision making framework. Interactive decision making using simulation modeling. 2 lectures, 1 laboratory. Prerequisite: IME 410, or equivalent.

IME 413 Flexible Manufacturing Systems (3)

Structure of flexible manufacturing systems. Planning and control for FMS. Tool management and operations control. Application of techniques related to production scheduling decisions. Cellular manufacturing and production flow analysis. Case studies of flexible manufacturing systems. Computer applications. 3 lectures. Prerequisite: IME 301. Recommended: STAT 321.

IME 416 Automation of Industrial Systems (3)

Automation in manufacturing and warehousing. Economic selection of automation systems. Projects in automation. 2 lectures, 1 laboratory. Prerequisite: IME 356 or equivalent.

IME 417 Supply Chain and Logistics Management (4)

Overview of key logistics and supply chain management concepts. Models and solution methods for the design, control, operation, and management of supply chains. Techniques that are used to analyze supply chains. Team projects in partnership with industry sponsors. 4 lectures. Prerequisite: IME 342, or IME 410 or consent of instructor.

IME 418 Product-Process Design (4)

Innovation for product development, engineering management of new product development and manufacturing competitiveness. Concurrent engineering. Study of manufacturability constraints in terms of prototyping, designing, testing, pre-production support, processing, quality, delivery, and customer satisfaction. Industrial design projects. Examination of relevant environmental and ethical problems. 3 lectures, 1 laboratory. Prerequisite: Senior standing in engineering or graduate standing or consent of instructor. Recommended: IME 341.

IME 420 Simulation (4)

Design and analysis of manufacturing and service systems by simulation. System modeling. Random number and function generators, programming, and characteristics of simulation languages. Design projects using real world problems. Introduction to rule-based expert systems. 3 lectures, 1 laboratory. Prerequisite: IME 326, IME 405, or consent of instructor.

IME 421 Manufacturing Organizations (3)

Theory and principles for manufacturing organizations. Competitive advantage. Strategic planning and operations management for organizations and teams in a rapidly changing environment. Engineering management concepts and practices. Team-based projects and cases. 3 seminars. Prerequisite: Junior standing; PSY 201, PSY 202, or KINE 250 or consent of instructor. Recommended: IME 314.

IME 422 Manufacturability Engineering (4)

Manufacturability constraints in terms of issues related to prototyping, designing, testing, preproduction support, processing, quality, delivery, and customer satisfaction. Hands-on projects to discuss the experimental results in dealing with the process of casting, machining, plastic modeling, and electronic board manufacturing. 3 lectures, 1 laboratory. Prerequisite: IME 341, IME 326. Recommended: IME 342.

IME 427 Process Optimization through Designed Experiments (4)

Experiments for optimization of industrial processes: process variables, response, measurements, analysis and interpretations. Statistical principles in design. Design approaches: conventional methods, response surface methodology, and Taguchi methods. Type of experiments: factorial, fractional factorial, mixture, and orthogonal arrays. Design projects using real world problems. 3 lectures, 1 laboratory. Prerequisite: IME 326 or consent of instructor.

IME 428 Engineering Metrology (4)

Measurement of attributes and variables; standards, accuracy and precision; mechanical, electronic and optical/laser measurement systems. Contact and

non-contact measurement; straightness, flatness and squareness; GDT (Geometric Dimensioning and Tolerancing); CMM (Coordinate Measurement Machines); surface roughness; metrology for electronic products. 3 lectures, 1 laboratory. Prerequisite: IME 335 or consent of instructor.

IME 429 Ergonomics Laboratory (1)

Investigation of various physiological, sensory, and cognitive capabilities and limitations of people in work and living environments through laboratory data collection, design of experiments and statistical analysis. 1 laboratory. Prerequisite: IME 319, IME 326.

IME 430 Quality Engineering (4)

Quality control, reliability, maintainability, and integrated logistic support. Statistical theory of process control and sampling inspection. Risks associated with decisions based on operating characteristics of control charts and sampling plans. Reliability and life testing methods. Economics of statistical QC. Specifications and standards. 4 lectures. Prerequisite: IME 326 or STAT 302.

IME 431 Supplier Quality Engineering (4)

Customer-supplier partnership. Functions of Supplier Quality Engineering. Supplier selection, development, process qualification, concurrent engineering, value engineering. Process characterization, repeatability, consistency, process control. Quality system standards. Supplier survey, audit, rating, measurement of quality, delivery performance and certification. Customer service, corrective action approaches. 3 lectures, 1 laboratory. Prerequisite: IME 430.

IME 433 Advanced Work Measurement (3)

Predetermined time systems. Time formulas. Standard data systems. Use of statistical methods. Standard data systems applied to clerical, manufacturing, and micro assembly. Developing and maintaining computerized systems. Course will be administered with project orientation. 2 lectures, 1 laboratory. Prerequisite: IME 223, IME 326 or equivalent.

IME 435 Reliability Engineering I (3)

Reliability concepts and mathematical models, mechanical device reliability, electrical device reliability, systems reliability and maintainability, reliability data, assurance program elements. 3 lectures. Prerequisite: IME 326.

IME 437 Advanced Human Factors Engineering (3)

Team-based approach to human factors assessment of consumer and industrial products, systems, and information technology. Team building principles and techniques in human factors analysis. Usability analysis and ergonomics auditing through experimental methods. 2 lectures, 1 laboratory. Prerequisite: IME 319 and either IME 326 or IME 503.

IME 440 Quality Process Management (4)

Quantitative approaches to engineering and management of quality. Statistical process control, quality assurance concepts. Variability loss and off-line QC. Tolerance design and experimental design. Human factors and managerial dimensions influencing quality. For non-majors only. 4 lectures. Prerequisite: Junior standing or consent of instructor.

IME 441, 442 Engineering Supervision I, II (1,1)

Theory and principles of supervision. Application of fundamental concepts and techniques of supervision provided by assignment in engineering laboratories. 1 laboratory each. Prerequisite: Consent of instructor.

IME 443 Facilities Planning and Design (4)

Design concepts and input requirements in planning and design of new or renovation of existing manufacturing systems. Product, process, and flow and activity analysis techniques. Flow lines and buffering techniques. Computer-aided layout design and evaluation. Design of handling systems. Math models of location problems. Multidisciplinary team project. 3 lectures, 1 laboratory. Prerequisite: IME 144, IME 223, IME 405 or IME 342, IME 314, or equivalent. Recommended: IME 319, IME 420.

IME 455 Manufacturing Design and Implementation I (3)

A mix of industry and in-house structured group projects. Projects progress through a complete cycle from design through implementation. Application

of project management methods. Examination of relevant economical and safety issues. 3 laboratories. Prerequisite: IME 418.

IME 457 Advanced Electronic Manufacturing (4)

Design and fabrication of commercial electronic products; PCB layout design, bill of material analysis and component purchasing, production planning and scheduling, programming automated surface-mount assembly line, marketing of products. Multidisciplinary project teams exposed to real-world challenges of electronics manufacturers. 2 lectures, 2 laboratories. Prerequisite: IME 156 or IME 157.

IME 458 Microelectronics and Electronics Packaging (4)

Materials, processes, and reliability of microelectronics and electronics packaging, surface mount assembly and printed circuit board fabrication. Overview of semiconductor manufacturing and optoelectronics packaging. 3 lectures, 1 laboratory. Prerequisite: MATE 210 and PHYS 133 or consent of instructor. *Crosslisted as CPE 488/IME 458/MATE 458.*

IME 470 Selected Advanced Topics (1–4)

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1–4 lectures. Prerequisite: Consent of instructor.

IME 471 Selected Advanced Laboratory (1–4)

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

IME 481 Senior Project Design Laboratory I (2)

Culminating design project typical of problems faced in professional practice. Individual or group projects typically involve system design, modeling, analysis and testing. Project method includes costs, planning, scheduling, appropriate research methodology and formal reports. 2 laboratories. Prerequisite: Senior standing in major and consent of instructor.

IME 482 Senior Project Design Laboratory II (3)

Continuation of IME 481. Involves research methodology: problem statement, method, results, analysis, synthesis, project design, construction (when feasible), and evaluation/conclusions. Project results presented in thesis-like formal reports suitable for reference library and formal oral presentations. 3 laboratories. Prerequisite: IME 481.

IME 493 Cooperative Education Experience (2) (CR/NC)

Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 6 units. Prerequisite: Sophomore standing and consent of instructor.

IME 494 Cooperative Education Experience (6) (CR/NC)

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 18 units. Prerequisite: Sophomore standing and consent of instructor.

IME 495 Cooperative Education Experience (12) (CR/NC)

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. A more fully developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 24 units. Prerequisite: Sophomore standing and consent of instructor.

IME 500 Individual Study (1–4)

Advanced study planned and completed under the direction of a member of the department faculty. Open only to students who have demonstrated ability to do independent work. Total credit limited to 4 units. Prerequisite: Consent of department chair and supervising faculty member.

IME 501 Graduate Survey I (4)

Survey of traditional industrial engineering applications in industrial systems, work methods, measurements and analysis. Facilities design, automation and logistics of industrial operations. Human factors and cost estimation of industrial applications. 3 seminars, 1 activity. Prerequisite: Graduate standing.

IME 502 Graduate Survey II (4)

Survey of current issues in data analysis and mathematical modeling of industrial systems, Queuing theory, Markov Chains quality control and supply chain issues. 4 lectures. Prerequisite: Graduate standing and consent of instructor.

IME 503 Applied Statistical Methods in Engineering (4)

Application of hypothesis testing, regression models, and ANOVA models to forecasting, process optimization, cost estimation, work measurement, inventory control, scheduling, and ergonomics. Probability distributions of process outputs in industries and service systems such as Normal, exponential, Uniform, Hypergeometric, Binomial, and Poisson. Applications in queuing, reliability, Markov chains. Expectations of random variables. Measures of central tendency and variation. Population and a random sample. Central limit theorem and its application in simulation of processes. 3 lectures, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

IME 507 Graduate Seminar (2)

Selected topics of interest to industrial engineering, integrated technology management, and engineering management graduate students. The Schedule of Classes will list topic selected. Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 seminar, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

IME 510 Systems Engineering I (4)

Project management. Scheduling and budgeting. Queuing theory. Process control and life-cycle cost analysis. Contracts and negotiation. 4 lectures. Prerequisite: Graduate standing or consent of instructor. *Crosslisted as AERO/IME 510.*

IME 511 Systems Engineering II (4)

Risk management. Design strategies to meet system/mission requirements. Design for supportability, manufacturability, reliability, etc. Quality function development and quality control concepts. 4 lectures. Prerequisite: AERO 510 or IME 510, graduate standing or consent of instructor. *Crosslisted as AERO/IME 511.*

IME 516 Mechatronics Systems Analysis (4)

Overview of smart products and intelligent manufacturing systems. Tools and technologies utilized in the design, manufacturing, and operations of such products and systems. Artificial Intelligence Technologies and Fuzzy Logic. Design of smart products and intelligent systems. Case studies. Team projects and formal presentations. 3 seminars, 1 laboratory. Prerequisite: IME 416 or ME 405 or equivalent.

IME 520 Advanced Information Systems for Operations (4)

Advanced information systems (IS) applications in manufacturing and service operations. Introduction of common IS applications, such as manufacturing execution systems; reporting systems; capacity planning systems; scheduling systems; and customer inquiry systems. Industry-specific analysis of IS requirements and availability. 4 seminars. Prerequisite: IME 410 or consent of instructor.

IME 526 Advanced Topics in Manufacturing System Design (4)

Modeling and analysis of manufacturing systems. Advanced topics in manufacturing system design to support development of complex systems: Virtual Reality, discrete event simulation, system architectures, systems integration, scheduling and control of manufacturing systems. Total credit limited to 12 units. 3 seminars, 1 laboratory. Prerequisite: IME 410 or equivalent.

IME 541 Advanced Operations Research (4)

Operations Research approach to model building. Linear programming and sensitivity analysis. Network flow models. Integer programming, large scale linear programming. Goal programming and multi-attribute decision making. Dynamic programming. Nonlinear programming and search

methods. Applications in model building and computer solutions in planning, resource allocation, scheduling, and other industrial and service operations. 3 lectures, 1 laboratory. Prerequisite: Graduate standing and consent of instructor.

IME 542 Reliability Engineering II (4)

Reliability engineering terminology and definitions. Reliability mathematics; probability plotting; load-strength interference and safety margin. Failure distributions and failure rate models. Weibull analysis; bath tub curve; reliability of parts. Reliability of systems; redundancy; reliability allocation. Maintainability and availability. Failure modes and effects analysis. Fault tree analysis. Failure data analysis; reliability testing; reliability growth testing. Electronic system, mechanical and software reliability. Safety and human reliability; reliability management. 3 lectures, 1 laboratory. Prerequisite: IME 503.

IME 543 Advanced Human Factors (4)

Theory and application of man-machine relations and system design. Concepts of mathematical models, human information input channels, decision making based on capability of human operator. 3 seminars, 1 laboratory. Prerequisite: IME 319 or equivalent, IME 326 or equivalent and graduate standing.

IME 544 Advanced Topics in Engineering Economy (4)

Review of interest calculations and comparison of economic alternatives. Replacement analysis. Capital planning and budgeting. Mathematical programming and capital budgeting. Utility theory. Decision making under risk and uncertainty. Application of simulation in risk modeling. Benefit-cost analysis. Multi-attribute decision making. Analytic hierarchy process. 3 lectures, 1 activity. Prerequisite: Undergraduate course in engineering economy.

IME 545 Advanced Topics in Simulation (4)

Validation of simulation models. Statistical techniques for variance reduction. Experimental design and optimization. Comparison of attributes of simulation languages. Review of current manufacturing and service industry applications. Case studies. 3 lectures, 1 laboratory. Prerequisite: IME 420 and graduate standing.

IME 548 Engineering Decision Making (4)

Principles, concepts, models, and case studies of decision making, both quantitative and nonquantitative. Emphasizes commonly used techniques when quantitative models do not exist, do not cover all key factors, or when sufficient data are not available. 3 lectures, 1 laboratory. Prerequisite: IME 301, IME 314, STAT 321 or equivalent and graduate standing.

IME 555 Computer-Integrated Manufacturing (4)

CIM and concurrent engineering concepts. Systems analysis methodologies and functional specifications. Technological and managerial strategies for system integration. Analysis of contemporary CIM frameworks. Information networks and protocols for integrated manufacturing systems. Implementation strategies for CIM and concurrent engineering. 3 seminars, 1 laboratory. Prerequisite: IME 335, IME 411 or equivalent, graduate standing.

IME 556 Technological Project Management (4)

Projects in industrial organizations and enterprises. Emerging technologies and project management. Relationship to strategic plans and managing change in organizations. Formulating, selecting, structuring, and planning projects. Project organization and control. Overcoming barriers. Application of project management software. 3 seminars, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

IME 557 Technological Assessment and Planning (4)

Assessing likely future technological environments, speed of change in competitive environments, relationship to business, strategic, and technology plans of firms. Past, present and technological evolution and operational changes. Technological and competitive impact assessment and business/technology strategy development. Use of case studies and company experiences. 4 seminars. Prerequisite: IME 503 or equivalent, and graduate standing.

IME 558 Executive Seminars (4)

Culminating overview of major issues facing organizations as they meet the challenge to sustain a competitive advantage in a business environment characterized by rapid and pervasive change. Topics include project management, virtual organizations, the service sector, manufacturing futures, and information technology. 2 seminars, 2 supervision. Prerequisite: Advanced graduate program status or consent of instructor.

IME 559 Engineering Research and Development (4)

Principles, approaches and practices for effective engineering innovation, design, research and development (R&D) in business and industry. Relationship of R&D with corporate strategy and technology base. R&D objectives through implementation. Integration of creativity, evaluation, design, and ongoing operations. Case studies. 4 seminars. Prerequisite: IME 314 or equivalent and graduate standing.

IME 560 Quality Engineering II (4)

Integrated total quality system engineering for manufacturing and service firms. Classical and modern quality philosophies and quality assurance and improvement methods. Statistical methods. Designing for quality, continuous quality improvement, and total quality system integration. Case studies. 4 seminars. Prerequisite: IME 421, IME 430, or equivalent.

IME 570 Selected Advanced Topics (1-4)

Directed group study of selected topics for advanced students. Open to graduate students and selected seniors. The Schedule of Classes will list title selected. 1-4 seminars. Prerequisite: Graduate standing and/or consent of instructor.

IME 571 Selected Advanced Laboratory (1-4)

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories. Prerequisite: Graduate standing or consent of instructor.

IME 575 Critical Technologies (4)

Scientific, engineering and strategic overview of numerous critical emerging technologies. Topics include: technologies critical for different engineering disciplines, critical to numerous industries, and/or critical to the national interest. Focus on each technology to include: understanding key scientific fundamentals, evaluating commercialization potential to industry, and identifying conditions and outlook for future technological breakthroughs. 3 seminars, 1 laboratory. Prerequisite: Engineering graduate student and consent of instructor.

IME 577 Engineering Entrepreneurship (4)

The special requirements of entrepreneurship in a high-tech environment. Guest lectures, focused seminar topics, a business plan project, and case studies provide the tools to evaluate and pursue technology-based business opportunities. 4 lectures. Prerequisite: Graduate standing or consent of instructor.

IME 580 Manufacturing Systems (4)

Modern approaches in production and inventory planning and control to support large-scale manufacturing systems, material requirements planning (MRP I), manufacturing resource planning (MRP II), and just-in-time (JIT) manufacturing systems. Enterprise resource planning (ERP) and integration with financials. Information requirements, operational issues, and policy matters. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

IME 591, 592 Integrated Product Development I, II (4) (4)

Team taught course addressing: product opportunity identification, customer needs analysis, concept definition, requirements definition, product-process analysis, product specification, design/process description, prototyping, project management, packaging, product promotion/introduction, and manufacturing ramp-up. Team projects in partnership with industry sponsors, field-trips and formal presentations. 3 seminars, 1 laboratory for each. Prerequisite: Graduate standing.

IME 593 Cooperative Education Experience (2) (CR/NC)

Advanced study analysis and part-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career

field. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

IME 594 Cooperative Education Experience (6) (CR/NC)

Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

IME 595 Cooperative Education Experience (12) (CR/NC)

Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. A fully-developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

IME 596 Team Project/Internship (1-10)

Integrative learning experience through internship and team project with industrial organization. Requires advanced study and focuses on industrial unstructured problem or opportunity requiring integration across disciplines. Team project involves student, faculty, and sponsoring firm representative(s) in a collaborative learning environment, and culminates in comprehensive written report. Total credit limited to 10 units, normally taken over 2 quarters. Prerequisite: Advanced graduate standing, completion of, or concurrent enrollment in, engineering courses in specialization, and consent of participating faculty.

IME 599 Design Project (Thesis) (1-9)

Each individual or group will be assigned a project for solution under faculty supervision as a requirement for the master's degree, culminating in a written report/thesis. Prerequisite: Graduate standing and consent of instructor.