INDUSTRIAL & MANUFACTURING ENGINEERING

https://ime.calpoly.edu

The mission of the Industrial Engineering and Manufacturing Engineering programs at Cal Poly is to educate, inspire, and support students to attain successful careers as engineering professionals utilizing a learn-by-doing approach that develops students' abilities to design and implement innovative, effective solutions for improving processes and systems in society and industry.

The Department focuses on programs that integrate engineering with a real concern for people. Our students study topics that lead to satisfying and productive careers and which provide strong preparation for graduate work in many fields. Programs reflect the traditional strengths of Cal Poly through close interaction between students and faculty in classroom, laboratory, and other activities. The programs use a project-based learning approach where students work on multiple real-life projects. Students often present results to industry representatives.

Department and university laboratories and computers are integrated into coursework to investigate, test, and apply theoretical principles learned in the classroom. The descriptions below provide details of the various programs.

Undergraduate Programs

- Industrial Engineering (BS) (https://catalog.calpoly.edu/engineering/industrial-manufacturing/industrial-engineering-bs/)
- Manufacturing Engineering (BS) (https://catalog.calpoly.edu/engineering/industrial-manufacturing/manufacturing-engineering-bs/)

Graduate Programs

- Engineering Management (MS) (https://catalog.calpoly.edu/engineering/industrial-manufacturing/engineering-management-ms/)
- Industrial Engineering (MS) (https://catalog.calpoly.edu/engineering/industrial-manufacturing/industrial-engineering-ms/)

IME Courses

IME 1101 Introduction to Industrial and Manufacturing Engineering (1 unit)
Term Typically Offered: F

Introduction of major topics in industrial and manufacturing engineering such as data analysis, process improvement, operations research, product design, and supply chain management. Professional ethics, cheating, and plagiarism. Resources for academic success. Career opportunities review. 1 laboratory. Formerly IME 101.

IME 1140 Technical Graphics Communication for Design and Manufacturing (1 unit)
Term Typically Offered: F
Recommended: IME 143 or IME 1143.

Basic techniques and practices of solid modeling and drafting essential to communicating in technical environments. Introduction to computer-aided drafting (CAD) and solid modeling, assemblies, and engineering drawings. Visualization and hand drafting. Design specifications for manufacturing, and dimensioning and tolerancing standards. 1 laboratory.

IME 1141 Introduction to Metal Casting and Prototyping (1 unit)
Term Typically Offered: F, SP, SU

Overview of modern industrial metal casting processes. Casting process selection. Design for manufacturing concepts for casting. Solidification and gating design. Automated systems for volume production. Process-property relationships. Hands-on casting projects. Prototype a casting using additive manufacturing. Not open to students with credit in IME 1149. 1 laboratory. Formerly IME 141.

IME 1142 Materials Joining (1 unit)
Term Typically Offered: F, SP, SU

Joining methods for sheet and plate metal structures and assemblies. Introduction to gas tungsten arc, gas metal arc, shielded metal arc, and resistance welding. Oxy-acetylene processes. Mechanical fasteners and adhesives. Sheet metal shearing, bending, brazing, and forming. Dimensioning and tolerancing. Not open to students with credit in IME 1149. 1 laboratory. Formerly IME 142.

IME 1143 Introduction to Design and Manufacturing (2 units)
Term Typically Offered: F, SP, SU
Corequisite: One of the following: IME 1140, ME 129, or ME 1148.

Introduction to manufacturing processes and systems. Theory and practice of common manufacturing methods, with emphasis on material removal techniques. Computer numerical control, parts measurement and quality, production methods, and design for manufacture. 1 lecture, 1 laboratory. Formerly IME 143.

IME 1149 Introduction to Manufacturing Processes: Metal Casting and Joining (1 unit)
Term Typically Offered: SP

Introduction to thermal processes of manufacture. Metal casting methods and mold design. Casting patterns. Product design principles. Welding methods and tooling. Design for welded assemblies. Thermal cutting. Energy consumption. Changes in microstructure and material properties. Hands-on practice and product testing. Not open to students with credit in IME 141, IME 142, IME 1141, or IME 1142. 1 laboratory.

IME 1156 Introduction to Modern Electronics Manufacturing (2 units)
Term Typically Offered: SP

Manufacture of printed circuit boards (PCB). Hand and automated PCB assembly. Electronic materials properties and their applications. Integrated circuit package design for performance. Introduction to smart manufacturing using microcontrollers, basic programming, data collection, and display. 1 lecture, 1 laboratory. Formerly IME 156.

IME 1223 Process Improvement Fundamentals (4 units)
Term Typically Offered: F, SP
Prerequisite: MATH 141 or MATH 1261. Recommended: IME 101 or IME 1101.

Principles of work simplification; methods, motion analysis, and workflow analysis. Process improvement through lean manufacturing. Work measurement and standards, time studies, productivity, work sampling. Introduction to production planning and control, material requirements planning, inventory modeling, and facilities design. Client-based project. 3 lectures, 1 laboratory. Formerly IME 223.

IME 2200 Special Problems for Undergraduates (1-2 units)
Term Typically Offered: F, SP, SU
Prerequisite: Consent of department chair.

Individual investigation, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly IME 200.

IME 2212 Introduction to Enterprise Analytics and Database Systems (4 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: CSC 101, CSC 232, CSC 1001, or CSC 1032.

Using large-scale datasets for decision making in industrial engineering. Design and management of database systems. Data acquisition, queries, and database applications. Collecting, preprocessing, describing, analyzing, and visualizing data. Storytelling and ethical considerations. 2 lectures, 2 laboratories. Formerly IME 212.

IME 2240 Additional Engineering Laboratory (1-2 units)
Term Typically Offered: TBD

Supervised laboratory experience in industrial and manufacturing engineering. The Class Schedule will list subtitle selected. Repeatable up to 4 units. 1 to 2 laboratories. Formerly IME 240.

IME 2243 Intermediate Design and Manufacturing (2 units)
Term Typically Offered: SP
Prerequisite: One of the following: IME 1140, ME 129, or ME 1148; and IME 143 or IME 1143.

Computer-aided design and manufacturing (CAD/CAM) with geometric dimensioning and tolerancing, assemblies, and prototyping techniques for metal, polymer, and composite components. Hands-on experience with computer numerical control (CNC) programming, manufacturing systems, and cellular manufacturing. Communication of design information to manufacturing. Non-traditional manufacturing processes. 1 lecture, 1 laboratory. Formerly IME 244.

IME 2315 Financial Decision Making for Engineers (2 units)
Term Typically Offered: F, SP, SU

Develop business case for engineering projects. Investment evaluation using after-tax Net Present Value and Internal Rate of Return. Sensitivity analysis. Financial statements. Fully allocate costs. Use of spreadsheets. Application to personal finance. Critical examination of systemic inequities in financial systems. Course may be offered in classroom-based or online format. 2 lectures. Replaced IME 315.

IME 3302 Operations Research and Management (4 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341.

Modeling via mathematical formulations; integer, binary, mixed-integer. The simplex method, spreadsheet modeling, and solver implementations. Engineering and business applications such as transportation, assignment, scheduling and network optimization. Multi-criteria decision-making using analytic hierarchy process, sensitivity analysis, goal programming, and Pareto analysis. 3 lectures, 1 activity. Formerly IME 301.

IME 3303 Project Organization and Management (3 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: IME 314, IME 315, or IME 2315.

Design, planning, and implementation of a business systems project. Project management motivational and influence techniques. Agile and other scheduling techniques with risk assessment. Resource leveling and management under constraints. Reducing duration, monitoring progress, auditing, and closing projects. Project management software. 2 lectures, 1 laboratory. Formerly IME 303.

IME 3320 Human Factors and Technology (3 units)
Term Typically Offered: TBD
2026-28 or later: Upper-Div GE Area 2/5
2020-26 catalogs: Upper-Div GE Area B
Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); and completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs). Recommended: One of the following: STAT 217, STAT 218, STAT 251, STAT 312, STAT 1110, STAT 1210, or STAT 3210.

Analysis of cognitive, sensory and physical limitations and capabilities of operators and users of technology, in working and living environments. Analysis of pertinent databases for a proactive approach to designing user-centered products, systems, and work environment. 3 lectures. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly IME 320.

IME 3326 Statistical Decision-Making and Quality Control (4 units)
Term Typically Offered: F, SP
Prerequisite: STAT 312, STAT 321, or STAT 3210.

Engineering applications of data gathering, statistical testing, experimental design, quality control tools, and improvement methods. Computer software utilization. 3 lectures, 1 laboratory. Formerly IME 326.

IME 3327 Test Design and Analysis in Manufacturing Engineering (4 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: ME 236, ME 3236, STAT 321, or STAT 3210.

Sampling methods for engineering experiments. Hypothesis testing for means and variances. Analysis of variance (ANOVA). Measurement capability analysis. Full and fractional factorial experiments design and analysis. Discrete data analysis. Statistical process control. Acceptance sampling. Applications in manufacturing engineering. 3 lectures, 1 laboratory. Formerly IME 327.

IME 3330 Fundamentals of Manufacturing Engineering (4 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: IME 141, IME 142, IME 1141, or IME 1142; IME 143 or IME 1143; ENGR 2211; one of the following: MATE 210, MATE 1210, or MATE 1220; MATE 215 or MATE 1215; and one of the following: IME 2243, ME 251, or ME 2248.

Engineering design and analysis of manufacturing processes based on material deformation, addition, subtraction, and joining. Manufacturability and production costs. Quality, cost, and safety in tool and fixture design. Equipment operation, parts inspection and dimensional metrology, and design projects. Field trip may be required. 3 lectures, 1 laboratory. Formerly IME 330.

IME 3331 Intermediate Metal Casting (4 units)
Term Typically Offered: TBD
Prerequisite: One of the following: IME 1140, ME 129, or ME 1148; and one of the following: MATE 210, MATE 1210, or MATE 1220. Recommended: One of the following: IME 141, IME 1141, or IME 1149.

Metal casting process advantages. Mold materials and tooling design for casting. Materials properties and selection. Modeling gating systems, solidification, and defect analysis. 3 lectures, 1 laboratory. Formerly IME 331.

IME 3332 Advanced Materials Joining (1 unit)
Term Typically Offered: TBD
Prerequisite: IME 142 or IME 1142.

Process design and advanced methods for materials joining. Post-weld treatments. Fixtures for weldments. Best practices for welding efficiency. Warpage, other defects, and methods of mitigation. Design for manufacturing. Hands-on projects. 1 laboratory.

IME 3336 Advanced Computer Aided Manufacturing (3 units)
Term Typically Offered: TBD
Prerequisite: IME 143 or IME 1143; one of the following: IME 244, IME 2243, ME 251, or ME 2248; one of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341; MATH 241 or MATH 2263; and one of the following: ME 236, ME 3236, STAT 312, or STAT 3210.

Advanced computer numerical control (CNC) programming and machine tool data collection for manufacturing. Machining center operation. Computation of toolpaths. Product and process design for CNC machining. CNC machine tool dynamics. Introduction to flexible manufacturing systems and robotics. Fabrication projects. 2 lectures, 1 laboratory. Formerly IME 336.

IME 3356 Manufacturing and Process Automation (4 units)
Term Typically Offered: F, SP
Prerequisite: EE 321 or EE 2115 and EE 2115L.

Computers in factory automation. Basic control theory. Programming and use of logic controllers, human-machine interface, machine vision, servo-motor control, robotics, industrial control systems, and safety. Interfacing electro-mechanical devices in manufacturing and process control. Analog and digital inputs and output. Smart manufacturing. 3 lectures, 1 laboratory. Formerly IME 356.

IME 3410 Production Planning and Control Systems (4 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: IME 223, IME 305, IME 342, or IME 1223.

Systems and tools that support enterprises by planning and scheduling their resources. Manufacturing resource planning (MRP II), enterprise resource planning (ERP), demand forecasting, bill of materials, material requirements planning (MRP) computations, lot size calculations, and capacity management. 3 lectures, 1 laboratory. Formerly IME 410.

IME 3420 Process and System Simulation (4 units)
Term Typically Offered: F, SP
Prerequisite: IME 305 or IME 3302. Corequisite: One of the following: IME 326, IME 327, IME 3326, or IME 3327.

Stochastic and deterministic modelling. Decision trees, Bayesian analysis, queueing systems, process analysis. Random number generators. Design, improvement, and analysis of logistic, production and service systems. Monte Carlo, discrete-event, and agent-based simulation. Model verification and validation. Complex systems simulation using software. 3 lectures, 1 laboratory. Formerly IME 420.

IME 3443 Facilities Design and Warehousing (4 units)
Term Typically Offered: F, SP
Prerequisite: IME 223 or IME 1223.

Analytical tools to design or renovate the layout of manufacturing or service facilities. Product and process flow analysis. Material handling and location problems. Computer-aided layout design, evaluation, and mathematical models for warehouse design. Team projects. 3 lectures, 1 laboratory. Formerly IME 443.

IME 4319 Human Factors and Ergonomics in Engineering and Systems Design (3 units)
Term Typically Offered: F, SP
Prerequisite: Junior standing; one of the following: IME 326, IME 327, IME 3326, or IME 3327; and one of the following: PSY 201, PSY 202, or PSY 2201.

Human factors and ergonomics concepts; cognitive, physical, and organizational aspects. Design of work and workspace, safety, human errors, and integration with intelligent and automated systems. Usability testing, user experience and user interface tools, ethical data collection, diversity, equity, and inclusion concerns. 2 lectures, 1 laboratory. Formerly IME 319.

IME 4372 Applications of Enterprise Analytics (4 units)
Term Typically Offered: F, SP
Prerequisite: IME 212 or IME 2212; IME 326 or IME 3326; and one of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341.

Applications of data analytics to solve enterprise problems. Supervised and unsupervised learning. Regression, classification, clustering, and deep learning. Model selection and evaluation. Model biases and data ethics. 3 lectures, 1 laboratory. Formerly IME 372.

IME 4400 Special Problems for Advanced Undergraduates (1-4 units)
Term Typically Offered: F, SP, SU
Prerequisite: Consent of department chair and consent of instructor.

Individual investigation, research, studies, or surveys of selected advanced problems. Repeatable up to 4 units. Formerly IME 400.

IME 4401 Sales Engineering (1 unit)
Term Typically Offered: TBD
Prerequisite: Senior standing and engineering major.

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. Half-semester course. Course may be offered in classroom-based, online, or hybrid format. 1 unit. Formerly IME 401.

IME 4403 Software Product Management (3 units)
Term Typically Offered: TBD
Prerequisite: One of the following: CPE/CSC 101, CSC 231, CSC 232, CPE/CSC 1001, CSC 1031, or CSC 1032.

Agile management of software products. Software development lifecycle and technology stack. Management of performance metrics, product features, and engineering requirements. Analysis of user data. Marketing, business planning, and product launch. Course may be offered in classroom-based or online format. 3 lectures. Formerly IME 403.

IME 4408 Systems Engineering (2 units)
Term Typically Offered: TBD
Prerequisite: Senior standing and engineering major; or graduate standing.

Function of systems engineering in guiding complex system development and bridging disciplines. System life cycle stages: concept development, engineering development, and post-development. Methods and tools employed to ensure successful system design and development. Half-semester course. 2 units. Formerly IME 408.

IME 4415 Service Enterprises Engineering and Management (4 units)
Term Typically Offered: TBD
Prerequisite: One of the following: IME 305, IME 342, or IME 3302.

Analysis, design, and control of service enterprises including workforce planning, customer queueing, service facility location, yield management, and call center management. Case studies from the entertainment, retailing, and financial sectors, among others. Course may be offered in classroom-based or online format. 4 lectures. Formerly IME 415.

IME 4417 Supply Chain and Logistics Management (4 units)
Term Typically Offered: F, SP
Prerequisite: IME 342 or IME 3302.

Key supply chain and logistics management concepts. Models and solution methods for the design, control, operation, and management of supply chains. Techniques for network planning and supply chain risk management. Course maybe offered in classroom-based or online format. 4 lectures. Formerly IME 417.

IME 4418 Product and Process Development (4 units)
Term Typically Offered: F
Prerequisite: One of the following: IME 326, IME 327, IME 3326, or IME 3327.

Innovative product design and development process. Product definition and market survey. Technology survey and down-selection. Product quality and reliability in product and process development. Process characterization and optimization. Failure mode and effects analysis. Change control management. Ramp and capacity expansion. Product and process certification. Lean six sigma. 3 lectures, 1 laboratory. Formerly IME 418.

IME 4421 Engineering Management (2 units)
Term Typically Offered: TBD
Prerequisite: Junior standing; and one of the following: PSY 201, PSY 202, or PSY 2201. Recommended: IME 315 or IME 2315.

Theory and principles for manufacturing, service, and non-profit organizations. Competitive advantage. Strategic planning and operations management for organizations and teams in a rapidly changing, diverse environment. Engineering management concepts, including ethical, sustainable, and inclusive leadership practices. Team-based projects and cases. Course may be offered in classroom-based, online, or hybrid format. 2 seminars. Formerly IME 421.

IME 4424 Industrial Engineering in Healthcare (2 units)
Term Typically Offered: SP
Prerequisite: IME 223 or IME 1223.

Application of industrial engineering tools and methodologies in the healthcare industry. The healthcare delivery system, patient flow, healthcare supply chains, financing, reliability, and patient safety. Data analysis. Management strategies. Emerging topics in healthcare. Social justice concerns. Half-semester course. 2 units. Formerly IME 424.

IME 4428 Engineering Metrology (3 units)
Term Typically Offered: TBD
Prerequisite: One of the following: IME 143, IME 144, IME 146, or IME 1143; and one of the following: IME 327, IME 503, IME 3327, IME 5503, STAT 312, or STAT 3210.

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. Geometric Dimensioning and Tolerancing (GD&T). Coordinate Measurement Machines (CMM). Surface roughness. Metrology for electronic products. 2 lectures, 1 laboratory. Formerly IME 428.

IME 4432 Additive Manufacturing (3 units)
Term Typically Offered: F, SP
Prerequisite: One of the following: IME 144, IME 1140, ME 251, or ME 2248; and one of the following: MATE 210, MATE 1210, or MATE 1220. Recommended: IME 330 or IME 3330.

Engineering principles, materials, equipment, process flow, post processing, and applications of additive manufacturing processes. Digital file preparation. Design for additive manufacturing. Process selection, environment considerations, safety, and cost analysis for manufacturing. 2 lectures, 1 laboratory. Formerly IME 432.

IME 4435 Reliability for Design and Testing (3 units)
Term Typically Offered: TBD
Prerequisite: One of the following: IME 327, IME 503, IME 3327, IME 5503, STAT 312, or STAT 3210; or graduate standing.

Reliability concepts and mathematical models. Failure distributions. Reliability of mechanical and electrical devices. Systems reliability, maintainability, and availability. Reliability management software. Product design considerations. Failure modes and effects. Fault trees. Reliability testing and program management. Course may be offered in classroom-based or online format. 3 lectures. Formerly IME 435.

IME 4441 Engineering Supervision (1 unit)
Term Typically Offered: F, SP
Prerequisite: Junior standing and consent of instructor.

Application of fundamental concepts and techniques of supervision provided by assignment in engineering laboratories. Equipment setup. Hardware and/or software configuration. Instructional support. 1 laboratory. Formerly IME 441.

IME 4450 Computer-Aided Manufacturing and Process Analysis (4 units)
Term Typically Offered: SP
Prerequisite: One of the following: CSC 101, CSC 232, CSC 1001, CSC 1032, or ME 2240; and one of the following: MATH 244, MATH 1151, or MATH 2341. Corequisite: IME 330 or IME 3330.

Computer-aided product modeling and manufacturing. Computer Numerical Control (CNC) programming. Software for process simulation, machine operation, and inspection. Motion control hardware and system design. Computer-aided engineering analysis of processes and tooling. CNC equipment setup and operation. CNC machining projects. 3 lectures, 1 laboratory. Formerly IME 450.

IME 4456 Sensing Systems and the Industrial Internet of Things (3 units)
Term Typically Offered: TBD
Prerequisite: One of the following: CSC 101, CSC 232, CSC 1001, or CSC 1032. Recommended: One of the following: DATA 301, DATA 3301, IME 212, or IME 2212; EE 201 or EE 2201; EE 241 or EE 2241; IME 101 or IME 1101; and IME 156 or IME 1156.

Internet-enabled device technologies for industrial applications. Sensor setup. Data collection, storage, and analysis for real-time control and decision-making. Internet communications standards and protocols. Ethics and security issues. Applications such as asset tracking, equipment maintenance, and smart facilities. Course may be offered in classroom-based or online format. 2 lectures, 1 laboratory. Formerly IME 456.

IME 4460 Value Chain Analysis (3 units)
Term Typically Offered: TBD
Prerequisite: Senior standing; and one of the following: IME 223, IME 1223, ITP 303, or ITP 3303.

Value chain concepts and their application to the analysis and improvement of business operations. Application of lean principles to optimize the value chain. Analysis of current industry trends and impact on the value chain. Course may be offered in classroom-based, online, or hybrid format. 3 lectures. Formerly IME 460.

IME 4461 Senior Project - Design I (2 units)
Term Typically Offered: F
Prerequisite: Senior standing; IME 315 or IME 2315; and one of the following: IME 314, IME 326, IME 327, IME 3326, or IME 3327. Corequisite: One of the following: IME 301, IME 330, IME 342, IME 3302, or IME 3330. Recommended: One of the following: IME 418, IME 430, IME 3420, or IME 4418; and completion of all IME 3000-level coursework.

Culminating design project typical of problems in professional practice. System design, modeling, analysis, and testing. Problem definition, planning, scheduling, literature review, conceptual and alternative designs. Business case development. Project documentation and reporting. Professional ethics. Field trip may be required. 1 lecture, 1 laboratory. Formerly offered as part of the IME 481, 482, 483 series; students may not earn credit for both IME 481 and IME 4461.

IME 4462 Senior Project - Design II (2 units)
Term Typically Offered: SP
Prerequisite: IME 481 or IME 4461.

Continuation of senior project. Design of potential solutions, evaluation of proposed solutions, prototype development or design implementation, solution testing. Formal project results documentation suitable for reference library. Formal oral presentations. Professional ethics. Field trip may be required. 1 lecture, 1 laboratory. Formerly offered as part of the IME 481, 482, 483 series; students may not earn credit for both IME 483 and IME 4462.

IME 4470 Special Advanced Topics (1-4 units)
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 8 units. Course may be offered in classroom-based, online, or hybrid format. 1 to 4 lectures. Formerly IME 470.

IME 4471 Special Advanced Laboratory (1-4 units)
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group laboratory study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 8 units. 1 to 4 laboratories. Formerly IME 471.

IME 4495 Cooperative Education Experience (12 units)
Term Typically Offered: F, SP, SU
CR/NC
Prerequisite: Sophomore standing and consent of instructor.

Work experience in business, industry, government, and other areas of career interest. Positions are paid and usually require relocation and course registration for one to two consecutive semesters. Formal report and work supervisor evaluation required. No major credit allowed. Repeatable up to 24 units. Credit/No Credit grading only. Formerly IME 495.

IME 5500 Individual Study (1-4 units)
Term Typically Offered: F, SP
Prerequisite: Consent of department chair, graduate advisor, and instructor.

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. Enrollment by petition. Repeatable up to 8 units. Formerly IME 500.

IME 5503 Applied Statistical Methods in Engineering (3 units)
Term Typically Offered: F
Prerequisite: Graduate standing.

Application of important statistical distributions in engineering and management. Sampling distributions and their roles in design of experiments. Applications of hypothesis testing, ANOVA, and analysis of covariance. Simple, multiple, and nonlinear regression in industry and service systems. Introduction to nonparametric analysis. Not open to students with credit in IME 3326 or IME 3327. 2 lectures, 1 laboratory. Formerly IME 503.

IME 5507 Graduate Seminar (2 units)
Term Typically Offered: F
Prerequisite: Graduate standing.

Seminars in industrial engineering and engineering management by researchers and practitioners from academia and industry. Thesis/project writing. Literature survey. Instructor-led scientific paper reading and analysis. Overview of graduate education requirements. Career paths including Ph.D. Ethics issues in research. 1 seminar, 1 laboratory. Formerly IME 507.

IME 5510 Model-Based Systems Engineering (3 units)
Term Typically Offered: TBD
Prerequisite: IME 408 or IME 4408; or graduate standing.

Introduction to Model-Based Systems Engineering (MBSE). Graphical models at different levels of abstraction. Systems Modeling Language (SysML) and Unified Modeling Language (UML). Block definition diagrams, use case diagrams, activity diagrams, and state-machine diagrams. Requirements engineering in MBSE. System simulation and design optimization. 2 lectures, 1 laboratory. Formerly IME 510.

IME 5520 Advanced Information Systems for Operations (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

Advanced information systems (IS) applications in manufacturing and service operations. Introduction of common IS applications, including manufacturing execution systems, reporting systems, capacity planning systems, scheduling systems, and customer inquiry systems. Industry-specific analysis of IS requirements and availability. 3 seminars. Formerly IME 520.

IME 5527 Design of Experiments for Industrial Applications (3 units)
Term Typically Offered: TBD
Prerequisite: One of the following: IME 326, IME 327, IME 503, IME 3326, IME 3327, IME 5503, STAT 312, or STAT 3210; or graduate standing.

Experimental design principles. Comparative experiments. Model building using analysis of variance. Regression models. Replication, randomization, and blocking. Complete and fractional factorial designs. Noise factors and robustness in design. Response surface methodology and optimization. Industrial applications. Hands-on design projects. 2 lectures, 1 laboratory. Formerly IME 527.

IME 5535 Change Management for Engineering Leaders (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

Engineering change processes, configuration management, implementation in project management, cultural change, change models, and personal change. Processes used in reacting to and managing changes. Learning through discussion and applications which might include conflict, emotion, and differing opinions. Course may be offered in classroom-based or online format. 3 lectures. Formerly IME 535.

IME 5541 Advanced Operations Research (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing. Recommended: One of the following: IME 420, IME 3302, or IME 3420.

Advanced modeling, analysis, and optimization techniques. Real-world industrial, business and service applications. Mixed-integer programming, nonlinear programming, dynamic programming, constraint programming, and stochastic programming. Heuristic solution techniques and state-of-the-art optimization software. 2 lectures, 1 laboratory. Formerly IME 541.

IME 5543 Applied Human Factors (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

Human factors/ergonomics analysis and evaluation of automation, mobile communication technology, and interface design for Internet websites. Usability analysis of consumer hardware/software products with an emphasis on a user-centric design approach. Team-based projects. 2 lectures, 1 laboratory. Formerly IME 543.

IME 5544 Advanced Engineering Economy (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing. Recommended: IME 315 or IME 2315.

Review of interest calculations and comparison of economic alternatives. Replacement analysis. Capital planning and budgeting. Mathematical programming. Utility theory. Decision making under risk and uncertainty. Application of simulation in risk modeling. Impact of financial strategy on historically marginalized groups. 2 lectures, 1 activity. Formerly IME 544.

IME 5545 Advanced Simulation (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing. Recommended: One of the following: IME 420, IME 3302, or IME 3420.

Advanced discrete-event, agent, and system dynamics simulation models. Integration of optimization, machine learning, and data analytics. Implementation, visualization, verification, and validation using simulation software. Large-scale data and scenario analysis. Real-world applications including transportation, logistics, telecommunication, manufacturing, service, and finance. 2 lectures, 1 laboratory. Formerly IME 545.

IME 5556 Technological Project Management (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

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. 2 lectures, 1 laboratory. Formerly IME 556.

IME 5565 Predictive Data Analytics for Engineers (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing; or one of the following: DATA 301, DATA 3301, IME 372, or IME 4372. Recommended: IME 326 or IME 3326; one of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341; and one of the following: STAT 302, STAT 312, STAT 3210, or STAT 3520.

Applications of predictive data analytics to enhance performance of engineering systems, processes, and products. Machine Learning pipelines for efficient data preprocessing and modeling. Engineering applications of Deep Learning. Web application deployment of prediction models. Model biases and data ethics. 2 lectures, 1 laboratory. Formerly IME 565.

IME 5570 Special Advanced Topics (1-4 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing and consent of instructor.

Directed group study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 8 units. Course may be offered in classroom-based, online, or hybrid format. 1 to 4 lectures. Formerly IME 570.

IME 5571 Special Advanced Laboratory (1-2 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing and consent of instructor.

Directed group laboratory study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 4 units. 1 to 2 laboratories. Formerly IME 571.

IME 5577 Engineering Entrepreneurship (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

The special requirements of entrepreneurship in a high-tech environment. Guest lectures, focused topics, a business plan project, and case studies provide the tools to evaluate and pursue technology-based business opportunities. 3 lectures. Formerly IME 577.

IME 5580 Manufacturing Systems (3 units)
Term Typically Offered: TBD
Prerequisite: Graduate standing.

Modern approaches in production and inventory management for large-scale manufacturing systems. Material requirements planning, manufacturing resource planning, and just-in-time manufacturing systems. Enterprise resource planning systems. Information requirements, operational issues, and policy matters. Not open to students with credit in IME 410 or IME 3410. Course may be offered in classroom-based or online format. 3 lectures. Formerly IME 580.

IME 5598 Project (1-4 units)
Term Typically Offered: F, SP
Prerequisite: Graduate standing and consent of instructor.

Culminating experience focusing on a significant industry or applied research project in the field of engineering management. The project involves student, faculty, and possibly a sponsoring representative in a collaborative learning environment culminating in a comprehensive written report and presentation. Repeatable up to 4 units. Formerly IME 596.

IME 5599 Thesis (1-6 units)
Term Typically Offered: F, SP
Prerequisite: Graduate standing and consent of instructor.

Analysis and solution of advanced industry or research problem in the field of industrial engineering. Supervision by faculty. Both a written thesis and an oral defense are required. Repeatable up to 6 units. Formerly IME 599.