Industrial and Manufacturing Systems Engineering (IMSE)

IMSE 111. Introduction to Industrial and Manufacturing Systems Engineering. 3 Credits.
Overview of industrial engineering and manufacturing engineering professional careers and work environments. Basic skill acquisition using computer software tools to solve engineering problems, prepare reports, plan projects, deliver professional presentations, and manage data.

IMSE 199. Special Topics. 1-5 Credits.
Special Topics.

IMSE 299. Special Topics. 1-5 Credits.
Special Topics.

IMSE 311. Work/Station Design and Measurement. 3 Credits.
Analytical methods for measuring human performance in industrial, commercial and manufacturing settings. Development of work procedures and design of workstations. Considerations of ergonomics, safety, performance effectiveness and efficiency, interactions between workstations, information and data requirements, production throughput, training and skill requirements, and resources. Weekly laboratory.

IMSE 330. Manufacturing Processes. 3 Credits.
Traditional manufacturing processing methods as employed in contemporary practice. Includes properties of materials, machining, casting, forming, and fabrication techniques. Several experiments will be conducted on various manufacturing processes in the laboratory. Coreq: ME 212.

IMSE 335. Welding Technology. 3 Credits.
Study of arc and gas welding technology together with related metallurgy. Laboratory instruction in welding techniques and skills. 2 recitations, 1 two-hour laboratory.

IMSE 380. CAD/CAM for Manufacturing. 3 Credits.
Coverage of CAD, numerical control, and CAM software. Use of manufacturing standards for geometric dimensioning and tolerancing. Prereq: ME 212.

IMSE 397. Fe/Coop Ed/Internship. 1-4 Credits.

IMSE 399. Special Topics. 1-5 Credits.
Special Topics.

IMSE 411. Human Factors Engineering. 3 Credits.
A survey of human factors engineering topics with an emphasis on optimizing person-machine and person-system interactions. Human physical and cognitive capabilities will be investigated to improve work design, interface design, and usability. Prereq: IMSE 311, IMSE 460. Dual-listing: IMSE 611.

IMSE 430. Process Engineering. 3 Credits.
Comprehensive analysis of selected manufacturing processes; mathematical modeling of process dynamics, and evaluation of processing alternatives. Design of effective and efficient processes for selected industrial products. Prereq: IMSE 330. Dual-listing: IMSE 630.

IMSE 431. Production Engineering. 3 Credits.
Design of a production system for selected manufactured products, development of production system flow maps and linked process dynamic models, evaluation of throughput and identification of constraints. Evaluation of alternative solutions for production constraints. Prereq: IMSE 330. Prereq or Coreq: Junior Standing. Dual-listing: IMSE 631.

IMSE 432. Composite Materials Manufacturing. 3 Credits.
Processes for manufacturing products from fiber-reinforced composite materials. Analysis of tooling, process variables and quality management during processing. Design of processes for manufacture of selected composite parts. Weekly laboratory. Prereq: IMSE 330, ME 331.

IMSE 433. Additive Manufacturing. 3 Credits.
A synchronized approach considering functional design, analysis and manufacturing that support seamless integration of geometry with performance. The course will address additive manufacturing principles; scope of additive manufacturing; bio-manufacturing. Prereq: IMSE 330. Dual-listing: IMSE 633.

IMSE 440. Engineering Economy. 3 Credits.
Capital investment decision foundation within rules of general and project accounting. Analysis of benefits and returns against cost for engineering installation, operation, life cycle and make-or-buy decisions. Prereq or Coreq: Junior standing. Dual-listing: IMSE 640.

IMSE 450. Systems Engineering and Management. 3 Credits.
Systems thinking as a framework for better understanding the complex processes. Foundational concepts and approaches for systems thinking to generate analytical model tools and systems-based models to support the decision-making processes. Prereq or Coreq: Junior standing. Dual-listing: IMSE 650.

IMSE 451. Logistics Engineering and Management. 3 Credits.
This course emphasizes integrated logistics management methods to improve the effectiveness and efficiency of material flow, information flow and cash flow for the entire supply chains. Prereq: IMSE 470. Coreq: IMSE 450. Dual-listing: IMSE 651.

IMSE 453. Hospital Management Engineering. 3 Credits.
Survey of management engineering roles in the delivery of health care. Review of functional relationships present in health care delivery systems. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction, process redesign, facility design, quality improvement, and systems integration. Dual-listing: IMSE 653.

IMSE 456. Program and Project Management. 3 Credits.
Integrated approaches to managing engineering, technology and business projects, addressing the project management lifecycle including initiating, planning, executing, controlling and closing. Additional topics include program management, portfolio management, and applying principles in a business environment. Prereq or Coreq: Junior standing. Dual-listing: IMSE 656.

IMSE 460. Evaluation of Engineering Data. 3 Credits.
Collection, analysis, evaluation, and presentation of engineering and scientific data, SPC, Sampling, Descriptive Statistics, Discrete and Continuous statistical distributions, Estimation Procedures, Hypothesis Testing, Linear Regression and ANOVA. Prereq: MATH 166. Dual-listing: IMSE 660.

IMSE 461. Quality Assurance and Control. 3 Credits.
Proactive and reactive quality assurance and control techniques; emphasis on quality planning, statistical process control, acceptance sampling, and total quality management. Issues in reliability and maintainability engineering. Prereq: IMSE 460. Dual-listing: IMSE 661.

IMSE 462. Total Quality In Industrial Management. 3 Credits.
The meaning and means for achieving 'total quality' in all dimensions of industrial activities and organizations. Topics include continuous improvement, statistical process control, leadership, and training. Dual-listing: IMSE 662.

IMSE 465. Introduction to Machine Learning. 3 Credits.
This course covers foundational ML topics, including linear and multiple regression, Lasso and Ridge regression, gradient descent, classification methods (kNN, decision trees, random forests, logistic regression), clustering techniques (k-means, k-modes, agglomerative clustering), neural networks (feedforward networks and backpropagation), and applications of large language models (LLMs). Selected engineering machine learning applications will be explored, and the role of responsible AI in contemporary technological advancements will be discussed. Prereq: IMSE 460. Dual-listing: IMSE 665.

IMSE 470. Operations Research I. 3 Credits.
Techniques to optimize and analyze industrial operations. Use of linear programming, transportation models, networks, integer programming, goal programming, dynamic programming, and non-linear programming. Prereq: MATH 129. Co-req: IMSE 460. Dual-listing: IMSE 670.

IMSE 472. Simulation of Business and Industrial Systems. 3 Credits.
Development of the fundamentals and techniques of simulating business and industrial systems. Monte-Carlo techniques and computer usage. Prereq: IMSE 460, high-level computer language. Dual-listing: IMSE 672.

IMSE 480. Production and Inventory Control. 3 Credits.
Planning and controlling of industrial production and inventory: demand forecasting, master scheduling, materials requirements planning, job scheduling, assembly line balancing, quality control, inventory, and just-in-time production. Prereq: IMSE 460. Dual-listing: IMSE 680.

IMSE 482. Automated Manufacturing Systems. 3 Credits.
Design of integrated production systems including flexible, programmed automatic control for fabrication, assembly, packaging, movement, and storage. Numerical control, flexible manufacturing systems, and computer integrated manufacturing. 2 recitations, 1 two-hour laboratory. Prereq: IMSE 311, IMSE 330, PHYS 252. Dual-listing: IMSE 682.

IMSE 484. Scheduling Methods. 3 Credits.
Concepts, methods, and results of scheduling theory. Modern sequencing and scheduling applications in industrial and manufacturing systems. Optimization methods, algorithms, and heuristic procedures to solve practical scheduling problems such as single machine, parallel machines, job families and batches, flow shop, and job shop. Prereq or Coreq: Junior Standing. Dual-listing: IMSE 684.

IMSE 485. Industrial and Manufacturing Facility Design. 3 Credits.
This course will focus on facilities planning with the emphasis on the design, analysis, and selection of manufacturing/service facilities. The topics of discussion will range from definition of facilities planning; role of product, process and schedule design on facilities planning; relationship among flow, space and activity. Student will also learn on how to determine the space requirements for personnel and equipment. The class also discuss material handling systems, principles of storage and warehousing, and quantitative models for the facilities planning. Prereq or Coreq: Senior standing. Dual-listing: IMSE 685.

IMSE 489. Industrial and Manufacturing Engineering Capstone. 3 Credits.
Capstone experience. Student projects in design, analysis, and experimental investigation related to industrial and manufacturing engineering. Prereq: IMSE 482 Prereq or Coreq: Senior standing with less than 36 hours of required class work to graduate.

IMSE 611. Human Factors Engineering. 3 Credits.
A survey of human factors engineering topics with an emphasis on optimizing person-machine and person-system interactions. Human physical and cognitive capabilities will be investigated to improve work design, interface design, and usability. Dual-listing: IMSE 411.

IMSE 630. Process Engineering. 3 Credits.
Comprehensive analysis of selected manufacturing processes; development of process flow maps, schematic and mathematical modeling of process dynamics, and evaluation of processing alternatives. Design of effective and efficient processes for selected industrial products. Seminar/case study format. Dual-listing: IMSE 430.

IMSE 631. Production Engineering. 3 Credits.
Design of a production system for selected manufactured products, development of production system flow maps and linked process dynamic models, evaluation of throughput and identification of constraints. Evaluation of alternative solutions for production constraints. Undergraduate: design of fixtures, dies and tooling for economical production. Graduate: In-depth analysis of contemporary production systems for selected manufactured products; development of production systems issues. Seminar/case study format. Recommended: IME 630. Dual-listing: IMSE 431.

IMSE 633. Additive Manufacturing. 3 Credits.
A synchronized approach considering functional design, analysis and manufacturing that support seamless integration of geometry with performance. The course will address additive manufacturing principles; scope of additive manufacturing; bio-manufacturing. Dual-listing: IMSE 433.

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Collection, analysis, evaluation, and presentation of engineering and scientific data, SPC, Sampling, Descriptive Statistics, Discrete and Continuous statistical distributions, Estimation Procedures, Hypothesis Testing, Linear Regression and ANOVA. Dual-listing: IMSE 460.

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Proactive and reactive quality assurance and control techniques; emphasis on quality planning, statistical process control, acceptance sampling, and total quality management. Issues in reliability and maintainability engineering. Prereq: IMSE 660. Dual-listing: IMSE 461.

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IMSE 682. Automated Manufacturing Systems. 3 Credits.
Design of integrated production systems including flexible, programmed automatic control for fabrication, assembly, packaging, movement, and storage. Numerical control, flexible manufacturing systems, and computer integrated manufacturing. 2 recitations, 1 two-hour laboratory. Dual-listing: IMSE 482.

IMSE 684. Scheduling Methods. 3 Credits.
Concepts, methods, and results of scheduling theory. Modern sequencing and scheduling applications in industrial and manufacturing systems. Optimization methods, algorithms, and heuristic procedures to solve practical scheduling problems such as single machine, parallel machines, job families and batches, flow shop, and job shop. Dual-listing: IMSE 484.

IMSE 685. Industrial and Manufacturing Facility Design. 3 Credits.
This course will focus on facilities planning with the emphasis on the design, analysis, and selection of manufacturing/service facilities. The topics of discussion will range from definition of facilities planning; role of product, process and schedule design on facilities planning; relationship among flow, space and activity. Student will also learn on how to determine the space requirements for personnel and equipment. The class also discuss material handling systems, principles of storage and warehousing, and quantitative models for the facilities planning. Dual-listing: IMSE 485.

IMSE 764. Experimental Design and Analysis for Advanced Applications. 3 Credits.
This course offers an advanced exploration of the principles, methodologies, and applications of Design of Experiments (DOE) across engineering, applied sciences, and industrial contexts. Students will develop the ability to design, execute, and critically analyze controlled experiments to investigate complex systems and quantify the effects of multiple factors on outcomes. The course emphasizes rigorous statistical reasoning, integration of computational tools (e.g., JMP, Minitab, or R), and the translation of experimental insights into actionable decisions. Case studies spanning diverse domains are employed to illustrate real-world applications and foster interdisciplinary perspectives.

IMSE 765. Data Analysis. 3 Credits.
Applications oriented. Topics include: statistical estimation, hypothesis testing, non-parametric methods, design of experiments, factorial experiments, response surface methodology, regression analysis, time series analysis and forecasting, multivariate methods, statistical control charts.

IMSE 770. Quantitative Modeling. 3 Credits.
Applications modeling and optimization methods. Domains: transportation, logistics, manufacturing, service systems scheduling, and supply-chain management. Decision models: linear programming and sensitivity analysis, transportation and assignment, network models and algorithms, and integer, dynamic and nonlinear programming. Cross-listed with ENGR 770.

IMSE 771. Probabilistic and Deterministic Methods. 3 Credits.
Models and tools include stochastic processes, Markov chains, deterministic and stochastic decision analysis, Markov decision process, Poisson processes, queuing, stochastic simulation modeling, time series, forecasting, and regression modeling. Domains include inventory, transportation, manufacturing, service systems, scheduling, and supply-chain management. Cross-listed with ENGR 771.

IMSE 774. Neural Networks. 3 Credits.
This course provides an in-depth exploration of neural networks, with a strong focus on deep learning. Students will learn fundamental concepts, including shallow and deep neural networks, optimization techniques, loss functions, and performance evaluation. The course covers key architectures such as Convolutional Neural Networks (CNNs), Transformers, Graph Neural Networks (GNNs), and Generative Adversarial Networks (GANs). Emphasis is placed on practical applications, with Python-based implementation, assignments, and a hands-on project aimed at solving real-world problems. Students will also engage in critical analysis of recent research in the field.

IMSE 775. Data Driven Modeling and Optimization. 3 Credits.
This course covers mathematical modeling and optimization fundamentals in the context of machine learning. Key areas include optimization basics, heuristics, data handling, interpretable machine learning models, and regression from an optimization perspective. It delves into Support Vector Machines and Large Language Models, along with the field of Natural Language Processing. Practical skills are developed through coding exercises and a hands-on project, combining theory with application.

IMSE 777. Graph Data Analytics. 3 Credits.
This course covers data analytics and machine learning (ML) with graph data structures, focusing on node, edge, and graph embedding, and representation learning. It includes descriptive network analysis, traditional ML on graphs, and graph neural networks. Practical aspects of the course involve coding for network analysis and ML. The course also features contemporary topic presentations by students and a hands-on project, blending theory with real-world application.

IMSE 780. Advanced Production and Inventory Control. 3 Credits.
Study of the theory and applications of production scheduling, inventory management, production planning, just-in-time production, and materials requirement planning.

IMSE 790. Seminar. 1-5 Credits.
A group of students engaged, under a professor or professors, in research or criticism and in presentation of reports pertaining thereto.

IMSE 794. Practicum/Internship. 1-8 Credits.

IMSE 798. Master's Thesis. 1-10 Credits.

IMSE 899. Doctoral Dissertation. 1-15 Credits.