MMIE 7100. PhD Seminar.
This course provides information regarding the resources that are available to the students in the mechanical and manufacturing engineering Ph.D. program for finding literature, using labs and facilities, selecting research topic and advisor, copyright and plagiarizing, and technical writing. It is expected that by the end of this course, students can select their advisor and research topic and write and present a literature review on the topic.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

MMIE 7199. Dissertation.
This course consists of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

MMIE 7299. Dissertation.
This course consists of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MMIE 7305. Advanced Design of Experiments.
This course teaches students to plan, design and conduct experiments efficiently and effectively, and to analyze the resulting data for obtaining valid conclusions. Students use computer experiments and software tools to optimize manufacturing, energy and service operations based on both deterministic and stochastic models. Topics include full and fractional factorial designs, blocking and confounding design, regression model, response surface method and design, and robust parameter design or Taguchi method. Through the course project, students apply the optimal design methodology to improve a real manufacturing or service process.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7310. Machine Learning and Artificial Intelligence for Engineers.
This course examines fundamental artificial intelligence and machine learning techniques useful for developing intelligent software tools to support engineering design and other engineering activities. The course covers the theory of techniques such as search, constraint satisfaction, probability, data mining, pattern recognition, and neural networks, and examines issues related to their implementation. It also considers their application to engineering tasks, such as design representation and automation.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7311. Cyber-Physical Systems Architecture.
This course covers principles and methods for technical system architecture with a focus on cyber-physical systems. Topics include the resolution of ambiguity to identify system goals and boundaries, the creative process of mapping form to function, and methods of decomposition and re-integration. Heuristic and formal methods are presented.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7312. Digital Twins.
This course introduces the concept of Digital Twins and describes how they are applied in engineering and what should be considered to implement this technology in products and manufacturing systems. Considerations include information technology infrastructure, enabling technologies, the business value of implementing Digital Twins, and what needs to happen across the organization to ensure successful implementation. This course also explores the digital twin approach to the design, operation, and maintenance of industrial assets and products.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7313. Advanced Robotics#.
This course provides knowledge of robotic technology and design techniques to improve the interaction between robots and humans through effective and safe automated solutions. Topics include forward and inverse kinematics, velocity kinematics, introduction to dynamics and control theory, sensors, actuators, basic probabilistic robotics concepts, fundamentals of computer vision, and robot ethics. In addition, modular robot programming will be covered, and the concepts learned will be applied using realistic simulators.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7314. Human-Robot Interaction.
This course focuses on human-robot interaction and social robot learning, exploring the leading research, design principles and technical challenges faced in developing robots capable of operating in real-world human environments. The course will cover a range of multidisciplinary topics, including physical embodiment, mixed-initiative interaction, multi-modal interfaces, human-robot teamwork, learning algorithms, aspects of social cognition, and long-term interaction. Prerequisite: MMIE 7313 with grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7315. Advanced Additive Manufacturing.
This course examines the standards, theory, techniques, applications, and development of additive manufacturing technology. Safety considerations, contemporary technologies, ideas, and processes will also be studied. Because additive manufacturing technologies are relatively new and growing, the course involves literature reviews and team projects. Projects include in-depth studies on futuristic ideas, biomimicry, contemporary technologies, materials, and processes.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

MMIE 7316. Cybersecurity for Mechanical and Manufacturing Systems.
This class covers the protection of information assets and systems by integrating technical controls with policies, best practices, and guidelines of cybersecurity. Taking both a policy-based and technical approach, this course examines external and internal security threats in highly connected enterprises and risks to core businesses relative to people, processes, data, facilities, and technologies. The course also addresses how to implement and effectively manage the major technical components of security architectures and selected methods of attacking enterprise architectures.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7317. Applied Data Science I.
This course covers machine learning tools. Topics include supervised algorithms, techniques for improving model performance, evaluation techniques, and software packages for implementation. Emphasis will be placed on real-world applications across various domains particularly relevant to mechanical, manufacturing or industrial engineering (MMIE) and engineering management (EM) fields. Prerequisite: MMIE 7305 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7318. Applied Data Science II.
This course focuses on concepts and techniques in unsupervised machine learning. Students will explore various algorithms and methodologies for extracting meaningful information from unlabeled data. The course covers dimensionality reduction, clustering methods, generative models, and deep unsupervised learning. Emphasis will be placed on understanding and implementation of unsupervised learning models across various domains particularly relevant to mechanical, manufacturing and industrial engineering (MMIE) and engineering management (EM) fields. Prerequisite: MMIE 7317 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7320. Advanced Solid Mechanics.
This course develops principles of advanced strength of materials and elasticity theory leading to solution of practical engineering problems concerned with stress and deformation analysis. Topics include tensor analysis, coordinate transformations, alternative measures of strain, stress measures, elastic constitutive equations, and formulation and solution of elasticity problems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7322. Advanced Fluid Mechanics.
This course is an in-depth exploration of the principles, theories, and applications of fluid dynamics at an advanced level. The topics covered in this course include the conservation of mass, momentum, and energy, as well as incompressible inviscid and viscous flows, and the Navier-Stokes equations. Moreover, students will explore similarity and dimensional analysis, boundary layers, separation phenomena, circulation and vorticity theorems, and both laminar and turbulent boundary layers, including high-speed flows.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7324. Advanced Heat Transfer.
This course offers specialized knowledge in advanced heat transfer principles and applications. It covers topics such as conduction in complex geometries, convective heat transfer, heat exchanger design, and radiative heat transfer. Emphasis is placed on real-world engineering applications, including thermal management in electronics and renewable energy systems. Students will engage in theoretical lectures, practical exercises, and numerical simulations. The course explores cutting-edge research, enabling students to solve complex engineering problems and optimize thermal systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7326. Advanced Mechanical System Control.
This course covers dynamic modeling, simulation, and control techniques applied to mechanical systems. Topics include state-space representation, controllability and observability, state and output feedback, state estimation and observers, full-state and reduced order observers, quadratic regulator theory, phase plane analysis, limit cycles, bifurcation and Lyapunov stability theories, feedback linearization, and selected techniques for non-linear control design.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7330. Advanced Finite Element Analysis.
This course covers variational and weighted residual approaches to the formulation of finite element equations with emphasis on solid mechanics problems. Topics include element formulation, numerical integration, imposition of constraints, convergence, error estimation, and an introduction to more advanced topics such as geometric and material nonlinearities, contact problems, and the solution of dynamic problems and time integration.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7332. Computations in Fluid Mechanics and Heat Transfer.
This course covers the theory and application of state-of-the-art computational fluid dynamics techniques. Topics include discretization methods such as the finite volume method and the finite element method and presents numerical modeling concepts like conservation and stability that are common to all methods. Specific physical modeling topics that will be covered are turbulence modeling (basic turbulent flow physics, Reynolds averaged models, and Large Eddy Simulation), and techniques for modeling flows with moving boundaries.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7340. Advanced Computer Aided Engineering.
This course covers application of computer-assisted math-based analysis and simulation techniques to the product development process. It combines computer-aided design (CAD) with disciplines such as finite element analysis (FEA), computation fluid dynamics (CFD), multiphysics, and engineering calculations. CAE aims to create products, assemblies, and component parts that are not only validated to survive their operating conditions but also optimized for desired characteristics like weight and strength.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7341. Advanced Micro and Nano Manufacturing.
This course covers advanced topics on micro and nano manufacturing processes, techniques, and applications. Topics include overall semiconductor manufacturing processes and materials, lithography, oxidation, etching, ion implantation, physical and chemical vapor deposition, atomic layer deposition, chemical mechanical planarization, thin film and surface technologies, microelectromechanical (MEMS) devices, and design issues for fabrication of micro and nano-systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7342. Advanced Polymer Nanocomposites#.
This course covers materials, processing, characterization, and applications of thermoset and thermoplastics polymer nanocomposites. Morphological, thermal, mechanical, ablative, magnetic, and electrical characterization will be discussed in detail. Applications include fire-resistant, ablative, fatigue-resistant, impact-resistant, bio-based, electrically conductive, magnetic, and high-temperature composites.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7362. Time Series Analysis and Forecasting.
This course aims to introduce theory and application of both Box-Jenkins statistical methods and deep learning techniques for time series modelling and forecasting. The course covers model identification, estimation, diagnostics and forecasting techniques for stationary and non-stationary univariate and multivariate time series. All data analysis in the course is performed using state-of-the-art software and real-world examples.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7367. Database Analytics for Web-Based Optimization.
This course teaches students how to develop data-driven and scalable optimization applications that bring high value to decision-makers in manufacturing and service enterprises. Design of user interfaces, database systems and access to cloud computing servers is covered. The scalable and distributed decision support systems taught in this course are also indispensable for students researching on mathematical optimization and doing large-scale experimentation. The techniques for experimenting with mathematical programming models in non-cloud high-performance computer clusters are also covered.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7370. Stochastic Simulation.
This course covers simulation modeling and programming in general-purpose languages (specifically VBA for Excel) and in specialized simulation environments (Simio, @Risk). The probability foundations of stochastic simulation, simulation optimization, and proper design and analysis of the simulation experiment are emphasized. Applications are drawn from manufacturing, financial, logistics and service systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7372. Network Flow Optimization.
This course covers network flow optimization, focusing on three classes of problems: shortest path problems, maximum flow problems, and minimum cost flow problems. The class will emphasize modeling and algorithms, introducing theory as needed. Students will extensively use network optimization software, with applications relevant to mechanical, manufacturing or industrial engineering (MMIE).
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7374. Applications of Data Science in Multi-Objective Optimization.
This course gives students an in-depth understanding of the intersection between data science techniques and multi-objective optimization. It equips students with the knowledge and skills required to address real-world problems that involve multiple conflicting objectives by leveraging data-driven approaches and optimization techniques. This course assumes a prerequisite solid understanding of data analysis, programming, and optimization concepts. Prerequisite: MMIE 7317 with a grade of "B"or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7379. Modeling and Design of Net-Zero Manufacturing and Service Enterprises.
This course teaches students to design and operate carbon neutral and zero-energy manufacturing, transportation, and service infrastructure through the integration of renewable energy. Students use statistics and probability theory, design of experiments, discrete event and agent-based simulation, and stochastic optimization to solve large scale, multi-layer manufacturing supply chain design and operation problems. Through the semester-long team project, students make both strategic and operational decisions on production, warehousing, transportation, and microgrid generation in the nexus of manufacturing, energy and climate.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MMIE 7399. Dissertation.
This course consist of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MMIE 7599. Dissertation.
This course consist of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MMIE 7699. Dissertation.
This course consist of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MMIE 7999. Dissertation.
This course consist of original research and writing in mechanical and manufacturing engineering to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit