Summary of Graduate Courses Offered in Fall 2024 (1)

Course Number	Day	Time	Course Title	Concentration Area in the MSME program
MEGR5090-001	MW	1430-1545	Topics in Mech Engineering: AI in Mechanical Engineering	
MEGR5092-001	MW	1600-1715	Topics in Motorsports Engineer: Materials Science in Battery Technology	Motorsports and Automotive Engineering; *or* Battery Engineering; *or* Solid Mechanics and Materials Science (need petition)
MEGR5092-002	TR	1300-1415	Topics in Motorsports Engineer: Battery Performance and Testing	Motorsports and Automotive Engineering; *or* Battery Engineering (need petition)
MEGR5210-090	TR	1730-1845	Automotive Power Plants	Motorsports and Automotive Engineering
MEGR5211-001	TR	1600-1715	Road Vehicle Dynamics	Motorsports and Automotive Engineering
MEGR5237-001	TR	1000-1115	Introduction to Control Systems	Dynamics and Controls
MEGR5271-001	TR	1300-1415	Orthopedic Biomechanics	Interdisciplinary Biomedical Engineering
MEGR5273-001	TR	1000-1115	Regenerative Neural Engineering	Interdisciplinary Biomedical Engineering
MEGR6141/8141-001	MWF	1115-1205	Theory of Elasticity	Solid Mechanics and Materials Science
MEGR6181/8181-001	TR	1600-1715	Engineering Metrology	Metrology and Manufacturing

Summary of Graduate Courses Offered in Fall 2024 (2)

Course Number	Day	Time	Course Title	Concentration Area in the MSME program
MEGR7090/8090-001	MWF	0905-0955	Topics in Mechanical Engineer: Materials Modelling at Atomistic Scale	Solid Mechanics and Material Science (need petition)
MEGR7090/8090-002	TR	1000-1115	Topics in Mechanical Engineer: Digital Twins and Manufacturing	Metrology and Manufacturing (need petition)
MEGR7090/8090-003	TR	0830-0945	Topics in Mechanical Engineer: Dynamic System Learning and Estimation	Dynamics and Controls; *or* Machine Learning in Mechanical Engineering (need petition)
MEGR7090/8090-004	MW	1730-1845	Topics in Mechanical Engineer: Data Driven Fluid Mechanics	Thermal Science and Fluid Mechanics (need petition)
MEGR7090/8090-005	TR	1300-1415	Topics in Mechanical Engineer: Linear Systems Theory	Dynamics and Controls (need petition)
MEGR7114/8114-001	MWF	1325-1415	Advanced Fluid Mechanics	Thermal Science and Fluid Mechanics
MEGR7172/8172-001	TR	1430-1545	Computational Methods in Engineering	Mathematics Requirement *or* capstone course
MEGR7174/8174-001	MW	1600-1715	Engineering Analysis I	Mathematics Requirement
MEGR7183/8183-001	MWF	1010-1100	Design of Precision Machines and Instruments I	Metrology and Manufacturing (need petition)
MEGR7223/8223-090	TR	1730-1845	Mathematical Concepts for Dynamics and Control	Dynamics and Controls
MEGR7284/8284-001	TR	1730-1845	Advanced Surface Metrology	Metrology and Manufacturing *or* capstone course

Brief Description of Special Topics Courses (1)

Course Number	Course Title	Brief Course Description
MEGR5090-001	Topics in Mech Engineering: AI in Mechanical Engineering	This course introduces AI-based techniques for solving mechanical Engineering problems. Prerequisite: received a grade of A from MEGR 2240_Computational Methods for Engineers or equivalent courses. Strong MATLAB coding skills are needed for the course.
MEGR5092-001	Topics in Motorsports Engineer: Materials Science in Battery Technology	This course introduces the materials science used in advanced battery technology, especially Li-ion battery technology. Discussions will include basic electrochemical engineering, battery component materials (i.e. electrodes, electrolytes, separator), underlying properties and performance, and full devices.
MEGR5092-002	Topics in Motorsports Engineer: Battery Performance and Testing	Introduce the basic characterization and fundamental working mechanisms of the equipment. Also, students will have the chance to operate the equipment including cyclers, electrochemistry workstation, glovebox battery assembling, etc.

Brief Description of Special Topics Courses (2)

Course Number	Course Title	Brief Course Description
MEGR7090/8090-001	Topics in Mechanical Engineer: Materials Modelling at Atomistic Scale	This course aims to use the atomistic computer simulation to model and understand the properties of real materials and their accompanying process and phenomena. It will primarily focus on two approaches: molecular dynamics and electronic structure calculation based on density functional theory. Some typical examples, codes, analytical tools will be also covered in this course. The expected outcomes include: (1) Understand the fundamental of Molecular dynamics simulation and its connection with statistical physics. (2) Apply molecular dynamics simulation technique to model the physical process in real materials. (3) Understand the concept of electronic structure simulation based on density functional theory. (4) Use the available software LAMMPS and VASP to compute material's properties.
MEGR7090/8090-002	Topics in Mechanical Engineer: Digital Twins and Manufacturing	Digital manufacturing is an integrated manufacturing approach that leverages computer-based technologies to enhance the efficiency of manufacturing operations and to improve the quality of products and services. As an integrated approach it links systems and processes across all areas, from design to production and on the maintenance and support of the end products. Examples of such computer-based technologies are: Internet of Things (IoT), Big Data, Artificial Intelligence, Machine Learning, Augmented Reality, Cloud Computing, Advanced Robotics, Additive Manufacturing, and Digital Twin. Digital Manufacturing technologies contributes for the fourth industrial revolution also be called Industry 4.0. This course on Digital Manufacturing provides students with the opportunity to acquire the fundamental knowledge of computer-based technologies used in manufacturing, and to prepare them for the implementation of such technologies in the industry. Therefore, the students will be better prepared to address the present and future manufacturing challenges, thus to be succeed in today's competitive business market.
MEGR7090/8090-003	Topics in Mechanical Engineer: Dynamic System Learning and Estimation	The process of developing models of dynamic systems from experimental data is called system identification or system learning, and using measurements of a system's output to infer its internal state is called state estimation. The need for system identification/learning and state estimation is ubiquitous in science and engineering, and this course will explore these topics in the context of dynamic systems modeled as ordinary differential equations. We will survey a broad range of topics including classical techniques and selected machine-learning-based methods. The class will include both theory and practical implementation. Students will complete regular homework assignments that include MATLAB programming and a final project based on their own research.

Brief Description of Special Topics Courses (3)

Course Number	Course Title	Brief Course Description
MEGR7090/8090-004	Topics in Mechanical Engineer: Data Driven Fluid Mechanics	This course takes a deep dive into the fundamentals of fluid mechanics with a data-driven approach, emphasizing the use of data analysis and computational techniques for a wide range of fluid flow problems, from simple canonical flows to more complex ones. It combines theoretical principles with modern data science tools to analyze, model, and predict fluid behavior in various scenarios. The curriculum covers traditional concepts and introduces cutting-edge, data-driven methods, such as machine learning, and the extraction and identification of flow features using computational fluid dynamics simulation datasets. Through practical projects, students will gain hands-on experience, preparing them for advanced research or careers in this interdisciplinary field. Prerequisites: (a) Undergraduate-level fluid mechanics course, (b) Basic knowledge of partial differential equations, and (c) Proficiency in mathematical analysis and linear algebra, (d) Basic knowledge of Numerical Methods, (e) Programming skill-sets in either MATLAB or Python.
MEGR7090/8090-005	Topics in Mechanical Engineer: Linear Systems Theory	Analysis, simulation, and control design for mechanical and electrical systems modeled by linear state-space equations, including robotic and mechatronic systems, aerospace and ground vehicles, and circuits. Review of linear algebra, linearization, linear time-invariant state-space models, matrix transfer functions, state equation solutions (uniqueness/existence), state transition matrices, stability criteria, observability, controllability, realizations, similarity transforms, canonical forms, state feedback by eigenvalue-placement, numerical simulations and controller implementation in MATLAB.