Summary of Graduate Courses Offered in Spring 2024

Course Number	Day	Time	Course Title	MSME Concentration Area
MEGR5092-001	MW	1730-1845	Introduction to Electric Vehicles and Batteries	Motorsports and Automotive Engineering (need petition)
MEGR5092-002	TR	1000-1115	Autonomous Ground Vehicles: Modeling and Control	Motorsports and Automotive Engineering; *or* Dynamics and Control (need petition)
MEGR5092-003	TR	1600-1715	Advanced Road Vehicle Dynamics	Motorsports and Automotive Engineering (need petition)
MEGR5092-090	TR	1730-1845	Hybrid Automotive Powerplants	Motorsports and Automotive Engineering (need petition)
MEGR5098-001	TR	0830-0945	Intelligent and Sustainable Machining Processes	Metrology and Manufacturing (need petition)
MEGR5242	MW	1430-1545	Applied Vehicle Aerodynamics	Motorsports and Automotive Engineering
MEGR5272	TR	1600-1715	Mechanics of the Human Locomotor System	Interdisciplinary Biomedical Engineering
MEGR5274	TR	1430-1545	Bioelectronic Medicine	Interdisciplinary Biomedical Engineering
MEGR7090/8090-001	MWF	0905-0955	Machine Learning in Manufacturing and Materials	Solid Mechanics and Materials Science; *or* Machine Learning in Mechanical Engineering; *or* Metrology and Manufacturing (need petition)
MEGR7090/8090-002	TR	1000-1115	Advanced Renewable Energy Systems	
MEGR7090/8090-003	MW	1430-1545	Battery Electrochemistry	Motorsports and Automotive Engineering (need petition)
MEGR7090/8090-004	TR	1600-1715	Phase Transformations in Solids	Solid Mechanics and Materials Science (need petition)
MEGR7090/8090-005	TR	1300-1415	Additive Manufacturing Technology	Metrology and Manufacturing (need petition)
MEGR7108/8108	TR	1430-1545	Finite Element Analysis & Applications	Solid Mechanics and Materials Science
MEGR7113/8113	MWF	1220-1310	Dynamics and Thermodynamics of Compressible Flow	Thermal Science and Fluid Mechanics
MEGR7143/8143	MWF	0905-0955	Inelastic Behavior of Materials	Solid Mechanics and Materials Science (need petition)
MEGR7163/8163	TR	1000-1115	Materials Characterization and Analysis	Solid Mechanics and Materials Science
MEGR7175/8175	MW	1600-1715	Engineering Analysis II	Mathematics Requirement
MEGR7182/8182	MW	1430-1545	Machine Tool Metrology	Metrology and Manufacturing
MEGR7187/8187	MWF	1010-1100	Flexures	Metrology and Manufacturing; *or* Dynamics and Control (need petition)

Brief Description of Special Topics Courses (1)

Course Number	Course Title	Brief Course Description
MEGR5092-001	Introduction to Electric Vehicles and Batteries	Introduction to the drivetrain and power supply of electric vehicles. Automotive drive cycle analysis and range estimation for conventional vehicles, hybrid vehicles and electric vehicles. Fuel efficiency, carbon emissions, and power requirements of all three types of vehicles will be discussed. Discussions on different types of batteries and their challenges. Basics of battery chemistry and sizing for vehicle demands.
MEGR5092-002	Autonomous Ground Vehicles: Modeling and Control	Terminology, design considerations and safety assessment of self-driving cars; commonly used hardware used for self-driving cars; main components of the self-driving software stack; programming of vehicle modeling and control; analysis of the safety frameworks and current industry practices for vehicle development. A project will include control code to navigate a self-driving car. Expected prerequisite knowledge: MATLAB or PYTHON, Linear Algebra, Statistics, Dynamic.
MEGR5092-003	Advanced Road Vehicle Dynamics	Advanced topics related to road vehicle dynamics. Topics will include tire mechanics and behavior modeling, transient handling dynamics, and vehicle modeling and simulation. This course will build on the foundations established in road vehicle dynamics to develop a more comprehensive understanding of vehicle behavior. The course will include instruction on the use of Dymola simulation software, and this software will be used to illustrate and explore the concepts covered over the semester.
MEGR5092-090	Hybrid Automotive Powerplants	Coverage of multiple power sources for vehicle propulsion. Topics will include traditional IC Engines with alternative fuels (e.g. hydrogen), hybrid drivetrains that incorporate an IC Engine with electric motors, plug-in hybrids, battery electric vehicles, and fuel cell vehicles. The challenges and opportunities for each system will be discussed including packaging, controls, thermal management, refueling, and total system efficiencies.
MEGR5098-001	Intelligent and Sustainable Machining Processes	This course is designed to introduce students to the fundamental skills and knowledge on machining system approach, machining technology, and programming of CNC machining tools. Topics include machine tool architecture, cutting tool technology and inspection, Computer Numerical Control (CNC) technology and Computer aided Manufacturing (CAM). Students will also have the opportunity to acquire knowledge on the most recent advances in machining technology, including on intelligent/smart and sustainable machining.

Brief Description of Special Topics Courses (2)

Course Number	Course Title	Brief Course Description
MEGR7090/8090-001	Machine Learning in Manufacturing and Materials	
MEGR7090/8090-002	Advanced Renewable Energy Systems	This course will offer students a comprehensive understanding of wind energy conversion and the intersection of cutting-edge technology in the energy infrastructure. Participants will delve into the process by which moving air is converted into electrical energy, learning the underlying physics of wind energy conversion and the mechanics of how the drivetrain transforms moving air into electrical power. As computing, communication, and sensing hardware become increasingly advanced, affordable, and compact, their integration into the energy landscape—from production facilities to transmission lines—expands. This course highlights the rising use of intelligent capabilities across energy equipment, households, and appliances, emphasizing their potential to elucidate complexities surrounding energy system operation, environmental considerations, and societal needs. Students will also develop essential modeling skills, learning to simulate multidisciplinary phenomena integral to the energy sector. Furthermore, they will acquire techniques to build a framework to gather, process, and model cyber-physical social (CPSS) information. By merging CPSS data (whether quantitative or qualitative) with the tools of data science and computer simulation, students will be equipped to perform concurrent engineering in both design and control. Design methods for intricate systems will be dissected, covering facets of system-level development, operation, and construction. Integrating these multifaceted learning outcomes, participants will undertake a culminating course project, focusing on an aspect of system development or distributed energy operation.

Brief Description of Special Topics Courses (3)

Course Number	Course Title	Brief Course Description
MEGR7090/8090-003	Battery Electrochemistry	This course introduces the fundamentals of electrochemistry, including electrochemical theory, double layer modeling and electrochemical methods. Additionally, important electrochemical applications, especially batteries, will be discussed, including corrosion, energy production and storage, and sensors (biosensors). Students will have the chance to collect electrochemical data using relevant equipment.
MEGR7090/8090-004	Phase Transformations in Solids	Phase transformation commonly occurs during materials manufacturing (e.g., additive manufacturing), processing and in service. This course lays a foundation for understanding phase transformation in terms of thermodynamics and kinetics, as well as transformation mechanisms down to the atomic scale. Special topics on phase transformation during additive manufacturing will also be included.
MEGR7090/8090-005	Additive Manufacturing Technology	3D printing or additive manufacturing (AM) is a class of technologies that build a 3D object directly from digital models. In recent years, with advances in material, energy, process and machine development, AM technologies are moving rapidly into the production end of manufacturing in creative and sometimes unexpected ways. AM technologies have been widely adopted in industries such as medical field, aerospace, education, arts, and architecture to name a few. Understanding the principles, advantages and limitations of AM technologies is important for future engineers in solving practical problems in a variety of working environments and bringing innovations to the industry. The objective of this course on 3D printing/AM is to provide students the opportunity to learn about various important aspects of AM technologies. The course will include an introduction to AM, computational aspects, physical modeling of part creation, process and quality control, feedstock materials, AM part properties, design for AM and applications of AM technologies and parts.