

MEGR Technical Electives

Spring 2024 Offerings

Course Number	Course Name Note: Students that do not complete the required prerequisites prior to the semester need to drop the follow-on course(s) (or they may be dropped from courses without notice)	Prerequisites
MEGR 3094-001 (Kumar)	Energy and Decarbonization (<i>approved Energy technical elective</i>) This course will be taught by industry experts and faculty engaged in energy-related research. The course will cover all energy sectors with focus on topics such as the impact of CO2 emissions, the need for decarbonization, various strategies for reducing CO2 emissions, and techno-socio-economic studies of the impact of decarbonization.	<i>MEGR 3111 with a grade of C or better</i>
MEGR 3216-001 (Lessani)	Thermal/Fluid Design (<i>IF MEGR 3221 is completed as the Design Elective, MEGR 3216 is approved to count as a technical/Motorsports/Biomedical/Energy elective. MEGR 3216 can be used to satisfy only <u>one</u> requirement.</i>) Design of systems utilizing thermodynamic, heat transfer, and fluid flow principles. Topics include: thermal system design, thermodynamic modeling, design applications with heat transfer, thermo-economic optimization of simple and complex systems.	<i>MEGR 3112, 3114 and 3116, all with a grade of C or better</i>
MEGR 3225-001 (Tabarraei)	Finite Element Analysis (<i>approved Motorsports, Biomedical, Precision and Energy elective</i>) Basic concepts of FEA are introduced. Simple elements such as truss and beam elements are emphasized, with an introduction to continuum elements for structural analysis and heat transfer elements for heat transfer. Mathematics software is used to illustrate the finite element process. A commercially available finite element code is also introduced.	<i>MEGR 2144 and MEGR 2240, both with a grade of C or better</i>
MEGR 3231-001 (Raquet)	Advanced CAD/CAM (<i>approved Motorsports and Precision technical elective</i>) An introduction to advanced CAD features and tools, CAM interface operations, design data management and reverse engineering; also application of the appropriate feature types to simplify the design process and increase the flexibility of the parametric model.	<i>ENGR 1202 and MEGR 2156 both with a C or better</i>
MEGR 3232-001 (Raquet)	Plastic Part Design (<i>approved Biomedical technical elective</i>) This course will be valuable to our students due partly to the strong emphasis we have on design and the great need for understanding in the application of polymer science to contemporary design. There are two important components of this course: the science and technology of polymers (materials), and the implementation of these materials into engineering design.	<i>MEGR 2156 with a grade of C or better</i>
MEGR 3262-001 (Suresh Babu)	Turbomachinery (<i>approved Energy elective</i>) A treatment of the types, uses, and principles of operation of turbomachines; usage of fluid mechanics, thermodynamics and a blend of additional theory and applications for the selection, specification, and use of turbomachines.	<i>MEGR 3112, MEGR 3114 with a grade of C or better</i>
MEGR 3272-001 (El-Ghanam)	Introduction to Bio-polymers and Composites (<i>approved Biomedical technical elective</i>) Basics of polymer science and engineering and correlation between structural parameters and properties of the polymers including mechanical and biocompatibility properties. Examples of medical devices made of polymers and used to fix artificial joints or augment tissue will be discussed.	<i>MEGR 3161 with a grade of C or better</i>
MEGR 3282-001 (Raja)	Statistical Process Control and Metrology (<i>approved Motorsports, Precision and Energy elective</i>) Introduction to metrology. Measurement of size, form and surface texture. Introduction to quality control, control charts for attributes and variables, acceptance sampling. Process capability estimation and process control.	<i>MEGR 2180 with a grade of C or better</i>
MEGR 4092-001 MEGR 4094-001 (Bombik)	Introduction to Electric Vehicles and Batteries (<i>approved Motorsports [4092] and Energy [4094]</i>) 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.	<i>MEGR 3111, MEGR 3121, and ECGR 2161 with a grade of C or better</i>
MEGR 4092-002 (Ghasemi)	Autonomous Ground Vehicles: Modeling and Control (<i>approved Motorsports elective</i>) 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, Dynamics.	<i>MEGR 3122 and MEGR 3171 with a grade of C or better</i>

MEGR 4092-003 (Stover)	Advanced Road Vehicle Dynamics (<i>approved Motorsports elective</i>) 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.	<i>MEGR 4211 with a grade of C or better</i>
MEGR 4092-090 MEGR 4094-090 (Garrett)	Hybrid Automotive Powerplants (<i>approved Motorsports elective [4092] and Energy [4094]</i>) 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.	<i>MEGR 2240, MEGR 3121 and ECGR 2161 all with a grade of C or better</i>
MEGR 4098-001 (Outeiro)	Architecture and Programing of Advanced CNC Machine Tools (<i>approved Precision elective</i>) 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)	<i>MEGR 2156 with a grade of B or better</i>
MEGR 4127-091 (Conrad)	Introduction to Robotics Modeling of industrial robots including homogeneous transformations, kinematics, velocities, static forces, dynamics, computer animation of dynamic models, motion trajectory planning, and introduction to vision, sensors, and actuators.	<i>MEGR 3171 and 3171L with a grade of C or better</i>
MEGR 4235-001 (Boreman)	Waves and Optics (<i>approved Precision elective</i>) Ray analysis of optical elements (mirrors, lenses and systems of lenses, prisms). Reflection and refraction at plane and spherical surfaces, thin and thick lenses, lens maker's equation, field of view, and numerical aperture. Wave properties of light, superposition of waves, diffraction, interference, polarization, and coherence. Students cannot earn credit for both this course and PHYS 4271.	<i>MATH 2171 and MEGR 3122 with a grade of C or better</i>
MEGR 4242-001 (Uddin)	Applied Vehicle Aerodynamics (<i>approved Motorsports technical elective</i>) Flow of air around streamlined and bluff bodies, aerodynamic forces, flow separation and reattachments, aerodynamic tools, introduction to computational fluid dynamics, use of commercial CFD packages to solve fluid flow problems, computer simulation and analysis of flow around bluff bodies and road vehicles including race cars.	<i>MEGR 2240 and MEGR 3114, with a grade of C or better</i>
MEGR 4272-001 (Zheng)	Mechanics of the Human Locomotor System (<i>approved Biomedical technical elective</i>) Introduces dynamic analysis of the human musculoskeletal system. Students learn to develop 3-D rigid body models of human movement, and how to calculate internal forces in muscles and joints during daily and sports activities. Students also learn how to use motion capture system and simulation software of human locomotion.	<i>MEGR 2144 with a grade of C or better</i>
MEGR 4274-001 (Yang)	Bioelectronic Medicine (<i>approved Biomedical technical elective</i>) The basic principles of neuroscience and neural engineering, and the use of engineering principles in bioelectronic medicine. Topics include: the use of optogenetics, electrical stimulation, electromagnetic stimulation, and brain machine Interfaces as applied to solving prevalent clinical issues related to neurology and neural engineering.	<i>MEGR 2156, MEGR 2180, or MEGR 2279 with a C or better</i>

Approved non-MEGR Technical Electives

BIOL 3161-001	Introduction to Biotechnology (<i>approved Biomedical technical elective</i>) An overview of basic molecular biology, techniques, and uses of biotechnology tools in environmental and biomedical fields.	<i>BIOL 1110 or BIOL 2120 with a C or above</i>
PHYS 3220-001	Mathematical Methods in Physics Topics include: distribution functions, solutions to ordinary and partial differential equations, boundary value problems, Fourier analysis, vectors and matrices, vector calculus, and complex variables.	<i>PHYS 2102 and MATH 2241 with a grade of C or better, plus MEGR 3121 as a pre- or co-requisite</i>

Important Notes:

- At least three of the four required technical electives must be MEGR courses.
- Students pursuing concentrations are required to complete technical electives that are approved for their concentration.
- Students with interest in a course that is outside of those listed above are required to seek approval from the Director of Undergraduate Programs before registering for such a course. Students will not receive credit otherwise.
- Students are responsible for meeting all required prerequisites for courses.