MEGR Technical Electives

Spring 2023 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 3090-001 (Joyee) CRN 25138	**Design and Analysis of Experiments in Engineering** Topics include: Simple comparative experiments, single factor experiment, randomized blocks, Latin squares, and related designs; factorial design, regression model, response surface method and other approaches to optimization; lectures and some labs that use Minitab.	*MEGR 2144 or 2180 with a grade of C or better*
MEGR 3092-001 (McAlpine) CRN 24918	**Control of electric drivetrains** *(approved Energy and Motorsports technical elective)* Topics include: hardware, sensors, programming, performance, motor selection, regenerative braking, etc. A Budget of $300 per student is required.Students will be required to purchase used electric toy type ride on vehicles and electronic components. Students will implement their own control systems utilizing an arduino type device, various sensors and hardware.	*MEGR 3171 with a grade of C or better*
MEGR 3094-001 (J.Xu) CRN 21162	**Fundamentals of Energy Storage Systems** *(approved Energy and Motorsports technical elective)* Treatment of electrochemical systems as well as thermal, mechanical, and hybrid chemical energy storage systems.	*MEGR 3111 and MEGR 3161 with a grade of C or better*
MEGR 3094-002 **CRN 22462**	**Energy and Decarbonization** *(approved Energy technical elective)* 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.	*MEGR 3111 with a grade of C or better*
MEGR 3216-001 (Lessani) CRN 21583	**Thermal/Fluid Design** ***(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.)*** 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.	*MEGR 3122, 3114 and 3116, all with a grade of C or better*
MEGR 3225-001 (Tabarraei) CRN 20457	**Finite Element Analysis** *(approved Motorsports, Biomedical and Energy technical elective)* The basic concepts of FEA are introduced. Necessary concepts from linear algebra are reviewed. 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.	*MEGR 2144 and MEGR 2240, both with a grade of C or better*
MEGR 3231-001 (Raquet) CRN 22673	**Advanced CAD/CAM** (*approved Motorsports technical elective*) 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.	*ENGR 1202 and MEGR 2156 both with a C or better*
MEGR 3232-001 (Raquet) **CRN 21018**	**Plastic Part Design** (*approved Biomedical technical elective)* 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.	*MEGR 2156 with a grade of C or better*
MEGR 3236-001 (Zhang) **CRN 25335**	**Introduction to Nanoscale Science and Engineering** (*approved Biomedical and Energy technical elective)* Introduction to nanoscale science and engineering. Topics include:nanomanufacturing, nanomaterials and nanostructures, properties and applications in biomedical and energy fields, experiments with nano-instruments, and related environmental issues.	*MEGR 3161 and MEGR 3171 with a grade of C or better*
MEGR 3272-001 (El-Ghanam) **CRN 23823**	**Introduction to Bio-polymers and Composites** *(approved Biomedical technical elective)* This course will address the 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.	*MEGR 3161 with a grade of C or better*
MEGR 3282-001 (Beaman) **CRN 20472**	**Statistical Process Control and Metrology** *(approved Motorsports and Energy engineering elective)* 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.	*MEGR 2180 with a grade of C or better*
MEGR 4127-091 (Conrad) **CRN 23075**	**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.	*MEGR 3171 and 3171L with a grade of C or better*

MEGR 4235-001 (Boreman) **CRN 24919**	**Waves and Optics** 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.**	*MATH 2171 and MEGR 3122 with a grade of C or better*
MEGR 4240-090 (Garrett) **CRN 24920**	**Advanced Automotive Powerplants** *(approved Motorsports technical elective)* This is a follow-on course to Automotive Powerplants (MEGR 4210). Advanced engineering principles governing internal combustion engine theory, design, and application.	*MEGR 4210 with a grade of C or better*
MEGR 4242-001 (Uddin) **CRN 24922**	**Applied Vehicle Aerodynamics** *(approved Motorsports technical elective)* Flow of air around streamlined and bluff bodies, aerodynamic forces, understanding 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.	*MEGR 2240 and MEGR 3114, with a grade of C or better*
MEGR 4244-001 (Stover) **CRN 24924**	**Tire Mechanics** *(approved Motorsports technical elective)* In-depth analysis of the tire and its influence on vehicle performance, including: design, materials, construction, structural response, rolling resistance, force and moment generation, NVH, traction, wear, high speed limit, and standards. Tire models, their limitations, and their governing equations.	*MEGR 2144 and with a grade of C or better; MEGR 3121 as a pre-or co-requisite*
MEGR 4272-001 (Zheng) **CRN 24926**	**Mechanics of the Human Locomotor System** (*approved Biomedical technical elective)* 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.	*MEGR 2144 with a grade of C or better*
MEGR 4274-001 (Yang) **CRN 24928**	**Bioelectronic Medicine** *(approved Biomedical technical elective)* 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.	*MEGR 2156, MEGR 2180, or MEGR 2279 with a C or better*

Approved non-MEGR Technical Electives

BIOL 3161-001 **CRN 20848**	**Introduction to Biotechnology** *(approved Biomedical technical elective)* An overview of basic molecular biology, techniques, and uses of biotechnology tools in environmental and biomedical fields.	*BIOL 1110 or BIOL 2120 with a C or above*
PHYS 3220-001 **CRN 22528**	**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.	*PHYS 2102 and MATH 2241 with a grade of C or better, plus MEGR 3121 as a pre- or co-requisite*
PHYS 4242-001 **CRN 22232**	**Quantum Mechanics II** Continuation of PHYS 4241. Topics include: perturbation theory, atoms in external electric and magnetic fields, the Stark and Zeeman effects, the WKB approximation, selection rules for electromagnetic radiation, scattering theory, multi-electron atoms, electrons in solids, Bose-Einstein and Fermi-Dirac distributions.	*PHYS 4241 with a grade of C or above.*

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.