MEGR Technical Electives - Spring 2019 offerings

Course No.	Course Name **Note: Students that do not complete the prerequisites prior to the spring semester must drop the follow-on course(s) (or they may be dropped during the Drop/Add period without notice).**	Prerequisites
MEGR 3090-001 (Ghasemi) **CRN 21842**	**Introduction to Control Systems** *(approved Energy and Motorsports technical elective)* This course will address both the theoretical and practical foundations for the design of automatic control systems. The course will cover control-oriented modeling, idealized time-domain control design and real-world frequency-domain design techniques.	*MEGR 3122 with a grade of C or better*
MEGR 3090-002 (El-Ghannam) **CRN 26200**	**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 3090-003 (Cho) **CRN 22923**	**Biomedical Manufacturing: 3D Biofabrication** *(approved Biomedical technical elective)* Biomedical manufacturing is an area that explores the next frontier of manufacturing technologies for biotechnology, advanced 3D modeling, rapid prototyping, bioinformatics, pharmaceutical production, and more. This course will cover 3D biofabrication technologies including 3-D printing, which has emerged for engineering biological specimens in the laboratory	*MEGR 2156, 2180 or 2279 with a grade of C or better*
MEGR 3090-004 (Morse/Evans) **CRN 24268**	**Metrology and Precision Engineering** This course covers the principles of precision design and their use in manufacturing and measurement. Topics will include a review of metrology and uncertainty, a case study of precision machine design, mechanical and optical methods of surface texture measurement, measurement of machine tool errors, coordinate metrology and its applications, and the role of vibration analysis in machine design.	*MEGR 2180 with a grade of C or better*
MEGR 3090-005 (Elliott) **CRN 26458**	**Biological Thermodynamics** *(approved Biomedical Engineering technical elective)* This course will explore the energy transductions that occur in and between living organisms, structures, and cells, and the thermodynamic principles that underlay these transductions; aqueous solution thermodynamics, fundamentals of biomolecule and cell thermodynamics and their application to problems in Biological and Biomedical Engineering. Biological/Biomedical Engineering applications that will be explored include cell cryopreservation, stabilization of protein therapeutics, and the design of drug delivery constructs.	*MEGR 3111 with a grade of C or better*
MEGR 3090-006 (Tarbutton) **CRN 27226**	**The Art of Machining and Machine Tool Control** *(approved Motorsports technical elective)* This is a new course that is being developed to cover machining and computer control of machining. **Registration requires consent of the instructors. Space is limited.**	*MEGR 2156 with a grade of A or better*
MEGR 3092-001 (Tkacik) **CRN 26202**	**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 3092-090 (Garrett) **CRN 23212**	**Advanced Automotive Powerplants** *(approved Motorsports technical elective)* This is a follow-on course to Automotive Powerplants (MEGR 3210). Topics include combustion, thermodynamic efficiency, fuel efficiency, torque and power, emissions, etc.	*MEGR 3210 with a grade of C or better*
MEGR 3094-001 (Sarunac) **CRN 22030**	**Introduction to Clean Coal Technology** *(approved Energy technical elective)* This course will cover the basics of coal combustion, pollutant formation, measurement of emissions; emissions regulations, measurement of power plant performance, and options for performance improvement of existing and the newly-constructed power-generation fleet.	*MEGR 3112 and 3114 with a grade of C or better; pre- or co-requisite: MEGR 3116*
MEGR 3094-002 (Keanini) **CRN 25385**	**Statistical Thermodynamics** *(approved Energy technical elective)* Macroscopic and microscopic thermodynamic states. Ensemble theory, including phase spaces and Liouville Theorem. Canonical and microcanonical ensembles. Quantum statistics. Theory of simple gases. Ideal (non-interacting) Boson systems.	*MEGR 3112 with a grade of C or better*
MEGR 3225 (Fang) **CRN 20789**	**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 26205**	**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 (Raquet) **CRN 21767**	**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 3234 (Zheng) **CRN 22033**	**Introduction to Biodynamics** (*approved Biomedical technical elective)* This course will introduce dynamic analysis of the human musculoskeletal system. Students will learn to develop lumped mass, planar and 3D rigid body models of human movement, and learn to calculate internal forces in muscles and joints during daily and sports activities.	*MEGR 2144 and 3121, both with a grade of C or better*
MEGR 3242 (Uddin) **CRN 22894**	**Applied Vehicle Aerodynamics** *(approved Motorsports technical elective)* The goal of this course is to provide the students with an in-depth knowledge of ground vehicle aerodynamics. Topics include: aerodynamic forces and moments; the effect of air viscosity; aerodynamic drag and drag reducing devices; aerodynamic lift and negative lift producing devices, spoiler and wings; rolling, pitching and yawing moments; effect of aerodynamic forces on speed, fuel consumption, acceleration, cornering, and braking; Wind tunnel testing and CFD.	*MEGR 2240, 3111, and MEGR 3114, all with a grade of C or better*
MEGR 3282 (Morse) **CRN 20807**	**Statistical Process Control and Metrology** *(approved Motorsports and Energy technical 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 (Conrad) **CRN 27404**	**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*

Approved non-MEGR Technical Electives

PHYS 3220 **CRN 25558**	**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 both with a grade of C or above.*
PHYS 4110 **CRN 22453**	**Introduction to Biomedical Optics** (*approved Biomedical technical elective)* This course will cover the basic principles underlying tissue optics, laser-tissue interactions, and optical imaging, microscopy, and spectroscopy for medical applications.	*PHYS 3141 and MATH 2171 with a grade of C or above. Pre- or co-requisite: PHYS 3121 or MEGR 2144.*
PHYS 4242-001 **CRN 24609**	**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:

- Students must take at least three of the four required technical electives from MEGR-designated courses.
- Students who wish to take a technical elective course outside the Department of Mechanical Engineering must receive approval from the Director of Undergraduate Programs **before** registering for such courses. Students will not receive credit toward the BSME curriculum for technical electives completed outside the MEGR department without prior approval.
- Students pursuing the Motorsports Engineering concentration must complete approved Motorsports technical electives only.
- Students pursuing the Energy Engineering concentration must complete approved Energy technical electives only.
- Students pursuing the Biomedical Engineering concentration must complete approved Biomedical technical electives only.