Mechanical Engineering

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Objectives

Mechanical Engineering is among the broadest and most versatile of the engineering professions. Mechanical engineering encompasses many diverse activities and fields of interest, including design for environment, machine design, solid mechanics, materials, environmentally conscious energy systems, fluid mechanics, heat transfer, thermodynamics, combustion, control systems, manufacturing, or a combination of these fields as is often the case in the development of complex projects. Mechanical engineers can pursue careers in design, manufacturing, research and development, sales, management, and consulting.

The mission of the Department of Mechanical Engineering is to provide educational opportunities for students seeking to enter the mechanical engineering profession, so that they can achieve competence in the field while recognizing their social responsibilities. The program provides a strong foundation in the areas of mathematics, basic sciences, engineering theory and practice, and the humanities and social sciences. It encourages further self development and life-long intellectual achievement. The program seeks to build student skills in written and oral communication, socially, economically and environmentally responsible decision making, and professionalism.

The following program objectives have been designed to support both the departmental and university missions:

- **Technical Proficiency:** Ability to apply knowledge of mathematics, physics and the principles of engineering appropriate to the students' chosen areas of specialization, to the solution of contemporary problems in mechanical engineering.
- **Communications Skills:** Ability to communicate effectively in written, graphical, and oral formats.
- **Professional Skills:** Mastery of the broad spectrum of abilities needed in professional practice including skills in teamwork, leadership, creativity and project management, and an understanding of professional ethics, business practices, safety, and economics.
- **Personal Breadth:** Appreciation of the non-technical aspects of engineering, including ethical considerations, concern for society and the environment, and multi-cultural perspectives, as well as a commitment to life-long learning and service to the professional and civic communities.

Degree Offered

Bachelor of Science in Mechanical Engineering

Major Offered

Mechanical Engineering

Departmental Requirements

In addition to the prerequisites, departmental candidacy is required for entry into 300- and 400-level courses. Candidacy is achieved by successfully completing all required 100 and 200 level CEEGR, CHEM, MEGR, MATH, and PHYS courses with a combined grade point average of at least 2.50, and completing ENGL 110. Only courses graded C (2.00) or better may be transferred to offset degree requirements. Both the cumulative grade point average and the College of Science and Engineering grade point average must be at least 2.50 for graduation. Before completing the design sequence (MEGR 487/488/489) students

must take a comprehensive exam (for details, refer to the Mechanical Engineering Student Handbook). Taking the Fundamentals of Engineering (FE) examination is required for the degree. This degree is accredited by the Engineering Accreditation Commission of ABET, formerly know as the Accreditation Board for Engineering and Technology.

Bachelor of Science in Mechanical Engineering
Major in Mechanical Engineering

In order to earn the bachelor of science in mechanical engineering degree with a major in mechanical engineering, students must complete a minimum of 180 credits including at least 45 credits in the core curriculum. A cumulative 2.50 grade point average is required, in addition to a science and engineering grade point average of 2.50, including the following:

I. Core Curriculum Requirements

45 credits in the core curriculum, including:

ENGL 110	**College Writing: Inquiry and Argument**	**5**
PHIL 110	**Introduction to Philosophy and Critical Thinking**	**5**
Choose one of the following two courses:		5
HIST 120	**Origins of Western Civilization**	
HIST 121	**Studies in Modern Civilization**	
ENGL 120	**Introduction to Literature**	**5**
PHIL 220	**Philosophy of the Human Person**	**5**
Social Science I (not economics)		**5**
Social Science II satisfied by CEEGR 302		
Theology and Religious Studies Phase II (200-299)		**5**
Ethics (upper division)		**5**
Theology and Religious Studies Phase III (300-399)		**5**
Interdisciplinary satisfied within major.		
Senior Synthesis filled by MEGR 487, 488, 489.		

II. Major Program Requirements

74 credits in mechanical engineering, including:

MEGR 105	**Engineering Graphics and Design**	**3**
MEGR 106	**Machine Shop**	**1**
MEGR 181	**Innovative Design**	**2**
MEGR 210	**Statics**	**4**
MEGR 230	**Dynamics**	**4**
MEGR 281	**Engineering Methods**	**4**
MEGR 304	**Data Acquisition and Instrumentation**	**4**
MEGR 321	**Thermodynamics**	**5**
MEGR 324	**Heat Transfer**	**5**
MEGR 350	**Materials Science**	**5**
MEGR 371	**Machine Elements**	**5**
MEGR 435	**Dynamic Systems**	**5**
MEGR 438	**Control Systems**	**4**
MEGR 487	**Engineering Design I**	**3**
MEGR 488	**Engineering Design II**	**4**
MEGR 489	**Engineering Design III**	**3**
Engineering Electives (approved by department)		**9**

Choose one of the following two courses: 4

MEGR 322 **Thermodynamics II**

MEGR 372 **Machine Elements II**

III. Other Major Department Requirements

61 credits in math, science and engineering, including:

CEEGR 221	**Mechanics of Materials I**	**4**
CEEGR 302	**Engineering Economy**	**3**
CEEGR 331	**Fluid Mechanics**	**4**
CHEM 121	**General Chemistry I**	**4**
CHEM 131	**General Chemistry Lab I**	**1**
ECEGR 315	**Elements of Electrical Engineering**	**5**
MATH 134	**Calculus I**	**5**
MATH 135	**Calculus II**	**5**
MATH 136	**Calculus III**	**5**
MATH 232	**Multivariable Calculus**	**3**
MATH 233	**Linear Algebra**	**3**
MATH 234	**Differential Equations**	**4**
PHYS 121	**Mechanics**	**5**
PHYS 122	**Electricity and Magnetism**	**5**
PHYS 123	**Waves and Optics**	**5**

NOTE: 1. A minimum of 45 credits in core curriculum courses is required for graduation. 2. The Fundamentals of Engineering (FE) examination is required for graduation.

Mechanical Engineering Courses

MEGR 100 **Introduction to Mechanical Engineering** **1**

An overview of mechanical engineering. Course includes seminars by practicing mechanical engineers who discuss day-to-day engineering and the latest advances in the industry. Typical industries represented include: aerospace, transportation, HVAC, power generation, manufacturing, medical equipment, and sports equipment. Graded CR/F. One seminar per week. (spring)

MEGR 105 **Engineering Graphics and Design** **3**

Technical sketching. Isometric, orthographic, auxiliary, and sectional views. Dimensioning. Introduction to computer-aided drafting (CAD) and solid modeling. Includes design project using CAD. Three two-hour sessions per week. Laboratory. (fall, winter)

MEGR 106 **Machine Shop** **1**

Manufacturing processes including casting, welding, forging, plastics forming and metal cutting. Lab includes industry tours and hands-on machine shop projects focusing on fundamental theory and operation of precision measuring instruments, hand tools, metal lathes and CNC mills. Pre or co-requisite: MEGR 105. Prerequisite: CEEGR 221. (fall, winter, spring)

MEGR 181 **Innovative Design** **2**

The design process, including performance prediction and prototype construction and testing. Includes a guided class project, team evaluation of an existing engineering design, and a major team design project. Final exam will consist of an oral presentation and performance demonstration of the team design. Two 70 minute sessions per week. Laboratory. Prerequisite: freshman or sophomore standing. (fall, winter)

MEGR 210 Statics 4
Vector algebra. Equilibrium of forces and moments, distributed forces, hydrostatics, friction, virtual work; all applied to simple bodies. Four lectures per week. Prerequisites: MATH 135, PHYS 121. (fall, winter)

MEGR 230 Dynamics 4
Vectors applied to kinematics and kinetics. Particle, system of particles, and rigid bodies related to translation, rotation, plane motion, relative motion, forces, impulse-momentum, work-energy. Four lectures per week. Prerequisites: MEGR 210. (winter, spring)

MEGR 281 Engineering Methods 4
Modern methods using computers to solve problems encountered in mechanical and civil engineering. Examples are stress analysis and beams (numerical integration, matrix methods, systems of simultaneous equations), stability of mechanical systems and columns (differential equations). Four lectures per week. Co-requisites: MEGR 230, MATH 233. (fall, spring)

MEGR 291-293 Special Topics ..... 1 to 5

MEGR 296 Directed Study ..... 1 to 5

MEGR 304 Data Acquisition and Instrumentation 4
Introduction to computer based data acquisition, including D to A and A to D conversion, real time operating systems, digital filtering, sensor selection and sensor interface design. Three lectures, one laboratory per week and a final design project. Pre or co-requisite: ECEGR 315. Prerequisite: MEGR 281. (spring)

MEGR 321 Thermodynamics 5
Thermal properties of ideal and real gases, liquids, vapors and mixtures. Conservation of energy. Second law. Conversion of thermal energy to work. Power, efficiency, cycles, air-conditioning, compressible gas flow. Four lectures and one laboratory per week. (fall)

MEGR 322 Thermodynamics II 4
Continuation of MEGR 321. Thermodynamics applied to ideal and real cycles, internal and external combustion engines, fans, blowers, compressors, nozzles, refrigeration, air-conditioning. Second-law analysis. Design problem. Four lectures per week. Prerequisite: MEGR 321. (winter)

MEGR 324 Heat Transfer 5
Heat transfer—conduction, convection and radiation. Conduction in one and two dimensions, steady state and transient. Forced and natural convection with phase change. Radiation between two or three black and gray bodies. Heat exchangers. Design problem. Four lectures and one laboratory per week. Prerequisite: MEGR 321. Pre- or co-requisite: CEEGR 331. (spring)

MEGR 342 Manufacturing Processes 3
Overview of manufacturing processes including casting, forming, machining and welding; physics governing processes, the associated process parameters and their influences. Two lectures and one laboratory or field trip per week. Prerequisite: MEGR 350.

MEGR 350 Materials Science 5
Atomic structure. Metallic bond. Structure of metals and non-metals. Equilibrium diagrams. Time-dependent transformations. Relation of structure to properties. Elastic and plastic deformation. Four lectures and one laboratory per week. (fall)

MEGR 371 Machine Elements 5
Advanced strength of materials including combined loading, beams, columns, connection forces and stress concentrations. Introduction to statistics and reliability. Introduction to finite element analysis. Material failure including static failure theories, fracture mechanics and fatigue. Design problem. Four lectures and one laboratory per week. Prerequisite: CEEGR 221. (winter)

MEGR 372 Machine Elements II 4
Continuation of MEGR 371. Fasteners, welds, springs, bearings, gears, shafts, lubrication, clutches and brakes. Design problem. Four lectures per week. Prerequisite: MEGR 371. (spring)

MEGR 391-393 Special Topics ..... 1 to 5

MEGR 396 Directed Study ..... 1 to 5

MEGR 404 Experimental Design 3
An introduction to the application of statistics in engineering problems. Topics include point estimates, population inference using p-values and confidence intervals, type 1 and type 2 error estimates, and ANOVA analysis when applied to engineering and manufacturing problems. Applications of statistics include statistical process control, sample size selection and experiment design using a factorial design approach. Three lectures per week. Prerequisite: junior standing.

MEGR 405 Introduction to Finite Elements 3
Development of theory and concepts of finite element analysis. Applications in all areas of mechanical engineering, including mechanics of solids, heat transfer, fluid mechanics and design. Weekly computer exercises. Three lectures per week. Prerequisites: MEGR 371, MEGR 324, and senior standing.

MEGR 422 Energy and Environment 3
Overview and discussion of primary energy consumption and energy conservation techniques. Theory and design of environmentally conscious energy conversion and relevant pollution reduction technologies. Assessment of energy conversion technologies with life-cycle analysis. Design and research projects. Three lectures per week. Prerequisites: MEGR 321 and junior standing.

MEGR 423 Introduction to Combustion 3
An introduction to the topic of combustion. The areas of study include the thermodynamics of combustion, chemical kinetics and combustion reaction analysis, study of diffusion and premixed flames, combustion related to spark-ignited and diesel engines, and special topics of combustion including pollution reduction, instrumentation for combustion processes, and microscale combustion. Three lectures per week. Prerequisites: MEGR 321 and junior standing.

MEGR 426 Heat/Ventilation/Refrigeration 3
Psychometrics; space heating and cooling loads; air conditioning; fans and ducts; heat exchangers; solar systems; refrigeration. Three lectures per week. Prerequisites: MEGR 321, MEGR 324.

MEGR 431 Vehicle Dynamics 3
Application of the principles of engineering mechanics to the dynamics of ground vehicles. Familiarization with methods to analyze, predict and design for vehicle dynamic performance. Acceleration and braking performance, aerodynamics and road loads, ride, directional response, rollover. Three lectures per week. Prerequisite: MEGR 230.

MEGR 432 Mechanical Vibrations 3
Analysis of structural vibrations of mechanical systems. Modeling of lumped and distributed parameter systems. Topics include: single- and multi-degree of freedom systems, free and forced vibrations, periodic and non-periodic forcing functions, mass/stiffness matrices, Lagrange's equations, and modal analysis. Continuous systems (string, rod, and beam vibrations). Design considerations and experimental testing methods. Three lectures per week. Prerequisite: junior standing.

MEGR 435 Dynamic Systems 5
Modeling of mechanical, thermal, hydraulic, pneumatic, and electrical linear and non-linear systems. Introduction to computer modeling and simulation using existing symbolic computer programs. Laplace transforms, stability criteria, and frequency response. Four lectures and one laboratory per week. Prerequisite: ECEGR 315 and MEGR 281; Pre- or co-requisite: MEGR 324. (fall)

MEGR 438 Control Systems 4

Feedback control system analysis. Proportional, integral and derivative control. Control system design, compensation. Root locus, Nyquist and Bode plots. Analog and digital simulation. Four lectures per week. Prerequisite: MEGR 435. (winter)

MEGR 451 Mechanics of Composite Materials 3

Introduction, basic concepts, fabrication methods, stress and strain analysis of fiber-reinforced composite materials. Elastic behavior of unidirectional lamina, lamination theory, effects of temperature and moisture, stress and failure analysis of laminates, composite structural design, and experimental characterization. Three lectures per week. Prerequisite: junior standing.

MEGR 471 Kinematics and Dynamics of Machinery 3

Analysis and synthesis of mechanisms based on combinations of linkages and cams. Considers geometry of motion, velocity and acceleration profiles, and associated forces. Uses manual analytical and graphical methods as well as more advanced computer methods. Three lectures per week. Prerequisite: MEGR 230.

MEGR 487 Engineering Design I 3

MEGR 488 Engineering Design II 4

MEGR 489 Engineering Design III 3

Group design project focusing on the integrative aspects of engineering subject matter. The project focuses on: (1) philosophy of design, a creative approach, and a comprehensive design project; planning, organizing and leading an engineering project; exercising judgment and considering economic factors; and (2) integrated aspects of creative design and analysis; case studies; design of a novel device or system. Format consists of classroom lectures and individual design team meetings each week. The three courses must be taken as a continuous sequence. Fulfills the senior synthesis core requirement. Prerequisite: department permission. (487 fall; 488 winter; 489 spring)

MEGR 491-493 Special Topics ..... 1 to 5

MEGR 496 Independent Study ..... 1 to 5

MEGR 497 Directed Reading ..... 1 to 5

MEGR 498 Directed Research ..... 1 to 5

MEGR 499 Undergraduate Research ..... 1 to 5

Analytical, numerical, or laboratory investigation of a research problem in mechanical engineering under the supervision of a mechanical engineering department faculty member. Graded CR/F. Prerequisite: junior standing.