Department of Engineering

GRACE COLLEGE

GRACE COLLEGE & GRACE THEOLOGICAL SEMINARY CATALOG 2024-2025

Department of Engineering

Faculty

Full-time Faculty
Fred A. Wentorf, Ph.D., Department Chair
David B. Ray, MS

Half-time faculty
David C. Winyard, Sr., Ph.D.

Part-time Instructors
Mearlin Bixler
Nolan Jones, BA
Matthew Reimink, MS

Grace College offers the Bachelor of Science in Mechanical Engineering (BSME) degree. The BSME program prepares graduates for entry into the workforce with the engineering skills to solve the ever-increasing challenges of improving the quality of life, of improving our infrastructure and security, of application and utilization of energy production, or contributing to the design of revolutionary new technologies. This degree is accredited by ABET, the premiere engineering accreditation agency for engineering programs.

The program benefits from its location in the "orthopedic capital of the world". This includes filling the classroom and laboratories with experts in their fields to educate and mentor our students, relevant work experience that is only five minutes from campus (in addition to more diverse experience opportunities in nearby locations like Ft. Wayne), industry-based senior projects, and research projects that are relevant to the real-world. This interaction is facilitated by an engaged advisory council of industry experts and growing group of industry leaders that support the program.

Department Purpose

In support of Grace College's mission, the Department of Engineering seeks to rigorously educate the next generation of Christian engineers by using thorough theoretical training, hands-on learning, and relevant work experience to prepare them to work in the engineering industry and serve the needs of the world.

Specifically, our program educational objective is to prepare graduates for the practice of engineering at the professional level and:

1. Apply their mechanical engineering education to solve technical problems and make the world a better place through service.
2. Maintain the curiosity that drives lifelong learning and allows for the flexibility to adapt to the fast-moving 21st century engineering world.
3. Fulfill their calling in life through engineering practice, continuing education, and community involvement.
4. Serve as ambassadors for the engineering profession and Grace College in word and deed.

In sum, Grace College mechanical engineering graduates will be *Engineered to Serve*.

MECHANICAL ENGINEERING

Of all fields of engineering, mechanical engineering is the most diverse and general. Mechanical engineers can be found working in almost any industry. Manufacturing, transportation, health care, and insurance are just a few of the types of firms that employ mechanical engineers. No other field of engineering provides a better professional base for interdisciplinary activities.

Mechanical engineers design machines of all types, from bicycles to spacecraft. They plan, design, and direct the manufacture, distribution, and operation of these machines. Mechanical engineers also design the power sources needed to operate the machines and provide for the environment in which they function. In fact, mechanical engineering involves all phases of energy production and utilization: engines, power plants, electrical generation, heating, ventilating, and air conditioning.

Mechanical Engineering Student Learning Outcomes

The Department of Engineering supports Grace College's emphasis on strengthening *character*, sharpening *competence*, and preparing for *service*.

ABET, the leading accreditation organization for engineering, mandates student outcomes 1-7 following, in its accreditation Criterion 3. The department has added outcomes 8-9 to meet the needs of its constituencies. Together, the nine outcomes constitute the department's definition of engineering competence:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. An ability to perform hands-on industry relevant engineering tasks like machining, testing, six sigma analysis, and designing using computer-aided design (cad) software
9. An ability to identify and perform service activities using their engineering skills.

Program Requirements

Students who choose this option will complete the following 136 credit hour program of study:

General Education Requirements (46 hours):

Grace Core (39 hours)

Other general education requirements (7 hours):

MAT 3130 Linear Algebra

CHM 1610/1620 General Chemistry I and Lab

Major Requirements (90 hours):

Math and Science Requirements (24 hours):
MAT 1230/1240 Calculus I and Lab
MAT 1250 Calculus II
MAT 2250 Calculus III
MAT 2280 Differential Equations
PHY 2240/2250 University Physics I and Lab
PHY 2260/2270 University Physics II and Lab
MAT 3200 Probability and Statistics

Mechanical Engineering Science (24 hours):
MEG 2110 Engineering Statics
MEG 2150 Strength of Materials
MEG 2200 Dynamics
MEG 2300 Engineering Materials
MEG 2400 Electrical Science (Circuits)
MEG 2500 Thermodynamics
MEG 2600 Heat Transfer
MEG 2700 Fluid Mechanics

Mechanical Engineering Fundamentals (36 hours):
MEG 1000 Engineering Service
MEG 1200 Intro to Mechanical Engineering
MEG 1400 Intro to Programming in MATLAB
MEG 1900 Engineering Modeling and Tolerancing
MEG 1950 Industrial Machining and Measurements
MEG 2000 Engineering Internship
MEG 2800 Kinematics and Linkage Design
MEG 2900 Machine Component Design
MEG 3100 Experimental Methods and Sensors
MEG 3200 Control Systems
MEG 3300 Advanced Manufacturing Processes
MEG 3400 Intro to Finite Element Analysis
MEG 4100, 4110 Senior Engineering Project

Technical Electives – choose from the following (6 hours):
MEG 3010, 3020, 3030 Special Topics in Engineering
MEG 3500 Orthopedic Biomechanics
MEG 3600 Robotics

ADMISSION REQUIREMENTS

Bachelor of Science in Mechanical Engineering (BSME):

Since engineering is a demanding field of study, the department has established its own elevated admission standards. Enrollment in studies leading to a Bachelor of Science in Mechanical Engineering (BSME) degree is open to students meeting the following requirements:

- Minimum high school GPA of 3.0 and top half of graduating class
- Standardized test scores (only ONE is required)
    - ACT composite score of at least 21, with at least 23 in the math section
    - SAT minimum combined score of 1060 in the math and reading sections, and at least 560 in the math section

Alternatively, the Department of Engineering Chair can admit individual students based on a transcript review and personal interview. The requirement for standardized tests may be waived under the admissions office's alternative transcript review and interview admission process.

ACCREDITATION

Grace College is accredited by the Higher Learning Commission, and the BSME degree is accredited by ABET.

COURSE DESCRIPTIONS

ENGINEERING FUNDAMENTALS

MEG 1000 Engineering Service

This course will allow the student to perform actual service using their engineering skills before graduation. These service activities could include a variety tasks including helping with engineering education in the surrounding school systems, performing engineering work for non-profits, or other ways to make the world a better place using their growing engineering skills. Faculty approval is needed for each student's engineering service project. A minimum recommendation for hours of service is 10. Zero hours.

MEG 1200 Introduction to Mechanical Engineering

This course will give an overview of the mechanical engineering profession, introduce key skills used in engineering, including problem solving, the design process, and quickly give an overview of Mechanical engineering sciences, including an introduction into basic statics and free-body diagrams. Hands-on laboratory activities, such as 3D printing, digital scanning, and mechanical tensile testing, will also be performed in this course to give the students a well-rounded engineering introduction. Four hours.

MEG 1400 Introduction to Programming in MATLAB

This course will begin with an introduction to basic programming including programming structure, variables, and loops. In this course, programming will be used to perform mechanical functions using various equipment. This course will also include an introduction to numerical methods for solving engineering problems. Prerequisite: MAT 1230/1240. Two hours.

MEG 1900 Engineering Modeling and Tolerancing

This course will teach graphical communication for engineers starting with the fundamentals of engineering drawings, then work significantly on 3D model creation, and end with an introduction to geometric dimensioning and tolerancing. Emphasis is placed on developing the skills needed for mechanical engineering design. Each student will design their own part or mechanism based on given design inputs. Three hours.

MEG 1950 Industrial Machining and Measurements

This course will begin with machine shop safety and then teach the processes of running a manual mill and lathe and other common machining tools. Students will use these new skills to design and build a final project.. The course will also focus on measurements of parameters key to design and manufacturing. Prerequisite: MEG 1900. Three hours.

MEG 2000 Engineering Internship
This course will include journaling, self and manager assessments, and other activities during an internship working as a professional engineer. One hour.

MEG 2800 Kinematics and Linkage Design
Study of the kinematics and kinetics of machines and mechanisms. Topics will include displacement, velocity, and acceleration analysis of linkage and cam mechanisms by graphical, analytical, and computational methods. Also covered are synthesis of mechanisms, gears, and gear trains. Design projects are normally required. Prerequisites: MAT 2280 and MEG 2200. Three hours.

MEG 2900 Machine Component Design
Review of stress/strain and force/deflection relationships. Introduction to static and dynamic failure theories. Discussion of design and selection of some machine elements. Design projects are normally required. Prerequisite: MEG 2100. Three hours.

MEG 3100 Experimental Methods and Sensors
This lecture and lab course will develop a basic understanding of the use of common engineering sensors in experimental and design applications. Introduction to sensors for the measurement of temperature, pressure, stress/strain, position and flow is accompanied by application of sensor signals including signal conditioning, filtering, and acquisition and processing. Experimental planning and execution fundamentals are covered as well as data analysis and statistical evaluation of experimental data. Computer based acquisition and analysis methods are directly experienced by hands on lab work. Prerequisite: MEG 2400. Three hours.

MEG 3200 Control Systems
This course will present the following concepts: basic elements of continuous-time signals and systems; differential equation models of systems; Fourier series and Fourier transforms; system response to periodic inputs; Laplace transforms; transfer functions and stability analysis. The final project typically involves design and tuning of an electromechanical and/or electrohydraulic motion control system. Prerequisites: MEG 1400, MEG 2400, and MAT 2280. Three hours.

MEG 3300 Advanced Manufacturing
This course will introduce different advanced manufacturing methods and introduce the students to CNC machining. Tools will be introduced that can be used to analyze and improve manufacturing processes using Six Sigma methodologies and tools. Upon successful completion of the exam at the end of the course, the student will obtain a Six Sigma Green Belt Certification. Prerequisite: MEG 1950. Three hours.

MEG 3400 Introduction to Finite-Element Analysis
Introduction to finite-element analysis and optimization to engineering design using commercial up-to-date software such as Solidworks. Prerequisites: MEG 2300 and MEG 2900. Three hours.

MEG 4100 / 4110 Senior Engineering Project
As part of the capstone engineering experience, students will work on projects over the course of two semesters that may be derived from industry sources or other integrated design problems. Projects may be undertaken by individuals or teams, and may be interdisciplinary or specific to an area of concentration. Prerequisite: Senior standing in the engineering program. Three hours each in consecutive fall and spring semesters, six hours total.

ENGINEERING SCIENCE

MEG 2110 Engineering Statics
This course covers static mechanical behavior. The topics covered include; force and moment vectors, equivalent systems, trusses, frames, and machines, equilibrium of particles and rigid bodies, static friction, centroids and moments of inertia.. Co-requisites: PHY 2240/2250 and MAT 1250. Three hours.

MEG 2150 Strength of Materials
The course covers material behavior, stresses, strains and deformations with simple applications in engineering designs. Topics include: elastic and elastic-plastic behavior; plane stress and strain; constitutive relationships, principal stress and strain; stresses in thin-walled pressure vessels; bending and shearing stresses in beams; Mohr's circle; deflections of beams; Euler buckling; short and long columns; torsion of solid and hollow circular sections; introduction to statistical indeterminacy and simple redundant structures. Labs will be used to help reinforce learnings of the course. Prerequisite: MEG 2110 Engineering Statics. Three credit hours.

MEG 2200 Dynamics
Introduction to particle and rigid-body kinematics and kinetics; motion analysis; work-energy and momentum methods; engineering applications; and, vibrations. Prerequisites: MEG 2100. Three hours.

MEG 2300 Engineering Materials
Introduction to common materials utilized in engineering applications. Content covered includes the primary types of materials (metals, ceramics, and polymers) and composites. Students learn the fundamental principles of material structure and relationship to properties as well as manufacture and application of those materials to engineering solutions. Prerequisite: CHM 1610/1620. Three hours.

MEG 2400 Electrical Science (Circuits)
Analysis of linear networks, AC and DC electric circuits that involve multiple independent sources, using Ohm's Law, Kirchhoff's voltage and current laws, Thévenin's and Norton's theorems, and the maximum power transfer theorem. Also explored is the steady state and transient behavior of capacitors and inductors. Includes laboratory experience. Prerequisite: MAT 1230/1240. Three hours.

MEG 2500 Thermodynamics
Introduction to the thermal-fluid sciences, beginning with a classical macroscopic study of energy, its forms and transformations, and the interactions of energy with matter, including properties of pure substances, the first and second laws of thermodynamics, entropy, power and refrigeration cycles, gas mixtures, and chemical reactions. Prerequisite: MEG 2100. Three hours.

MEG 2600 Heat Transfer
Introduction to heat transfer by conduction, convection, and radiation and applications to heat exchanges, ducts and pipes, surfaces, phase changes, and mass transfer. Prerequisites: MEG 2500 and MEG 2700. Three hours.

MEG 2700 Fluid Mechanics
Introduction to Newtonian fluids; statics, continuity, momentum, and energy principles; dimensional analysis and similarity; laminar and turbulent, incompressible, internal and external, viscous flow; boundary layers; and the basics of pumps and fluid systems. Prerequisites: MAT 2250 and MEG 2200. Three hours.

TECHNICAL ELECTIVES

MEG 3010, 3020, 3030 Special Topics in Engineering
Study of advanced subjects in engineering science and practice. May involve intermediate or advanced study of prerequisite introductory courses. Topics may vary from one semester to the next based on student interests and the availability of qualified faculty. Prerequisite: junior or senior standing in engineering or instructor permission. One to three hours, repeatable.

MEG 3500 Orthopedic Biomechanics
The human musculoskeletal system will be investigated and then evaluated as a mechanical system. Experimental data and research documents will be used to solve different biomechanical problems. An introduction to orthopedic implant science will also be included. Prerequisite: MEG 2900. Three hours.

MEG 3600 Robotics
This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid-body dynamics, 3D graphic simulation; control design, actuators, and sensors. Training and certification on a KUKA 6-axis educational robot will be included in this course. Prerequisites: MEG 2800, MEG 3100, and MEG 3200. Three hours.