MECHANICAL ENGINEERING BSME

Mechanical Engineering

College of Science, Engineering & Technology
Department of Mechanical and Civil Engineering
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Accreditation. The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.ABET.org

Mechanical Engineering (ME) is essential to a wide range of activities that include the research, design, development, manufacture, management, and control of engineering systems, subsystems, and their components. Mechanical engineers use the fundamentals of engineering mechanics, energy, thermal-fluid sciences, and material sciences to design and analyze mechanical systems that perform useful tasks required by society. For example, mechanical engineers work with the design and function of machines, devices, and structures in the areas of manufacturing, processing, power generation, and transportation (air, land, sea, and space). As a result of a rapidly expanding technology in recent years, mechanical engineers have become more versed in computer-aided design; robotics; bioengineering; environmental engineering; solar, wind, and ocean energy sources; and space exploration. The breadth of the field provides the graduate with many possibilities for a satisfying career.

Typically, mechanical engineers are employed by the manufacturing, power, aerospace, automotive, computer hardware and software, and processing industries. Careers are also available in design and development organizations as well as in many federal and state agencies.

Program Objectives. The Mission of the Mechanical Engineering program at Minnesota State Mankato is to provide a broad-based education that will enable graduates to enter practice in the mechanical engineering profession, serving the needs of the State of Minnesota and the Nation.

Within 3-6 years of graduation, graduates of the mechanical engineering program at Minnesota State University, Mankato are expected to contribute to the profession and to society as a whole by achieving a combination of the following milestones.

1. Based on their strong technical foundation in mechanical engineering,they have advanced professionally to increased levels of responsibility, have successfully transitioned into business or management, or have successfully completed an advanced degree.
2. They have demonstrated an ability to communicate technical information through internal and external technical reports or proposals, patent applications, published papers and articles, or conference presentations.
3. They have participated in, or served as an officer of, a local, regional, or national professional engineering society, standards committee, or state/local board.
4. They have participated in continuing education or pursued additional industry certification.
5. They have become a registered professional engineer.

The program mission and educational objectives are fully compatible with the mission of Minnesota State Mankato and the College of Science, Engineering, and Technology. Program objectives are monitored by the constituencies (mechanical engineering profession through the program's Industrial Advisory Board and employers, alumni, students, and faculty of the program).
Other important features of the mechanical engineering program at Minnesota State Mankato include the following:

- Students are required to take the Fundamentals of Engineering exam in their senior year - a precursor to professional registration.
- Students are encouraged to work in engineering related areas for exposure to industrial practice. Internships are strongly recommended.
- Senior students must participate in a full academic year design experience working in a team similar to development teams in industry and government. Industrial sponsored projects are offered when available.

Preparation. Recommended high school preparation is one year each of precalculus (or equivalent), physics and chemistry. Engineering drafting and a computer language are also recommended. Without this background it may take longer than four years to earn the degree.

Academic Map/Degree Plan at www.mnsu.edu/programs/#All

POLICIES/INFORMATION

Program Admission. Admission to the Mechanical Engineering Program is granted by the department, and is necessary before enrolling in 300- and 400-level courses. Near the end of the sophomore year, students must submit an application for admission to the mechanical engineering program. Applications to the program may be obtained from the Department of Mechanical and Civil Engineering or downloaded from the department homepage.

Before being admitted to upper division mechanical engineering courses, a student must complete a minimum of 48 credits, for grade, including the following courses applicable to the degree: General Physics (calculus based) 8 credits; Calculus and Differential Equations 16 credits; Introduction to Engineering 2 credits; Computer Graphics Communication 1 credit; Geometric Dimensioning and Tolerancing in Engineering Design 2 credits; Introduction to Problem Solving and Engineering Design 2 credits; Engineering Mechanics (Statics and Dynamics) 6 credits; Electrical Engineering (Circuits, including lab) 4 credits; Chemistry 3 credits; and English Composition 4 credits.

To be admitted to the mechanical engineering program, a student must earn a grade of "C" (2.00) or better and a cumulative GPA of 2.50 in the courses listed above. All core course grades (including those for repeated courses) will be considered in the computation of the GPA for admission to the program. Provisional admission to the program for one semester may be granted in limited cases.

All admitted students are required to take a department-administered diagnostic test early in their junior year.

Transfer Students. The department makes a special effort to accommodate transfer students. Transfer students are encouraged to contact the department as soon as possible to facilitate a smooth transition. Generally, no transfer credits are allowed for upper division mechanical engineering courses. Transfer students must complete a minimum of 12 credits at Minnesota State Mankato prior to being considered for full admission to the program.

Satisfactory Progress. Once admitted to the mechanical engineering program, a student must demonstrate satisfactory progress by maintaining a cumulative GPA of at least 2.30 in all upper-division mechanical engineering courses as calculated by the Registrar.

P/N Grading Policy. P/N credit is not allowed for any course used to meet mechanical engineering degree requirements.

Probation Policy. An admitted student who does not maintain satisfactory progress as defined above will be placed on program probationary status for a maximum of one semester. During the probationary period, the student must complete at least 8 credits, approved by the department, of upper division engineering courses for grade from the prescribed Mechanical Engineering curriculum. Students may not receive a degree without first conforming to the satisfactory progress criteria. A student who fails to meet satisfactory progress for a second semester (consecutive or non-consecutive) will not be allowed to continue in the program.

Appeals. A student may appeal any departmental decision in writing. The department will consider such appeals individually.

MECHANICAL ENGINEERING BSME
Degree completion = 128 credits

Required General Education
Required Special General Education (23 credits)

The Bachelor of Science in Mechanical Engineering degree does not adhere to the

standard general education program required by other majors. Rather, it requires a special distribution of communication, humanities, and social science courses. Courses may be chosen to satisfy the university cultural diversity requirement concurrently.

Required Humanities and Social Science Courses (minimum of 16 credits).
To satisfy this requirement, the courses selected must provide both breadth and depth and not be limited to a selection of unrelated introductory courses. Each student should discuss with his/her mechanical engineering advisor the selection of courses to meet this requirement early in their academic career. A current list of acceptable courses is posted in the department office and on the department web site. Specifically, the minimum requirements consist of (a) three credits of microeconomics or macroeconomics, (b) at least 6 credits in the humanities area, and (c) at least 6 credits in the social science area; again, (a), (b), and (c) must total at least 16 credits.

To provide the measure of depth to the course of study, at least 3 credits at the 300-level or above must be included in the 16 credit requirement. At least one upper division course must follow a course in the same subject area as a course at the 100 or 200 level.

ENG	101	Composition (4)
(choose 3-4 credits)		
CMST	102	Public Speaking (3)
ENG	271W	Technical Communication (4)

Prerequisites to the Major

CHEM	191	Chemistry for Engineers (3)
MATH	121	Calculus I (4)
MATH	122	Calculus II (4)
MATH	223	Calculus III (4)
MATH	321	Ordinary Differential Equations (4)
PHYS	221	General Physics I (4)
PHYS	222	General Physics II (3)
PHYS	232	General Physics II Laboratory (1)

Major Common Core

EE	230	Circuit Analysis I (3)
EE	240	Evaluation of Circuits (1)
EE	244	Introduction to Digital Systems (2)
ME	101	Introduction to Engineering - Mechanical (2)
ME	103	Computer Graphics Communication (1)
ME	201	Introduction to Problem Solving and Engineering Design (2)
ME	203	GD&T in Engineering Design (2)
ME	206	Materials Science (3)
ME	212	Statics (3)
ME	214	Dynamics (3)
ME	223	Mechanics of Materials (3)
ME	241	Thermodynamics (3)
ME	291	Engineering Analysis (3)
ME	321	Fluid Mechanics (3)
ME	324	Heat Transfer (3)
ME	329	Applied Thermodynamics (3)
ME	333	Manufacturing Processes (3)
ME	336	Mechanical Engineering Experimentation I (2)
ME	341	Linear Systems (3)
ME	417	Design of Machine Elements (3)
ME	420	Computer Aided Engineering (3)
ME	428	Design Project I (3)
ME	436W	Mechanical Engineering Experimentation II (2)
ME	438W	Design Project II (3)
ME	463	Automatic Controls (3)
ME	466	Mechanical Engineering Experimentation III (2)
ME	492	Mechanical Engineering Seminar (1)

Major Restricted Electives
Consult with your advisor for selection of mechanical engineering electives.

Mechanical Engineering Electives (choose 6 credits)
Science Electives (choose 4 credits)

BIOL	105	General Biology I (4)
BIOL	105W	General Biology I (4)
CHEM	202	General Chemistry II (5)
ENVR	101	Perspectives in Environmental Science (4)
MATH	247	Linear Algebra I (4)
MATH	422	Partial Differential Equations (4)
PHYS	223	General Physics III (3)
PHYS	233	General Physics III Laboratory (1)

Required Minor: None.

COURSE DESCRIPTIONS

ME 100 (1) Explorations in Engineering
This course offers an introduction to the various disciplines of engineering and their relationship to the principles of physics and mathematics. Students are prepared for academic success and the transition into an engineering program.
Fall
GE-12

ME 101 (2) Introduction to Engineering - Mechanical
To prepare students for a career in engineering with emphasis on mechanical; introduce the engineering fundamentals and the skills necessary to have a successful learning experience; and to prepare students for engineering education and profession through interactions with upper-class engineering students and practitioners.
Prerequisite: MATH 113 or MATH 115 or MATH 121

ME 102 (1) Introduction to Engineering II
A continuation of ME 101 covering historical and global perspectives, engineering discipline and functions, professional aspects of engineering, ethical aspects of engineering, creativity and innovation, basics of personal computers--word processing and spreadsheets, introduction to problem solving.
Variable

ME 103 (1) Computer Graphics Communication
Standards of graphics communication. Orthographic projections, dimensioning, tolerancing, section views. Extensive use of modern software to create engineering drawings. Introduction to solid modeling of parts and assemblies. This course includes laboratory component.

ME 203 (2) Geometric Dimensioning and Tolerancing in Engineering Design
This course is intended to provide the students with an understanding of the principles and methodologies of geometric dimensioning and tolerancing. Topics include: Datums, Material condition symbols, Tolerances of Form and profile, Tolerances of orientation and runout, location tolerances, and Virtual condition. This course includes laboratory component.
Prerequisite: ME 103, ME 201

ME 201 (2) Introduction to Problem Solving and Engineering Design
This course has two main parts. Part one covers problem solving and fundamentals of programming including data types, decision making, repetitive loops, and arrays. Engineering applications requiring programming are included. Part two covers engineering design philosophy and methodology, communication skills, and teamwork. A design project is also included.
Prerequisite: ME 101
Co-requisite: ME 103, MATH 121
Fall, Spring

ME 206 (3) Materials Science
Physical principles of elastic and plastic deformation of materials. Dislocation theory. Fatigue, creep, fracture, hardness, phase diagrams and other mechanical phenomena in materials. Ceramics and composite materials. Residual stresses. Lecture and lab demonstrations.
Co-requisite: ME 223
Fall

ME 212 (3) Statics
Resultants of force systems, equilibrium, analysis of forces acting on structural and machine elements, friction, second moments, virtual work.
Prerequisite: PHYS 221
Fall, Spring

ME 214 (3) Dynamics
Kinematics and kinetics of particles, systems of particles and rigid bodies, work-energy, linear and angular impulse momentum, vibrations.
Prerequisite: ME 212
Fall, Spring

ME 223 (3) Mechanics of Materials
Load deformation, stress, strain, stress-strain relationship, buckling, energy concepts, stress analysis of structural and machine elements.
Prerequisite: ME 212
Fall, Spring

ME 241 (3) Thermodynamics
Fundamental concepts of thermodynamics. Thermal properties of substances and state equations. Conservation of mass, first and second laws. Examples of applications to different engineering systems.
Prerequisite: PHYS 221
Fall

ME 291 (3) Engineering Analysis
Probability and statistics. Uncertainty, distributions. Numerical solution of algebraic, transcendental and differential equations. Numerical integration and differentiation. Structured programming language required.
Prerequisite: CIVE 201 or ME 201
Co-requisite: MATH 321
Fall, Spring

ME 293 (1) MAX Scholar Seminar
This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Students will be required to participate in mentoring of lower division MAX scholarship recipients and provide written and oral presentations of various topics during the semester. This course may be repeated and will not count towards graduation requirements.
Prerequisite: Recipient of a MAX scholarship or instructor consent.
Fall, Spring

ME 299 (2) Thermal Analysis
Basic principles of thermodynamics, fluid mechanics, and heat transfer. First and second laws of thermodynamics and application to engineering systems and their design. Not for mechanical engineering major.
Prerequisite: PHYS 221 with "C-" (1.67) or better
Spring

ME 321 (3) Fluid Mechanics
Introduction to fluid flow, fluid properties, fluid statics, the integral and differential approach to basic flow equations. Bernoulli's equation, similitude and dimensional analysis, viscous internal and external flows, one dimensional compressible flow.
Prerequisite: ME 214
Co-requisite: ME 241 or ME 299
Fall

ME 324 (3) Heat Transfer
Steady and unsteady conduction. Free and forced convection. Heat transfer by radiation. Combined modes of heat transfer. Elements of heat exchangers design. Includes significant design component.
Prerequisite: ME 241, ME 321
Spring

ME 329 (3) Applied Thermodynamics
Energy analysis and design of thermodynamic systems including power and refrigeration cycles. Thermodynamic relations. Application of thermodynamics to mixtures and solutions. Psychometrics. Introduction to chemical thermodynamics. Third law of thermodynamics. Includes significant design component.Prerequisite: ME 241
Spring

ME 333 (3) Manufacturing Processes
Introduction to manufacturing, tribology, casting, bulk deformation, sheet metal forming, material removal, joining, polymers, powder metals, ceramics, automation, integrated systems. Design for manufacture. Includes significant design component.
Prerequisite: ME 206, ME 223
Spring

ME 336 (2) Mechanical Engineering Experimentation I
Experiments in Mechanical Engineering, load-deformation, load-failure, fatigue, impact, hardness. Introduction to traditional machining and material processing. This course includes laboratory.
Co-requisite: ME 333
Spring

ME 341 (3) Linear Systems
Analysis of linear systems in the time and frequency domains. Physical systems modeled and analyzed using time domain techniques. Fourier and Laplace Transforms.
Prerequisite: ME 291
Fall

ME 398 (0) CPT: Co-Operative Experience
Curricular Practical Training: Co-Operative Experience is a zero-credit full-time practical training experience for one summer and on adjacent fall or spring term. Special rules apply to preserve full-time student status. Please contact an advisor in your program for complete information.
Prerequisite: ME 201. At least 60 credits earned; in good standing; instructor permission; co-op contract; other Prerequisites may also apply.
Fall, Spring, Summer

ME 415 (3) Structural Analysis
Minimum design loads for buildings using ASCE 7 guidelines and load distribution. Analysis of determinate structural systems including the case of moving loads. Analysis of indeterminate structures using the flexibility and moment distribution methods. Use of software to enhance the analysis.
Prerequisite: ME 223
Fall

ME 416 (3) Thermal/Fluid Systems Design
The application of the principles of thermodynamics, fluid mechanics, and heat transfer to the design and analysis of selected energy systems of current interest, such as nuclear, solar, geothermal, and also conventional systems. Lecture and design projects.
Prerequisite: ME 324, ME 329
Variable

ME 417 (3) Design of Machine Elements
Application of principles of mechanics to the design of various machine elements such as gears, bearings, springs, rivets, welding. Stresses in mechanical elements. Design factors, fatigue, manufacturability. Lectures and design projects.
Prerequisite: ME 214, ME 223
Spring

ME 418 (3) Mechanical Systems Design
The application of mechanics to the design and analysis of motion and force transmitting systems. Optimum design. Includes significant design component.
Prerequisite: ME 417
Variable

ME 420 (3) Computer Aided Engineering
This course provides the students with sound understanding of both solid modeling techniques and finite element analysis. It covers the major features as well as feature manipulation techniques. It also provides a background in deriving, understanding and applying the stiffness matrices and finite element equations for various types of finite elements and systems. Static stress analyses, sensitivity studies and optimization studies are covered. Includes significant design component.
Prerequisite: ME 417, ME 324
Co-requisite: Senior standing in ME.
Fall

ME 422 (3) Mechanics of Composite Materials
Introduce anisotropic mechanics theories, engineering application of various composite materials, mechanical behaviors and fabrication of composites, experimental and theoretical approach for composite designs, contemporary issues such as nano/microcomposites. Includes significant design component.
Prerequisite: ME 223

ME 424 (3) Analysis and Design of Heat Transfer Equipment
Analysis of heat and mass flow, design of heat exchangers and accompanying piping system. Methods of heat transfer enhancement, heat pipes. Includes significant design component.
Prerequisite: ME 324
Variable

ME 426 (3) Aerosol Theory and Technology
Introduction to the theory of aerosols and particulate systems. Properties, behavior, and physical principles of aerosols; including particle size statistics, Brownian motion and diffusion, and coagulation. Application in areas such as environmental systems, respiratory deposition, bioterrorism, and materials processing.

ME 428 (3) Design Project I
The first course in a two semester sequence that provides a complete design experience under professional guidance. The course covers: the product realization process, financial analysis, quality, patents, ethics and case studies. The students initiate a design project early in the semester to be completed in ME 438W.
Prerequisite: ME 324, ME 329, ME 333, ME 336, ME 341, ME 417
Fall

ME 429 (3) Energy Conversion
Methods of energy conversion. Topics may include hydroelectric, geothermal, wind and solar power generation, as well as unconventional methods of energy conversion. Term design problems.
Prerequisite: ME 324, ME 329
Variable

ME 436W (2) Mechanical Engineering Experimentation II
Experimental and analytical studies of phenomena and performance of fluid flow, heat transfer, thermodynamics, refrigeration and mechanical power systems. This course includes laboratory component. Extensive writing component.
Prerequisite: ME 291, ME 324, ME 329
Fall
WI

ME 438W (3) Design Project II
The second course of a two semester sequence providing a complete design experience and introduction to professional practice. This course includes: completion of the design project, design presentations, and the final design report. Students will prepare for and complete the Fundamentals of Engineering exam.
Prerequisite: ME 428
Spring
WI

ME 439 (3) Air Conditioning & Refrigeration
Refrigeration cycles and equipment, refrigerant properties, heating and cooling loads, psychometric analysis of air conditioning. Distribution of air conditioning medium and air quality as applied to design. Includes significant design component.
Prerequisite: ME 324, ME 329
Variable

ME 447 (3) Design of Machine Elements II
Application of principles of mechanics of materials and of material failure theories to the design and analysis of shafts, journal bearings, helical, bevel and worm gears, clutches, brakes, couplings, and flexible mechanical elements. Statistical consideration.
Prerequisite: ME 417
Spring

ME 450 (3) Finite Element Method
Energy and residual methods, 2D and 3D problems in stress analysis. Application of steady and transient heat flow, hydrodynamics, creeping flow. Includes significant design component.
Prerequisite: ME 223 and ME 324 or instructor consent
Variable

ME 463 (3) Automatic Controls
Analysis of control systems using the methods of Evans, Nyquist and Bode. Improvement of system performance by feedback compensation. Introduction to digital control. Includes significant design component.
Prerequisite: ME 341
Fall

ME 464 (3) Mechatronics
Synergistic combination of mechanical engineering, electronics, controls and programming in the design of mechatronic systems. Sensors, actuators and microcontrollers. Survey of the contemporary use of embedded microcontrollers in mechanical systems, case studies. Includes significant design component.
Prerequisite: ME 417, ME 463
Spring

ME 466 (2) Mechanical Engineering Experimentation III
Experiments in vibrations: Motion measurement, force measurement, free vibration, frequency response, impact response, noise, signal processing. Experiments in control: system modelling and characterization in the time and frequency domains, feedback and compensation, PID control, control of velocity and position. This course includes laboratory. Extensive writing component.
Prerequisite: ME 463
Spring

ME 466W (2) Mechanical Engineering Experimentation III
Experiments in vibrations: Motion measurement, force measurement, free vibration, frequency response, impact response, noise, signal processing. Experiments in control: system modelling and characterization in the time and frequency domains, feedback and compensation, PID control, control of velocity and position. This course includes laboratory. Extensive writing component.
Prerequisite: ME 463
Spring
WI

ME 491 (1-4) In-Service
Variable

ME 492 (1) Mechanical Engineering Seminar
To acquaint students with various engineering careers, various industries, and various societal and ethical problems.
Prerequisite: Senior standing in Mechanical Engineering
Co-requisite: ME 428
Spring

ME 493 (1) MAX Scholar Seminar
This class provides MAX scholars with an opportunity to explore a set of topics related to achieving success in academic, professional and personal realms. Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Students will be required to participate in mentoring of lower division MAX scholarship recipients and provide written and oral presentations of various topics during the semester. This course may be repeated and will not count towards graduation requirements.
Prerequisite: Recipient of a MAX scholarship or instructor consent.
Fall, Spring

ME 494 (1) Global Experience in Engineering and Technology
This class provides students pursuing a minor in "Global Solutions in Engineering and Technology" with an opportunity to explore a set of topics related to achieving success in advance of and following an international experience (internship, study abroad, etc.). Speakers will include faculty, graduate students, visiting researchers and industry members as well as student participants. Returning students will be required to participate in mentoring of students preparing for their international experience and provide written and/or oral presentations of various topics during the semester. This course is required both before and after participation in the international experience (min. 2 cr.).
Variable

ME 497 (1-6) Internship
Variable

ME 499 (1-6) Individual Study
Variable

ME 540 (3) Introduction to Computational Fluid Dynamics
This course introduces the numerical methods used for solving partial differential and integral equations of the type commonly occurring in fluid mechanics and heat transfer. The course provides a background in geometry and mesh generation, solution processes, and post-processing. Error control and numerical stability will be discussed. Numerical solutions for selected problems in fluid mechanics and heat transfer will be derived. Students will learn to use a commercial CFD software package. Includes significant design component.
Prerequisite: ME 291; CIVE 321 or ME 321; ME 299 or ME 324
On Demand: Fall, Spring