

MECHANICAL ENGINEERING

Mechanical engineers are problem-solvers who make things work better, more efficiently, and more economically. They are also innovators who creatively design machines and systems that enhance our lives. The Mechanical Engineering discipline spans mathematics, physics, computing, mechanical systems, manufacturing, energy systems and thermal-fluids, to name just a few. Mechanical engineers must also possess good communication skills and be able to work in teams. Mechanical engineers should be aware of social and environmental consequences of their work. In the Mechanical Engineering Department, students receive basic preparation in all of these areas. Additionally, through choice of elective courses they may further specialize in areas such as biomechanics, renewable energy systems, robotics, product design, controls, automotive and advanced manufacturing.

A degree in mechanical engineering prepares students for a range of career opportunities including those in industry, government, consulting, and entrepreneurial activities. Mechanical engineers are in high demand across a range of industries such as automotive, materials processing, heavy equipment, paper, plastics, power, aerospace, medical devices, chemical, electronics, or many other large and small industries. Their work may involve research and development of new products, design of equipment or systems, supervision of production, plant engineering, administration, sales engineering, or testing of individual components or complete assemblies. A degree in mechanical engineering may also be used as a springboard to non-engineering fields, including medicine, law, or business, and provides a broad foundation for graduate work in science and engineering.

In the Mechanical Engineering Department at UW-Madison, course options are grouped according to three major disciplines: **Mechanical Systems**, **Energy Systems**, and **Manufacturing**. The required course list is made up of foundational courses from each of these three sub-disciplines as well as core mathematics and science courses. In addition, the department offers specialization tracks which leverage key expertise within the department. These specialization tracks include **Biomechanics** and **Sustainable Energy Systems**.

Mechanical Engineering Disciplines:

1. **Mechanical systems** covers the design and analysis of products and equipment. Mechanical engineers who focus on design conceive of new devices and machines and also refine and improve existing designs. The design engineer must be proficient in kinematics, machine elements, mechanics, strength and properties of materials, dynamics, vibrations, etc.
2. **Energy systems** has taken on special significance with the current awareness of the limited energy sources and the effects of energy use on the environment. In this field, mechanical engineers carry out work on the behavior of liquids, gases, and solids as they are used in all types of energy-conversion systems. Automotive engines, gas turbines, steam power plants, refrigeration systems, air pollution control, cryogenics and energy utilization require this type of background. The proficient engineer must have a knowledge of thermodynamics, fluid dynamics, heat transfer, and related subjects.
3. Mechanical engineers who focus on **Manufacturing** are involved with planning and selecting manufacturing methods, with designing and developing manufacturing equipment, and with increasing the efficiency and productivity of current manufacturing technologies for

polymer, metal, and ceramic products. The manufacturing engineer uses chemistry, materials science, mechanics of materials, materials processing principles and practices, principles of computer control, engineering statistics, data-science and other physical and thermal sciences to improve manufacturing operations and systems, and the products they produce.

Mechanical Engineering Specialization Tracks:

In addition to the core curriculum, the department offers specialization tracks which leverage key expertise within the department. The specialization tracks provide guidance on the selection of elective courses that fit within the regular Mechanical Engineering curriculum. The tracks also allow a student to work on specialization-relevant design projects in their senior capstone design sequence.

Biomechanics: Biomechanics involves the application of mechanical engineering principles to address problems in medicine and biology. Students in the biomechanics track select from elective courses in biology, physiology, tissue mechanics, movement biomechanics, orthopedic biomechanics and biofluidics. There is also the potential to pursue research opportunities with our biomechanics faculty who do work on traumatic brain injury, wearable sensors, prosthetics, orthopedics, cardiovascular mechanics, rehabilitation and more. Students in the biomechanics track can simultaneously complete the Biology in Engineering Certificate (BEC) program with additional classes in advanced biology and a biology in engineering seminar. Students in the biomechanics track are well prepared for traditional mechanical engineering careers, as well as more specialized opportunities in medical device design, biomechanical systems, and biomechanics research. The biomechanics track can also be used to prepare for graduate programs in biomechanics and professional degrees in medicine and physical therapy.

Sustainable Energy Systems: Energy systems, broadly speaking, encompass the flow of energy from source to end use. From the sun to the laptop, the mantle of the earth to the office building, the Mesozoic Era to today's jet airliner. There are numerous methods to collect, store and transport this energy. All these methods involve technical challenges and efficiency losses. The Mechanical Engineering student who follows the Sustainable Energy Systems track will take technical electives which cover the fundamental thermodynamics of power generation, the technologies and efficiencies of renewable energy, the social and environmental costs of current technologies and the tradeoffs and compromises engineers must make to fuel modern technological society. Students in the Sustainable Energy Systems track can simultaneously complete the Certificate in Engineering Thermal Energy Systems (CETES) with additional thermal energy-related courses. Energy systems continue to be intertwined with global economics, international relations, corporate sustainability and national policies. A graduate with the technical knowledge of these relationships is appealing to employers in a vast range of engineering fields and industries.