MECHANICAL ENGINEERING
Industry Guide

Introduction

Mechanical Engineering is a diverse profession that goes far beyond designing machinery. By nature, mechanical engineering is broad and the skills you will develop will qualify you for a range of opportunities. A mechanical engineer is someone who applies physics and mathematics to analyze, design, manufacture, and maintain mechanical systems.

Mechanical Engineers can create sophisticated computer-controlled robots to perform jobs with great accuracy that may be too dangerous or tedious for humans; develop hip implants and other specialized medical or assistive devices; design cars, ships, and aircraft and work at making them more efficient and environmentally friendly; study fluid flow patterns and build industrial pipelines; find new clean energy solutions and advanced technology to protect the environment; and much, much more.
Because Mechanical Engineering is so broad, it allows you to follow your own special interests and reach your full personal potential.

Key Areas of Study:

- Thermodynamics, Fluid Mechanics, Heat Transfer, Mechanical Design, Solid Mechanics, Manufacturing Processes, Materials Science, Robotics and Automation, Control Systems, Dynamics and Vibration, Finite Element Analysis (FEA), Energy Systems, Renewable Energy, Aerospace Engineering, Automotive Engineering, Biomechanics, HVAC Systems, Mechatronics, 3D Printing and Additive Manufacturing, and Computational Fluid Dynamics (CFD).

Industries

Engineers generally receive some of the highest starting salaries of graduating Bachelor's students, and mechanical engineers have a huge variety of work opportunities. Here are just some of the fields you may consider as a mechanical engineer:

- Advanced Manufacturing
- Building Technologies
- Clean Energy
- Forestry and Bioproducts
- Health
- Marine Engineering
- Mining
- Oil & Gas
- Transportation

Furthermore, mechanical engineers are also highly valued in engineering consulting firms. Mechanical engineers in consulting firms leverage their technical expertise and problem-solving skills to deliver high-impact solutions tailored to the specific needs of their clients. Their work often involves a blend of hands-on engineering, strategic planning, and client interaction, making it both challenging and rewarding.
Please note that this document is not meant to be an exhaustive list but an overview of the industries where mechanical engineers may work.

Industries

ADVANCED MANUFACTURING

Advanced manufacturing involves the use of innovative technologies to improve products and processes. It integrates robotics, automation, and smart systems to enhance productivity and efficiency. Mechanical engineers play a key role in designing and optimizing these systems, from developing robotics for assembly lines to implementing lean manufacturing techniques for waste reduction. This field combines traditional engineering principles with cutting-edge advancements like additive manufacturing and IoT-enabled machinery.

ESSENTIAL SKILLS:

- CAD/CAM software
- Robotics programming
- Lean manufacturing principles
- Process optimization
- Quality control
- Additive manufacturing.

POSITIONS:

- Process Engineer
- Manufacturing Engineer
- Automation Specialist
- Robotics Engineer
- Quality Assurance Engineer

BUILDING TECHNOLOGIES

Building technologies focus on creating efficient, safe, and sustainable buildings. This field involves HVAC systems, structural integrity, energy efficiency, and smart building systems. Mechanical engineers are instrumental in designing systems that ensure comfort, energy efficiency, and sustainability, such as ventilation systems, thermal insulation, and renewable energy integrations in buildings.

ESSENTIAL SKILLS:

- Energy modeling
- HVAC design
- Structural analysis
- Green building standards (e.g., LEED)
- Construction management
- Thermal analysis

POSITIONS:

- HVAC Engineer
- Structural Engineer
- Building Systems Engineer
- Sustainability Consultant
- Project Manager

CLEAN ENERGY

The clean energy sector focuses on renewable and sustainable energy sources, such as wind, solar, and hydropower, to reduce environmental impact. Mechanical engineers contribute to this field by designing and optimizing energy systems, improving storage solutions like batteries, and developing efficient power generation and distribution methods. This work is crucial for advancing the global transition to sustainable energy systems.

ESSENTIAL SKILLS:

- Energy modeling software
- Renewable energy systems design
- Power electronics
- Thermodynamics
- Sustainability assessments

POSITIONS:

- Renewable Energy Engineer
- Energy Systems Designer
- Grid Engineer
- Battery Systems Engineer
- Wind Energy Specialist

FORESTRY AND BIOPRODUCTS

Forestry and bioproducts involve the sustainable use of natural resources to create eco-friendly materials, such as biofuels, biomaterials, and composites. Mechanical engineers in this field work on the processing, manufacturing, and quality testing of these materials, leveraging their understanding of material science and process engineering to innovate sustainable solutions.

ESSENTIAL SKILLS:

- Biomass processing
- Material characterization
- Environmental impact assessments
- Project management
- Process simulation

POSITIONS:

- Bioproducts Engineer
- Forest Operations Manager
- Environmental Engineer
- Biomaterials Scientist

Industries

HEALTH

Mechanical engineers in the health sector contribute to designing and developing medical devices, prosthetics, and rehabilitation technologies that enhance patient care and quality of life. This field blends principles of mechanics, materials science, and human-centered design to create innovative solutions such as surgical tools, implants, and diagnostic devices. Pathways into this industry often include specialized coursework, hands-on projects in biomechanics, and internships in medical device companies.

ESSENTIAL SKILLS:

- Biomechanics
- Medical Device Design and Prototyping
- Human Factors Engineering
- Materials Science and Selection
- Regulatory Compliance (e.g., FDA, Health Canada)
- CAD Tools for Medical Applications

POSITIONS:

- Entry Level: Medical Device Engineer Intern, Junior Biomedical Engineer
- Mid-level: Prosthetics Designer, Rehabilitation Engineer
- Senior: Senior Medical Device Engineer, Research Scientist, Medical Technology Consultant

MARINE ENGINEERING

Marine engineering encompasses the design, construction, and maintenance of vessels, submarines, and offshore structures. Mechanical engineers in this field ensure these systems are efficient, safe, and durable, addressing challenges like propulsion systems, fluid dynamics, structural integrity, and corrosion resistance in demanding marine environments. Pathways into this industry often include internships in shipyards, coursework in marine systems, and hands-on experience with CAD tools for marine applications.

ESSENTIAL SKILLS:

- Fluid Mechanics and Dynamics
- Structural Analysis for Marine Environments
- Propulsion System Design
- Corrosion Engineering and Prevention
- CAD for Ship and Offshore Structure Design
- Knowledge of Marine Standards and Regulations

POSITIONS:

- Entry Level: Marine Engineer Intern, Junior Marine Systems Engineer
- Mid-level: Naval Architect, Offshore Engineer
- Senior: Senior Marine Systems Engineer, Marine Surveyor, Lead Propulsion Engineer

MINING

The mining industry focuses on extracting minerals and natural resources from the earth, with mechanical engineers playing a crucial role in designing, maintaining, and optimizing machinery and processes. Engineers in this sector address challenges such as ventilation systems, rock mechanics, and sustainable mining practices to enhance safety, efficiency, and environmental stewardship. Pathways into this field often include internships at mining companies, coursework in resource extraction, and experience in heavy machinery or process optimization.

ESSENTIAL SKILLS:

- Mine Design and Planning
- Rock Mechanics and Structural Analysis
- Ventilation System Design
- Mineral Processing Techniques
- Safety Standards and Compliance
- Environmental Impact Assessment

POSITIONS:

- Entry Level: Mining Engineer Intern, Junior Rock Mechanics Engineer
- Mid-level: Ventilation Engineer, Mine Planner, Process Engineer
- Senior: Senior Mining Engineer, Principal Process Engineer, Rock Mechanics Specialist

OIL & GAS

The oil and gas industry encompasses the extraction, processing, and distribution of fossil fuels. Mechanical engineers play a critical role in designing drilling equipment, optimizing pipeline systems, and maintaining safety protocols. Their expertise in thermodynamics, fluid mechanics, and structural analysis ensures efficient and reliable energy production while meeting environmental and safety standards. Pathways into this industry often include internships with oil and gas companies, hands-on experience with drilling and pipeline systems, and advanced knowledge of energy systems.

ESSENTIAL SKILLS:

- Fluid Mechanics and Dynamics
- Petroleum Engineering Principles
- Thermodynamics and Heat Transfer
- Pipeline Design and Optimization
- Safety Standards and Compliance

Industries

Positions:

- Entry Level: Drilling Engineer Intern, Junior Reservoir Engineer
- Mid-level: Pipeline Engineer, Safety Engineer, Production Engineer
- Senior: Senior Drilling Engineer, Reservoir Specialist, Principal Pipeline Engineer

TRANSPORTATION

Transportation engineering involves designing vehicles, infrastructure, and systems to enable the efficient and safe movement of people and goods. Mechanical engineers in this field focus on vehicle design, propulsion systems, and integrating automation into transportation networks. Their work drives innovations in fuel efficiency, emission reduction, and smart mobility solutions. Pathways into this industry often include internships in vehicle manufacturing, transportation planning, or logistics engineering, along with experience in automation and urban infrastructure design.

ESSENTIAL SKILLS:

- Transportation Systems Modeling
- Vehicle Dynamics and Propulsion Design
- Automation and Control Systems
- Logistics and Supply Chain Optimization
- Urban Planning and Smart Mobility

POSITIONS:

- Entry Level: Junior Transportation Engineer, Vehicle Design Engineer Intern
- Mid-level: Systems Integration Engineer, Operations Manager
- Senior: Senior Vehicle Design Engineer, Transportation Systems Architect, Smart Mobility Specialist

Technical Skills

CORE SKILLS

SOLID MECHANICS:
Proficiency in analyzing stresses, strains, and deformations in materials and structures, essential for designing mechanical systems and components.

FLUID MECHANICS:
Understanding the principles of fluid behavior, including flow dynamics, pressure distribution, and applications in hydraulics and aerodynamics.

DYNAMICS AND VIBRATIONS:
Knowledge of system dynamics, kinematics, and vibration analysis, crucial for motion studies and designing stable mechanical systems.

THERMODYNAMICS AND HEAT TRANSFER:
Expertise in energy systems, heat transfer principles, and thermodynamic processes, vital for engines, HVAC, and energy-efficient systems.

MATERIALS SCIENCE:
Familiarity with material properties, selection, and failure mechanisms to ensure strength, durability, and performance in engineering designs.

CONTROL SYSTEMS:
Understanding feedback systems, stability, and control techniques for automation and precision in mechanical systems.

MECHANICAL DESIGN:
Proficiency in designing mechanical components and assemblies, including CAD software and engineering analysis tools.

BASIC MACHINE SHOP PRACTICES:
Experience with machining techniques such as milling, turning, and drilling, as well as an understanding of machining safety protocols.

RAPID PROTOTYPING:
Skills in rapid prototyping, including 3D printing, CNC machining, and other manufacturing techniques for creating and testing designs efficiently.

SOFTWARES AND TOOLS

CAD SOFTWARE:

- AutoCAD: 2D/3D design and drafting.
- SolidWorks: 3D modeling and simulation.
- PTC Creo: Parametric CAD design.
- Fusion 360: Cloud-based CAD for design and manufacturing.

FEA SOFTWARE:

- ANSYS: Structural, thermal, and fluid simulations.
- Abaqus: Non-linear FEA for mechanical systems.
- COMSOL: Multi-physics simulations (structural, thermal, fluid).

CFD SOFTWARE:

- ANSYS Fluent: Fluid dynamics and heat transfer simulations.
- OpenFOAM: Open-source CFD for complex flow problems.
- SimScale: Cloud-based CFD and FEA simulation.

SIMULATION SOFTWARE:

- MATLAB: Numerical analysis and simulations.
- Simulink: Dynamic system modeling and simulation.
- Simufact: Simulation for manufacturing processes.

VERSION CONTROL & COLLABORATION:

- Git/GitHub: Version control and collaboration.
- Microsoft Teams and Slack: Communication and teamwork.

DATA ANALYSIS & VISUALIZATION:

- Python (Pandas, Matplotlib, NumPy)
- Excel: Basic data organization and analysis.

TESTING & MEASUREMENT:

- LabVIEW: Hardware control and data acquisition.
- 3D Scanners: Reverse engineering and quality inspection.

How to get Involved

- Engineering Design Teams
- MECH Undergraduate Engineering Club
- EUS
- UBC Clubs
- Personal Projects
- UBC Work Learn Program

Other Resources

- Canadian Society for Mechanical Engineering (CSME)
- About your degree - Mechanical
- Industry Sectors