



# MECHANICAL ENGINEER

## WORK SKILLS, INTEREST & COMPETENCIES

### Introduction

Mechanical engineers research, design and develop machinery and systems for heating, ventilating and air conditioning, power generation, transportation, processing and manufacturing. They also perform duties related to the evaluation, installation, operation and maintenance of mechanical systems.

A mechanical engineering degree is a combination of maths, science, technology, business and management. Throughout your studies you acquire not only an understanding of general engineering principles but also a range of transferable skills. Mechanical engineering courses are designed to ensure graduates are:

- able to solve problems using both logic and creative/innovative approaches;
- numerate and highly computer literate, with excellent analytical skills;
- able to plan and prioritise, work to deadlines and under pressure;
- cost/value-conscious and aware of the necessary social, cultural, environmental, health and safety, and wider professional responsibilities;
- capable of careful attention to detail, exercising good judgement and accepting responsibility;
- able to communicate with others and work in multidisciplinary teams.

### **Job Prospects**

Mechanical Engineering being the broadest of all Engineering fields, the job prospects on offer for skilled Mechanical Engineers are aplenty and unending. These professionals can find employment both in the government and private sector undertakings.

Major industries that employ mechanical engineers include

Automobile

Space Research,

Aeronautical,

Energy and Utilities,

Air Conditioning & Refrigeration

Bio-Mechanical Industry.

Giant manufacturing plants

Turbine manufacturing plants

Oil and Gas Exploration and refining

Agriculture

## Typical work activities

### Tasks

- Read and interpret blueprints, technical drawings, schematics, or computer-generated reports.
- Assist drafters in developing the structural design of products using drafting tools or computer-assisted design (CAD) or drafting equipment and software.
- Research, design, evaluate, install, operate, and maintain mechanical products, equipment, systems and processes to meet requirements, applying knowledge of engineering principles.
- Confer with engineers or other personnel to implement operating procedures, resolve system malfunctions, or provide technical information.
- Recommend design modifications to eliminate machine or system malfunctions.
- Conduct research that tests or analyzes the feasibility, design, operation, or performance of equipment, components, or systems.
- Investigate equipment failures and difficulties to diagnose faulty operation, and to make recommendations to maintenance crew.
- Develop and test models of alternate designs and processing methods to assess feasibility, operating condition effects, possible new applications and necessity of modification.

- Develop, coordinate, or monitor all aspects of production, including selection of manufacturing methods, fabrication, or operation of product designs.
- Specify system components or direct modification of products to ensure conformance with engineering design and performance specifications.

## Knowledge

**Engineering and Technology** — Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.

**Design** — Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.

**Mechanical** — Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

**Mathematics** — Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.

**Physics** — Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and sub-atomic structures and processes.

**Production and Processing** — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

**Computers and Electronics** — Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

**English Language** — Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

**Customer and Personal Service** — Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.

**Administration and Management** — Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.

## WORK SKILLS REQUIRED

## Skills

**Complex Problem Solving** — Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

- Encounter team conflicts. They meet with the individuals involved, reinforce the fact they are on the same team and discuss options for solving the conflicts that maintain quality and safety.
- Find that engineering plans cannot be implemented due to unexpected financial or physical barriers. For example, a mechanical engineer may find that beams are blocking locations where pipes should pass. The mechanical engineer consults a civil engineer to find out if it is possible to move the beams and reviews engineering plans to identify alternative ways to pass the pipes.
- Find that machine or equipment components do not fit together well. For example, an engineer in a manufacturing facility finds that bearings on a conveyor belt are looser than the desired push fit. The engineer determines the correct dimensions for the bearings, revises the drawings, makes note of design changes and notifies the millers and others who will be affected by the changes.
- Encounter project delays. For example, they may learn that essential pieces of equipment will be shipped late. They determine the consequences to their project budgets and schedules and identify strategies, such as locating alternate vendors and accelerating other areas until the equipment arrives, to minimize the effects.
- Are faced with cost overruns in mechanical engineering projects. They consult with team members to review in detail why the costs are higher than expected. They brainstorm to identify less expensive methods and materials that meet the clients' specifications and timelines.
- May find that completed jobs do not meet safety and regulatory standards.
- Lose time and money when equipment they have installed malfunctions or fails to perform as expected. For example, following testing, mechanical engineers may determine that equipment is not performing as expected. They consult industry standards which describe potential problems that can be encountered, how to investigate them, potential solutions and remedial actions. They analyze data and formulate and investigate hypotheses to find the source of the problems. They re-design the equipment and conduct

additional testing to demonstrate that the new pieces of equipment are of acceptable quality.

## Decision Making

- Decide which products to purchase and contractors to select. For example, they review catalogues to determine if the parts are standard or must be customized and consider costs, volume discounts, delivery times and past experience with product vendors. When selecting contractors they consider factors such as work quality, safety records, reputation and ability to deliver on time.
- Decide which measuring tools and methods to use. For example, they may decide where to place sensors within machines to get the best measurements when conducting vibration analysis. They consider their previous experience, machine layouts, the horizontal or vertical orientation of machines and the shapes of bearings to determine the sensor placements.
- Decide which materials and equipment to use for engineering projects. They take into account client specifications, industry norms and cost. For example, they may decide the most appropriate flow meters to use by considering available technology, the level of precision needed, availability and costs.
- Decide the appropriate codes and standards to apply when completing client projects. They use their technical knowledge and experience to select the most appropriate codes such as the American Society of Mechanical Engineering Codes and the International Organization for Standardization standards or Indian standards.
- Decide which clients have priority when multiple clients are experiencing technical difficulties simultaneously. They consider the types of services required, the time of the calls and the production losses and costs for the clients. For example, one robot out of operation in a car assembly plant can shut down the entire production and may cost crores of rupees per hour to the client.

## Critical Thinking — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

- Judge the accuracy and completeness of mechanical engineering drawings before forwarding them for implementation. They ensure that the drawings adhere to required codes and standards and that the information is complete

and presented in a clear and concise manner. They check that sufficient details have been provided for work to proceed.

- May assess employee performance by evaluating the skill sets, strengths and limitations of employees. Engineers' abilities to accurately assess employees influences employees' and team productivity, which ultimately affects the organizations' overall success.
- Judge the functionality or serviceability of equipment. They analyze evaluation data and apply International standards to calculate fault severities and consider standardization codes for, pipeline, structural steel codes, provincial boiler and pressure vessel acts, etc and client limitations such as linguistic or financial barriers. Accurate judgements are vital to customer satisfaction and the credibility and profitability of the engineering firm.
- Conduct operations, environmental, safety and construction audits to assess quality, conformity with standards, safety and environmental risks. For example, they conduct operational audits in manufacturing plants and construction sites to verify that the organizations meet all provincial and federal regulations. They may also conduct environmental audits to check that organizations have spill containment procedures in place, that all tanks are double-walled and that organizations are following recycling and composting guidelines.

**Active Listening** — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

**Judgment and Decision Making** — Considering the relative costs and benefits of potential actions to choose the most appropriate one.

**Mathematics** — Using mathematics to solve problems.

**Reading Comprehension** — Understanding written sentences and paragraphs in work related documents.

**Science** — Using scientific rules and methods to solve problems.

**Operations Analysis** — Analyzing needs and product requirements to create a design.

**Active Learning** — Understanding the implications of new information for both current and future problem-solving and decision-making.

**Speaking** — Talking to others to convey information effectively.

## Abilities

**Information Ordering** — The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers,



letters, words, pictures, mathematical operations).

**Mathematical Reasoning** — The ability to choose the right mathematical methods or formulas to solve a problem.

**Deductive Reasoning** — The ability to apply general rules to specific problems to produce answers that make sense.

**Written Comprehension** — The ability to read and understand information and ideas presented in writing.

**Near Vision** — The ability to see details at close range (within a few feet of the observer).

**Problem Sensitivity** — The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

**Inductive Reasoning** — The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).

**Oral Comprehension** — The ability to listen to and understand information and ideas presented through spoken words and sentences.

**Category Flexibility** — The ability to generate or use different sets of rules for combining or grouping things in different ways.

**Number Facility** — The ability to add, subtract, multiply, or divide quickly and correctly.