

CONCEPTS OF
MECHANICAL
ENGINEERING – I
(25ME111)

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Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

I Semester Scheme of Studies – Mechanical Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	SC	25SC11I	Engineering Mathematics-I	4	0	4	8	6	50	20	50	20	-	-	100
2	ENG	25EG01I	Essential English Communication	4	0	4	8	6	50	20	-	-	50	20	100
3	ME	25ME01I	Computer Aided Engineering Drawing	3	0	4	7	5	50	20	-	-	50	20	100
4	ME	25ME11I	Concepts of Mechanical Engineering-I	4	0	4	8	6	50	20	50	20	-	-	100
Audit Course															
5	ME	25ME12T	Environmental Sustainability	2	0	0	2	2	50	20	-	-	-	-	50
6	Personality Development		NCC/NSS/YOGA/SPORTS...	Students are expected to engage in any one of these activities from 1 st semester to 6 th semester (No Credits)											
Total				17	0	16	33	25	250	-	100	-	100	-	450

5. CIE Assessment Methodologies

Sl.No	CIE Assessment	Test Week	Duration (minutes)	Max Marks	Average of all CIE=50 Marks
1.	CIE-1 Theory Test	4	90	50	
2.	CIE-2 Practice Test	7	180	50	
3.	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all practices and activities through Rubrics	1-13	-	50	
Total					50 Marks

WEEK 01

- Introduction to Mechanical Engineering
- Scope of Mechanical Engineering
- Career's opportunities for Mechanical Engineers
- Fundamental Units – Definition and units of Length, Mass, Time & Temperature in CGS, FPS, MKS & SI Units with conversions.
- Derived Units – units of Area, Volume, Density, Velocity, Acceleration, Force, Work, Energy Power in CGS, FPS, MKS & SI Units with conversions.
- (Formulae & Simple numerical examples)

INTRODUCTION TO MECHANICAL ENGINEERING

- Mechanical engineering is the study of physical machines that may involve force and movement. It is an engineering branch that combines engineering physics and principles of mathematics with materials science, to design, analyse, manufacture and maintain mechanical systems.
- Its primary goals are to convert energy into productive forms; design, develop, produce and test machines; and understand and apply the interactions of solids, liquids and gases.
- It is one of the oldest and broadest branch in the engineering field, Mechanical engineering requires an understanding of main areas such as mechanics, dynamics, thermodynamics, materials science, design, structural analysis and electricity.

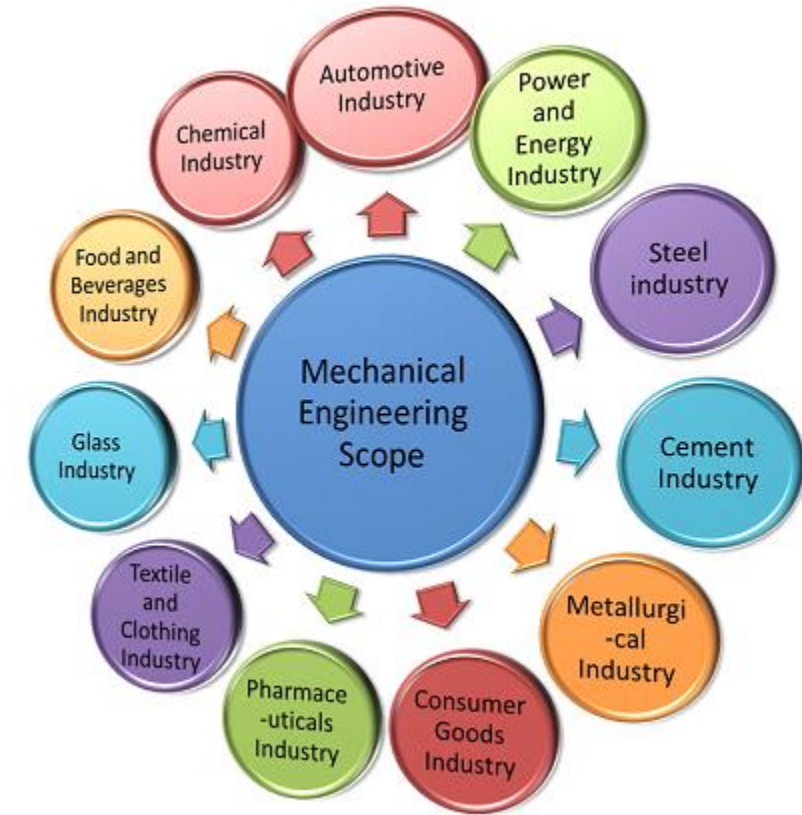
SCOPE FOR MECHANICAL ENGINEERING

Mechanical engineering in India has a wide scope, with opportunities in many sectors. Mechanical engineers are in high demand and the field is expected to grow in the future.

Sectors

Manufacturing Mechanical engineers can work in manufacturing plants.

- **Automotive:** Mechanical engineers can work in the automotive industry.
- **Aerospace:** Mechanical engineers can design and test aircraft, missiles and spacecraft.
- **Energy:** Mechanical engineers can work in the energy sector.
- **Construction:** Mechanical engineers can work in construction and infrastructure.
- **Research and development:** Mechanical engineers can work on developing new technologies and products.
- **Biomedical:** Mechanical engineers can work in the biomedical field.
- **Robotics:** Mechanical engineers can work in robotics.
- **HVAC:** Mechanical engineers can work in HVAC systems.



Design Engineer:

Design engineers work on creating and developing new products and systems using computer-aided design (CAD) software.

Manufacturing Engineer:

Manufacturing engineers focus on improving the efficiency and productivity of manufacturing processes.

Quality Control Engineer:

Quality control engineers ensure that products meet the required quality standards by testing and analyzing materials and products.

Maintenance Engineer:

Maintenance engineers are responsible for maintaining and repairing mechanical systems and equipment.

Research and Development Engineer:

Research and development engineers work on developing new technologies and products by conducting research and experimentation.

Job Roles:

Aerospace engineer: Designs and tests aircraft, missiles and spacecraft.

Research and development engineer: Develops new technologies and products through research and experimentation.

Chief mechanical engineer: A high-paying job for mechanical engineers.

Mechanical developer: A high-paying job for mechanical engineers.

BENEFITS:

- Mechanical engineers enjoy good job stability, job prospects and salaries.
- Mechanical engineering skills are in demand worldwide.
- Mechanical Engineering is one of India's most popular and sought after fields. It is a field of engineering which involves the application of principles of physics, mathematics, and materials science for the design, development, manufacture, operation and maintenance of machines, tools, engines and other mechanical products



SCOPE OF MECHANICAL ENGINEERING IN FUTURE:

Mechanical engineering is an ever-evolving field with a promising future due to the increasing demand for mechanical systems and technologies across various industries.

Here are some of the key areas where mechanical engineering is expected to have significant scope in the future:

Renewable Energy: With the growing concern about climate change and the need to reduce greenhouse gas emissions, **renewable energy sources like wind, solar and hydropower** are gaining popularity. Mechanical engineers will be crucial in designing and developing efficient renewable energy systems.

Robotics and Automation: Robotics and automation are transforming various industries, from manufacturing to healthcare. Mechanical engineers **will be in demand to design and develop robots and automated systems that can work efficiently and safely.**

Nanotechnology: Nanotechnology is an emerging field **that deals with designing and manipulating materials at the nanoscale.** Mechanical engineers will be required to design and develop nanoscale materials and devices for various applications.

Artificial Intelligence: Artificial Intelligence (AI) is increasingly used to optimize various systems and processes. Mechanical engineers will be **required to design and develop mechanical systems that integrate AI technologies.**

3D Printing: 3D printing is revolutionizing the manufacturing industry **by enabling the creation of complex geometries and custom parts.** Mechanical engineers will be required to design and develop 3D printers and create optimized designs for 3D printing

CAREER OPPORTUNITIES FOR MECHANICAL ENGINEERS:

Mechanical engineering is a vast field with numerous career opportunities in various sectors. Here are some of the popular career opportunities for mechanical engineers:

Automotive Engineering: This field involves designing and developing automobiles like cars, trucks, buses and motorcycles.

Aerospace Engineering: Aerospace engineering involves designing and developing of aircraft, spacecraft and satellites.

Energy Engineering: This field focuses on designing and developing of renewable energy sources like wind turbines, solar panels and hydroelectric power systems.

Manufacturing Engineering Manufacturing engineering involves designing and developing of manufacturing processes to improve efficiency, productivity and quality.

Robotics Engineering: Robotics engineering involves designing and developing robots for industrial and personal use.

Bio-mechanical Engineering: Biomechanical engineering involves designing and developing 1 medical devices, prosthetics and implants.

Materials Engineering: Materials engineering involves designing and developing of new materials for various applications, such as aerospace, construction and medical fields.

HVAC Engineering: HVAC engineering involves designing and developing of heating, ventilation and air conditioning systems for buildings.

JOB POSSIBILITIES IN VARIOUS SECTORS FOR MECHANICAL ENGINEERS:

Manufacturing Sector: Production Engineer, Quality Control Engineer, Process Engineer, Plant Manager, Maintenance Engineer and Operations Manager.

Automotive Industry: Design Engineer, Manufacturing Engineer, Automotive Technician, Quality Engineer, Research and Development Engineer, Production Engineer.

Aerospace Industry: Aerospace Engineer, Design Engineer, Research and Development Engineer, Flight Test Engineer, Propulsion Engineer and Manufacturing Engineer.

Energy Sector: Energy Engineer, Thermal Engineer, Renewable Energy Engineer, Power Plant Engineer, Operations Manager, Research and Development Engineer.

Consulting Firms: Mechanical Engineer Consultant, Design Consultant, Project Manager, Technical Consultant and Operations Consultant.

Construction and Infrastructure: Product Manager, Site Engineer, HVAC Engineer, Structural Engineer, Project Co-ordinator and MEP Engineer.

Government Sector: Public Works Department (PWD), Indian Railways, Indian Army, Indian Navy, Defence Research and Development Organisation (DRDO), Indian Space Research Organisation (ISRO).

Research and Development: Research Engineer, Product Development Engineer, Test Engineer, Design Engineer and Quality Control Engineer.

Mechanical engineering graduates have plenty of career options across various sectors and choosing a career path that aligns with their interests and skillset is essential.

MECHANICAL ENGINEERING A GOOD CAREER IN INDIA:

Yes, mechanical engineering is a good career option in India as it is one of the oldest and broadest fields of engineering. The scope of mechanical engineering in India is vast, with opportunities available in various sectors like automobile, aerospace, energy, construction and many more. Mechanical engineers are in high demand in India, and the field offers good job prospects and competitive salaries. The Indian government is also investing heavily in various infrastructure projects, which is leading to a surge in demand for mechanical engineers.

Some of the popular job profiles for mechanical engineers in India include:

Design Engineer: Design engineers work on creating and developing new products and systems using computer-aided design (CAD) software.

Manufacturing Engineer: Manufacturing engineers focus on improving the efficiency and productivity of manufacturing processes.

Quality Control Engineer: Quality control engineers ensure that products meet the required quality standards by testing and analyzing materials and products.

Maintenance Engineer: Maintenance engineers are responsible for maintaining and repairing mechanical systems and equipment's.

Research and Development Engineer: Research and development engineers work on developing new technologies and products by conducting research and experimentation.

FUNDAMENTAL UNITS:

The units in which the fundamental quantities are measured are called fundamental units.

Fundamental units are the basic units of measurement defined by the international system of units (SI). They include the meter (m) for length, kilogram (Kg) for mass, second (s) for time, kelvin (K) for temperature.

Definitions:

Length (L or l): It can be defined as the distance between two points and it can be measured in terms of metre (m).

Mass (M or m): It can be defined as the amount of matter in an object and it can be measured in terms of kilogram (Kg).

Time (t): It can be defined as the duration of an event and it can be measured in terms of second (s).

Temperature (T): It can be defined as the degree of hotness or coldness of an object and it can be measured in terms of kelvin (K).

FUNDAMENTAL UNITS:

Units of Length, Mass, Time and Temperatures in CGS, FPS, MKS and SI Units :

Units Table

Sl.No.		CGS	FPS	MKS	SI
1.	Length	Centimeter (cm)	Foot	Meter	Metre
2.	Mass	Gram	Pound	Kilogram (Kg)	Kilogram (Kg)
3.	Time	Second	Second	Second	Second
4.	Temperature	Degree Celsius($^{\circ}\text{C}$)	Degree Fahrenheit($^{\circ}\text{F}$)	Kelvin (K)	Kelvin (K)

DERIVED UNITS

These are the units generated from a combination of base units, supplementary units and other derived units.

Definitions:

Area (A): Area can be defined as the amount of space inside a two-dimensional shape. It is measured in square units, like square meters (m²) or square feet.

Volume (V): Volume is defined as the space occupied within the boundaries of an object in three-dimensional space. It is measured in terms of m³.

Density (ρ): Density can be defined as mass per unit volume of a given material and it is measured in terms of kg/m³ in SI unit for solids.

$$\text{Density } \rho = \frac{\text{Mass}}{\text{Volume}} = \frac{m}{v}$$

Velocity (v): Velocity can be defined as the rate of change in displacement of an object or particle with respect to time and it is measured in terms of m/s in SI unit.

Acceleration (a): Acceleration can be defined as the rate of change of velocity with respect to time and it is measured in terms of m/s².

$$\text{Acceleration, } a = \frac{(\text{Initial velocity} - \text{Final velocity})}{\text{Time}}$$

$$a = \frac{\text{Change in velocity}}{\text{Time}}$$

Force: Force is an external agent capable of changing a body's state of rest or motion and it can be measured in terms of newton (N) in SI unit.

Push or pull of an object is considered a force. Forces can change an object's speed, its direction and even its shape.

$$F = m \times g \text{ (Mass } \times \text{ Acceleration due to gravity.) } kg.m/s^2$$

Where, m= mass, g=acceleration due to gravity.

Work: Work can be defined as the product of force and the magnitude of displacement in the direction of force and it is measured in terms of N-m in SI unit.

$$\text{Work or work done} = \text{Force} \times \text{displacement}$$

$$W = F \times d \quad N - m \text{ or Joule (J)}$$

Power: Power can be defined as the workdone per unit time or the rate of doing work and it can be measured in terms of N-m/s

$$\text{Power} = \frac{\text{Workdone}}{\text{Time taken}} = \frac{W}{t} = \frac{N - m}{s}$$

Energy: Energy can be defined as the capacity to do work and it can be measured in terms of N-m or Joule (J).

Mechanical energy is equal to the workdone on a body in changing either its position or its velocity and these are:

Potential energy: It is the energy possessed by a body for doing work, by the virtue of its position. For example, a body raised to some height above the ground level possesses potential energy because it can do some work by falling on earth's surface. The potential energy

$$PE = W \times h = m \times g \times h \quad N - m$$

Where, W=Weight of the body

m=Mass of the body

h = Distance through which the body falls.

Kinetic energy: It is the energy possessed by a body, for doing work, by the virtue of its mass and velocity of motion. If a body of mass m attains a velocity v from rest in time t, under the influence of force F and moves a distance 's', then

$$Workdone = F \times s = m \times a \times s \text{ (Where, } F = ma)$$

Kinetic energy of a body,

$$KE = m \times a \times \frac{v^2}{2a}$$
$$KE = \frac{1}{2}mv^2 \quad N - m$$

We know that $v^2 - u^2 = 2as$

Since, $u = 0$ because body starts from rest

Then $v^2 = 2as$

Therefore $s = (v^2/2a)$

WEEK 01 REVIEW QUESTIONS

1. What is mechanical engineering?
2. What is mechanical engineering? Explain.
3. Write the scope for mechanical engineering.
4. Explain the scope for mechanical engineering.
5. Write the scope for mechanical engineering in future.
6. What are the career opportunities for mechanical engineers?
7. What are the popular job profiles for mechanical engineers in India?
8. Explain fundamental units.
9. What are the derived units?

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