Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: 23ES1006

1st / 3rd Semester Regular/Back Examination: 2025-26
SUBJECT: Basic Mechanical Engineering
BRANCH(S): AUTO, BIOMED, C&EE, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MECH, METTA, MINING, MMEAM, AE, AEIE, AERO, AIML, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CS, CSE, CSE(CS), CSEAI, CSEAIML, CSEDS, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ENV, ETC, MANUTECH, MECH, METTA, MINERAL, MINING, MME, PLASTIC
Time: 3 Hours
Max Marks: 100
Q.Code: U689
Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) State the Zeroth Law of Thermodynamics and its importance.
b) Define entropy. State its unit.
c) State the significance of the critical point of a substance.
d) Distinguish between SI and CI engines.
e) Define specific gravity of a fluid.
f) Estimate the difference in pressure between 10 m of mercury column and 10 m of water column in Pascals.
g) What are the criteria for selection of manometric fluid.
h) What is hardness? Name the hardest and softest material in engineering.
i) State two advantages of belt drives.
j) What is meant by degree of freedom (DOF) of a robot?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain the terms: process, path, state, and cycle in relation to thermodynamics with illustrative diagrams.
b) Discuss the limitations of the First Law of Thermodynamics. How are they addressed?
c) State and explain the Second Law of Thermodynamics with Kelvin–Planck and Clausius statements.
d) Explain the modes of heat transfer with suitable examples.
e) A hydraulic press has a ram of 15 cm in diameter and a plunger of 1.5 cm in diameter. What force would be required on the plunger to raise a weight of 25 kN on the ram?
f) Define viscosity. Discuss the causes of viscosity of a fluid. How does viscosity of a fluid vary with temperature?

g) Define vapor pressure of a liquid. How is it related to boiling? Highlight the parameters affecting vapor pressure of a liquid.

h) Discuss common casting defects, their causes, and remedies.

i) Explain the principle and working of arc welding with a neat sketch.

j) Compare hot working and cold working processes.

k) Explain the construction and working of gear drives.

l) Describe different types of clutches used in automobiles.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** During process A, system receives 20 kJ heat and produces 30 kJ work. The process B between same end conditions, receives of 15 kJ heat. Determine the change in internal energy during the process and work done in process. Prove that if the cycle is formed using processes A and B, the given data confirms to the first law of thermodynamics. **(8 + 8)**

b) Air at 12 °C and 85 kPa enters the diffuser of jet engine steadily with a velocity of 220 m/s. The inlet area of the diffuser is 0.38 m^2. The air leaves the diffuser at a negligible velocity compared to inlet velocity. Calculate (i) mass flow rate of air (ii) the temperature of air leaving the diffuser.

Q4 **a)** A shaft of 6 cm in diameter and 60 cm long is pulled steadily a V = 0.6 m/s through a sleeve 6.02 cm in diameter. The clearance is filled with oil having kinematic viscosity of 0.006 m^2/s and specific gravity, S = 0.88. Estimate the force required to pull the shaft. **(8 + 8)**

b) An inverted U-tube manometer is connected to two pipes, A and B, transporting water (density, ρ_w = 1000 kg/m^3). The top of the manometer is filled with oil (specific gravity, S = 0.8). The center of pipe A is 30 cm higher than B. The oil-water interface in the left limb (connected to A) is 20 cm below the center of A. The oil-water interface in the right limb is 40 cm below the center of B. Find the pressure difference $P_A - P_B$.

Q5 **a)** Compare casting, welding, and forming processes. **(8 + 8)**

b) Discuss the role of material properties in manufacturing process selection.

Q6 **a)** Describe different types of brakes and their applications. **(8 + 8)**

b) Describe the anatomy of a robot with the help of a block diagram.