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

Total Number of Pages: 02 **Course: IDD (B.Tech and M.Tech)**
Sub_Code: 23ES1006

2nd Semester Regular/Back Examination: 2024-25
SUBJECT: Basic Mechanical Engineering
BRANCH(S): AE, AEIE, AERO, AUTO, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, MECH, METTA, MINING
Time: 3 Hours
Max Marks: 100
Q.Code: S535

Answer Question No.1 (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) Define a thermodynamic system and differentiate between open and closed systems.
b) State the limitations of the first law of thermodynamics.
c) State the second law of thermodynamics in terms of heat engines.
d) What is a perpetual motion machine? Differentiate between PPM1 and PMM2.
e) How does viscosity of a fluid vary with temperature?
f) Define vapor pressure. How does it affect the boiling of a liquid?
g) What is the role of flux in arc welding?
h) What is the function of a mould in casting?
i) What is a clutch used for in power transmission systems?
j) What is a link in robotic anatomy?

Part-II

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

a) Define and explain the terms: system, boundary, surroundings, and universe in thermodynamics.
b) Define internal energy in a thermodynamic system. Prove that it's a property of the system.
c) Define efficiency and COP of a heat engine (heat pump). Establish the relation between COP of a heat pump and a refrigerator.
d) A heat pump is used to heat the house in the winter. A house requires 80 kJ/s heat for heating in winter which is delivered by heat pump from outside air. Work required to operate the heat pump is 10 kW. Calculate COP of heat pump and heat abstracted from the outside.
e) What are different modes of heat transfer? Explain with suitable examples.
f) Describe the working of a four-stroke SI engine with a neat schematic diagram.

g) Write short notes on: (I) kinematic viscosity, (II) surface tension, (III) compressibility and (IV) specific gravity of a fluid.

h) Classify engineering materials and explain their properties with examples from each category.

i) Discuss the advantages and limitations of casting as a manufacturing process.

j) What are composite materials? Give two examples and explain their typical applications in manufacturing.

k) Compare and contrast belt drives and gear drives in terms of maintenance and typical usage.

l) Explain with diagrams the common robot configurations: Cartesian, cylindrical, and articulated.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 a) A piston cylinder device operates 1 kg of fluid at 20 atm pressure. The initial volume is 0.04 m^3. The fluid is allowed to expand reversibly following a process $pV^{1.45}$ = Constant so that the volume becomes double. The fluid is then cooled at constant pressure until the piston comes back to its original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate work done in the cycle. **(8 + 8)**

b) Air flows through a diffuser entering at 200 m/s and 250 K, and exits at 40 m/s. The inlet area is 0.01 m^2 and the exit area is 0.05 m^2. Assume adiabatic flow. Calculate the mass flow rate of air and determine the exit temperature. Use R = 0.287 kJ/kg.K and C_p = 1.005 kJ/kg.K.

Q4 a) Two large parallel plates are spaced 5 mm apart. The gap is filled with a viscous oil of viscosity μ = 0.25 Pa.s. The top plate (1 m^2 area) is to be moved at 1.5 m/s while the bottom plate is fixed. Calculate the force required to move the top plate. **(8 + 8)**

b) A tank contains water to a height of 5 m. Determine the pressure at the bottom of the tank in kPa. If oil (specific gravity = 0.8) is added on top of the water to a height of 2 m, calculate the new total pressure at the bottom.

Q5 a) Describe the steps involved in the casting process and explain any three defects that may occur during casting. **(8 + 8)**

b) What is metal forming? Explain the basic types of forming operations such as forging, rolling, and extrusion.

Q6 a) Explain the working of mechanical brakes with a suitable sketch. **(8 + 8)**

b) A robotic arm in an automated manufacturing unit uses an articulated configuration driven by motors through gear drives. It also has an emergency stop mechanism using a braking system. Discuss the role of each power transmission device in this system. Explain the robot configuration and joint types that would be most suitable for this application.