Registration No.:

2nd Semester Back Examination: 2024-25
SUBJECT: Basic Mechanical Engineering
BRANCH(S): AEIE, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MECH, METTA, MINERAL, MME
Time: 3 Hours
Max Marks: 100
Q.Code: S536
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)   Differentiate between intensive and extensive properties with suitable examples.
   b)   Why C_p is always greater than C_v?
   c)   What is meant by the state and process in thermodynamics?
   d)   Define dryness fraction.
   e)   List the four strokes of a four-stroke internal combustion engine.
   f)   What is the primary function of a clutch in power transmission?
   g)   What is the function of a gearbox?
   h)   Define a robot and mention any two of its applications.
   i)   What is the basic working principle of a thermocouple?
   j)   What is the main difference between static and dynamic measurements?

Part-II

Q2   Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)   (6 x 8)
   a)   State and explain the First Law of Thermodynamics for a closed system undergoing a cycle.
   b)   Explain the concept of entropy and its relevance in thermodynamic processes.
   c)   Describe the thermodynamic properties of pure substances during phase change with the help of P-V and T-s diagrams.
   d)   Steam at 1 MPa has a dryness fraction of 0.85. Using steam tables, find: (I) Specific Enthalpy (II) Specific Volume, and (III) Internal Energy.
   e)   With the help of a neat schematic, explain the working principle of a single-stage reciprocating air compressor.
   f)   Explain the working principles of belt drives and gear drives. Compare their applications and advantages.
   g)   Explain the basic types of brakes used in mechanical systems. How do they function to stop or slow down a rotating shaft?

h) Define the terms robot joint, link, and configuration. Explain their significance in robot motion and workspace.

i) Describe the anatomy of an industrial robot and explain the role of each part.

j) Explain the working principle of a Bourdon tube for pressure measurement with a neat diagram.

k) Explain how a strain gauge is used to measure strain in a component. Include a brief on Wheatstone bridge configuration.

l) Name the mechanical instruments used for measuring the following entities: (I) pressure, (II) Temperature, (III) Force, (IV) Flow velocity, (V) Flow rate, and (VI) Torque.

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

Q3 **a)** Air is compressed from 1 bar and 27°C to 6 bar in a single-stage adiabatic compressor. Assume γ = 1.4, R = 0.287 kJ/kgK. Find: (i) Final temperature and (ii) Work required per kg of air.   **(8 + 8)**

b) In a gas turbine unit, the gas flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of the gases inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate (i) the rate at which heat is rejected to the turbine (ii) the area of the inlet pipe given that the specific volume of gases at the inlet is 0.45 m^3/kg.

Q4 **a)** Draw a labeled schematic of a steam power plant and explain the working of each component briefly.   **(8 + 8)**

b) A refrigerator removes 500 kJ of heat from a cold space and requires 200 kJ of input work. Calculate the Coefficient of Performance (COP) of the refrigerator. Calculate the COP of the heat pump operating on the same cycle. Determine the amount of heat rejected to the surroundings.

Q5 **a)** Describe the working principle of inverted U-Tube manometer for pressure measurement in a fluid.   **(8 + 8)**

b) Describe the following robot configurations with neat, labeled diagrams: (I) Cartesian, (II) Cylindrical, (III) Articulated, and (IV) SCARA

Q6 **a)** A strain gauge has a gauge factor of 2 and shows a resistance change of 0.3 ohms. The original resistance was 120 ohms. Calculate the strain.   **(8 + 8)**

b) Discuss the use of a Pitot-static tube in measuring fluid velocity. How is dynamic pressure used in this method?