Question Paper Code	14052

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025
Third Semester
Mechanical and Automation Engineering
24MUPC301 - THERMODYNAMICS AND FLUID MECHANICS
Regulations - 2024

Duration: 3 Hours   Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K–Level	CO

1. In thermodynamics, a system that can exchange only energy but not mass with its surroundings is called a:
   a) Open system   b) Closed system
   c) Isolated system   d) Adiabatic system
   1   K2   CO1

2. The Steady Flow Energy Equation (SFEE) applies to:
   a) Closed systems only
   b) Unsteady systems
   c) Flow systems where conditions do not change with time
   d) Systems with zero energy transfer
   1   K2   CO1

3. A device that converts all heat input into an equivalent amount of work without any losses violates:
   a) Zeroth Law   b) First Law
   c) Second Law (Kelvin–Planck statement) d) Law of Conservation of Mass
   1   K2   CO2

4. If one ton of refrigeration equals 3.516 kW, then a refrigerator with a capacity of 2 TR has a cooling rate of:
   a) 1.758 kW   b) 3.516 kW c) 7.032 kW   d) 10.548 kW
   1   K2   CO2

5. In the Diesel cycle, heat is added at:
   a) Constant pressure   b) Constant volume
   c) Constant temperature   d) Variable pressure
   1   Kx   CO3

6. The air-standard assumption considers the working fluid to be:
   a) A real gas undergoing phase change
   b) Air behaving as an ideal gas throughout the cycle
   c) A mixture of fuel and air with chemical reactions
   d) Steam with variable specific heats
   1   Kx   CO3

7. If the density of oil is $850 \, \text{kg/m}^3$ and the density of water is $1000 \, \text{kg/m}^3$, the specific gravity of oil is:
   a) 0.75   b) 0.85 c) 0.90   d) 1.00
   1   K2   CO4

8. When a body floats in a fluid, the buoyant force is equal to:
   a) The weight of the body
   b) The weight of the fluid displaced
   c) The density of the body multiplied by volume
   d) The volume of the fluid
   1   K2   CO4

9. A stream function for a two-dimensional flow is given by $\psi = 3x^2 y$ velocity potential function ϕ must satisfy:
   a) $\partial^2\phi/\partial x^2 + \partial^2\phi/\partial y^2 = 0$ b) $\partial\psi/\partial x + \partial\phi/\partial y = 0$
   c) $\partial\psi/\partial x = \partial\phi/\partial y$ d) $\partial\psi/\partial x = -\partial\phi/\partial y$
   1   K2   CO5

10. The Hydraulic Gradient Line (HGL) represents the variation of:
    a) Total head   b) Pressure head + datum head
    c) Velocity head + pressure head   d) Pressure head only
    1   K2   CO6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **14052**

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

11.	Compare intensive and extensive properties.	2	K2	CO1
12.	Write the expressions of SFEE for Steam Turbine.	2	K1	CO1
13.	Draw p-V and T-s diagram for Carnot cycle	2	K2	CO2
14.	What is the difference between Refrigerator and heat pump?	2	K2	CO2
15.	Plot the Diesel engine cycle on P-V and T-S diagram. Name the various process of theDiesel cycle.	2	K2	CO3
16.	Define mean effective pressure and comment its application in internal combustionEngines.	2	K2	CO3
17.	Define Capillary rise and Capillary depression.	2	K1	CO4
18.	Define Buoyancy.	2	K1	CO4
19.	What are the types of fluid flow?	2	K1	CO5
20.	What are the assumptions made for Bernoulli's equation?	2	K2	CO5
21.	Write the expressions for head loss due to friction.	2	K2	CO6
22.	Justify $Q = \sqrt{2gH}$ is a dimensionally homogenous equation.	2	K2	CO6

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23. a) 1.5 Kg of air gas at a pressure of 8 bar and 20°c occupies the volume of 0.15 m³. It expands adiabatically to a pressure of 0.9 bar and volume 0.73 m³   *11   K3   CO1*
Determine
i) Values of two specific heats C_p and C_v
ii) Specific internal energy
iii) The work done during the process.

OR

b) Air flows steadily at the rate of 0.05 kg/s through an air compressor, entering at 7 m/s with a pressure of 100 KPa and specific volume of 0.95 m³ /Kg and leaving at 5 m/s with a pressure of 700 KPa and a specific volume of 0.19 m³ /Kg. The internal energy of the air leaving is 90 KJ/Kg greater than that of the entering air. Cooling water surrounding the cylinder absorbs heat from the air at the rate of 58 KW. Calculate the power required to drive the compressor and the inlet and outlet cross sectional areas   *11   K3   CO1*

24. a) A Reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and -20°C. The heat transfer to the heat engine is 2000 KJ and the network output for thecombined engine & refrigerator is 360 KJ.Calculate (i) The heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C .   *11   K3   CO2*

OR

b) Two Carnot engines A and B are operated in series. The first one receives heat at 870○C and rejects to a reservoir at T. B receives heat rejected by the first engine and in turn rejects to a sink 300 K. calculate the temperature T for (i) Equal work output of both engines. (ii) Same efficiencies. (iii)Mention Clausius inequality for open, closed and isolated systems.   *11   K3   CO2*

25. a) In an SI engine working on the ideal Otto cycle, the compression ratio is 5.5. thePressure and temperature of compression are 1 bar and 27 °C, respectively. ThePeak pressure is 30 bar. Determine the pressure and temperature at the salient points, the air-standard efficiency and the mean effective pressure. Assume ratioof specific heats to be 1.4 for air.   *11   K3   CO3*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **14052**

OR

b) In an air standard dual cycle, the pressure and temperature at the beginning of the compression are 1 bar and 57°C respectively. The heat supplied in the cycle is 1250 kilo Joule/kg, two-third of this being added at constant volume and rest a Constant pressure. If the compression ratio is 16, determine the maximum Pressure and temperature in the cycle thermal efficiency and MEP. *11 K3 CO3*

26. a) The velocity distribution for flow over a flat plate is given by u = ¾ y – y² in which u is the velocity in m/sec at a distance y metre above the plate. Determine the shear stress at y = 0.15m. Take dynamics viscosity of fluid as 8.6 poise. *11 K3 CO4*

OR

b) A U-tube manometer is used to measure the pressure of water in a pipe line., which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. *11 K3 CO4*

27. a) The following cases represents the velocity components, determine the third component of velocity such that they satisfy the continuity equation.
(i) u = x² + y² +z² ; v = xy² – yz² + xy
(ii) v = 2y² , w = 2xyz *11 K2 CO5*

OR

b) A horizontal Venturi meter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm² and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through Venturi meter. Take Cd = 0.98. *11 K2 CO5*

28. a) The rate of flow of water through a horizontal pipe is 0.25 m³/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm². Determine: (i) loss of head due to sudden enlargement, (ii) pressure intensity in the large pipe, (iii) power lost due to enlargement. *11 K3 CO6*

OR

b) Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by V =$\sqrt{2gH}\emptyset\ [\frac{D}{H},\frac{\mu}{\rho VH}]$, where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. *11 K3 CO6*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **14052**