

**I B. Tech II Semester Supplementary Examinations, January/February - 2023****THERMODYNAMICS**

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

*Answer any FIVE Questions ONE Question from Each Unit  
All Questions Carry Equal Marks*

**UNIT - I**

- 1 a) Classify the types of systems, explain the energy conversion in them. [6M]  
 b) To a closed system 150 kJ of work is supplied. If the initial volume is  $0.6 \text{ m}^3$  and pressure of the system changes as  $p = 8 - 4V$ , where  $p$  is in bar and  $V$  is in  $\text{m}^3$ , determine the final volume and pressure of the system. [8M]

(OR)

- 2 a) How does a homogeneous system differ from a heterogeneous system? [5M]  
 b) A fluid at a pressure of 3 bar, and with specific volume of  $0.18 \text{ m}^3/\text{kg}$ , contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to a law,  $p = C/v^2$  where  $C$  is a constant. Calculate the work done by the fluid on the piston. [9M]

**UNIT - II**

- 3 a) Explain how the first law of thermodynamics applied to a process? [7M]  
 b) Derive the expression for work done in Polytrophic process. [7M]

(OR)

- 4 a) Explain clearly the difference between a non-flow and a steady flow process. [7M]  
 b) 12 kg of air per minute is delivered by a centrifugal air compressor. The inlet and outlet conditions of air are  $C_1 = 12 \text{ m/s}$ ,  $p_1 = 1 \text{ bar}$ ,  $v_1 = 0.5 \text{ m}^3/\text{kg}$  and  $C_2 = 90 \text{ m/s}$ ,  $p_2 = 8 \text{ bar}$ ,  $v_2 = 0.14 \text{ m}^3/\text{kg}$ . The increase in enthalpy of air passing through the compressor is 150 kJ/kg and heat loss to the surroundings is 700 kJ/min. Find: (i) Motor power required to drive the compressor; (ii) Ratio of inlet to outlet pipe diameter. Assume that inlet and discharge lines are at the same level. [7M]

**UNIT - III**

- 5 a) Compare the first law and second law of thermodynamics with suitable examples? [7M]  
 b) Discuss the equivalence of Clausius Statement to the Kelvin-Planck Statement. [7M]

(OR)

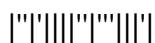
- 6 a) Define Gibb's and Helmholtz's functions? Compare the importance of them? [7M]  
 b) Heat flows from a hot reservoir at 800K to another reservoir at 250K. If the entropy change of overall process is 4.25kJ/K, make calculation for the heat flowing out of the high temperature reservoir? [7M]

**UNIT - IV**

- 7 a) Explain with a neat diagram p-V-T surface. [7M]  
 b) What amount of heat would be required to produce 4.4 kg of steam at a pressure of 6 bar and temperature of  $250^\circ\text{C}$  from water at  $30^\circ\text{C}$ ? Take specific heat for superheated steam as  $2.2 \text{ kJ/kg K}$ . [7M]

(OR)

- 8 a) Derive the Clausius Claperon equation. [7M]  
 b) Why can not a throttling calorimeter measure the quality, if the steam is wet? Explain how is the quality been measured? [7M]



**UNIT - V**

- 9 a) write down the Dalton's law of partial pressure and explain its importance. [6M]  
b) 0.45 kg of CO and 1 kg of air is contained in a vessel of volume  $0.4 \text{ m}^3$  at  $15^\circ\text{C}$ . [8M]  
Air has 23.3% of  $\text{O}_2$  and 76.7% of  $\text{N}_2$  by mass. Calculate the partial pressure of each constituents and total pressure in the vessel. Molar masses of CO,  $\text{O}_2$  and  $\text{N}_2$  are 28, 32 and 28 kg/k mol.

**(OR)**

- 10 a) Draw the psychrometric chart and show any two psychrometric processes on it. [7M]  
b) A sample of moist air at 1 atm and  $25^\circ\text{C}$  has a moisture content of 0.01% by volume. Determine the humidity ratio, the partial pressure of water vapour, the degree of saturation, the relative humidity and the dew point temperature. [7M]

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