

22406

12425

03 Hours / 70 Marks

Seat No.

--	--	--	--	--	--	--	--

-
- Instructions* –
- (1) All Questions are *Compulsory*.
 - (2) Answer each next main Question on a new page.
 - (3) Illustrate your answer with neat sketches wherever necessary.
 - (4) Figures to the right indicate full marks.
 - (5) Assume suitable data, if necessary.
 - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
 - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

- 1. Attempt any FIVE of the following: 10**
- a) Define homogenous system and heterogenous system in thermodynamics process.
 - b) Define Intensive and Extensive properties.
 - c) State Zeroth law of thermodynamics.
 - d) State First law of thermodynamics with mathematical expression.
 - e) Define heat capacity and specific heat.
 - f) Give Vander Waal's equation of state for real gases.
 - g) State clausius inequality.

P.T.O.

2. Attempt any THREE of the following: 12
- a) Explain the Macroscopic approach adopted in thermodynamics.
 - b) Prove that $C_p - C_v = R$ for an ideal gas.
 - c) State Gibbs phase rule. A binary mixture of benzene and toluene is in equilibrium with its own vapour. Determine the number of degrees of freedom.
 - d) Derive the relation between 1st and 2nd law of thermodynamics.
3. Attempt any THREE of the following: 12
- a) Suppose 40 J of energy is transferred by heat to a system, while the system does 10 J of work. Later 25 J of heat is transferred out of the system, while 4 J of work is done on the system. What is the net change in the system's internal energy.
 - b) State the sign convention used for heat and work.
 - c) Derive the entropy change of an ideal gas in terms of temperature and pressure.
 - d) Ten kilograms of water at 375 K is mixed adiabatically with 30 kg of water at 275 K. Evaluate the change in entropy. Assume that specific heat of water is 4.2 kJ/kg K and is independent of temperature.
4. Attempt any THREE of the following: 12
- a) Draw the phase diagram for carbon dioxide system.
 - b) Calculate the entropy change when 2 moles of water at 273 K is heated to steam at 473 K. C_p for water = 4.2 kJ/kg K. of C_p for steam = 1.9 kJ/kg K. Latent heat of vaporization at 373 K = 2257 kJ/kg.
 - c) Calculate the entropy change for the following gas phase reaction occurring at 1 bar and 298 K. $\text{CO} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2$. The absolute entropies of CO, O_2 and CO_2 are respectively 198 J/mole K, 205.2 J/mol K and 213.8 J/mole K.
 - d) Derive the relation between ΔG and K .
 - e) Explain the temperature dependency of equilibrium constant with temperature for exothermic reaction. (Based on Van't Hoff equation)

5. Attempt any TWO of the following:**12**

- a) Explain Joule Thomson porous plug experiment.
- b) Explain phase diagram of water system with sketch.
- c) Derive the relation between K_p , K_c and K_y .

6. Attempt any TWO of the following:**12**

- a) Draw the phase diagram for sulphur system and explain it.
 - b) Explain P-V diagram for a pure substance.
 - c) Derive the relation between conversion and thermodynamics equilibrium constant for 2nd order reversible reaction of the form $A + B \rightleftharpoons R + S$.
-