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.

Marks

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 interms of temperature and pressure.

d) Ten kilograms of water of 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. $CO + \frac{1}{2}O_2 \rightarrow CO_2$. 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)

Marks

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 2^{nd} order reversible reaction of the form $A + B \rightleftharpoons R + S$.