# 22406

**21222**

**3 Hours / 70 Marks** Seat No. | | | | | | | | |

15 minutes extra for each hour

*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) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(7) Use of Steam tables, logarithmic, Mollier's chart is permitted.

**Marks**

**1. Attempt any FIVE of the following:** **10**

a) Define Isochoric process.

b) Define Adiabatic process.

c) State Zeroth Law of thermodynamics.

d) Define heat capacity and specific heat.

e) Give sign convention used for work and heat.

f) State Gibb's phase rule.

g) State third law of thermodynamics.

**Marks**

**2. Attempt any THREE of the following:** **12**

a) Define extensive properties and intensive properties with examples.

b) Explain Joule - Thomson porous plug experiment.

c) An ideal gas is compressed adiabatically from 1.5 bar (150 KPa) and 65°C (338 K) to a pressure of 9 bar (900 KPa). The process is reversible and $\gamma = 1.23$ Calculate the temperature at the end of compression.

d) Assuming that air is a mixture of 21% oxygen and 79% Nitrogen by volume. Calculate entropy of 1 kmol of air relative to pure oxygen and nitrogen all at the same temperature and pressure.

**3. Attempt any THREE of the following:** **12**

a) Define :–

i) Isothermal process

ii) Cyclic process

iii) Irreversible process

iv) Quasistatic process

b) Calcualte W, Q and $\Delta H$ for one mole of an ideal gas which expands from $V_1$ to 10 $V_1$ at 300 K isothermally under reversible conditions.

c) State second law of thermodynamics and explain the relation between first and second law of thermodynamics.

d) Calculate the increase in entropy of 03 mol of an ideal gas as it changes from 27°C at 0.2 atm to 277°C at 2 atm $C_p = 7$ cal/mol. k.

**Marks**

**4. Attempt any THREE of the following:** **12**

a) Draw and explain the phase diagram for water system.

b) Two mol of an ideal gas occupying volume of 2 $dm^3$ at 300 k are heated to 325 k. If the volume due to heating becomes 4 $dm^3$. Calculate the entropy change of the gas.

Data : $C_V$ = 12.5 J/(mol.k)

c) Calculate the entropy change involved in the isothermal reversible expansion of 5 gram moles of an ideal gas from a volume of 5 lit to a volume of 50 lit at 27°C.

d) Derive the relation between $\Delta G$ and K.

e) Explain the feasibility of chemical reaction from free energy change.

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

a) Prove that Cp – Cv = R for an ideal gas.

b) Explain P - H thermodynamic diagram.

c) In an experiment at 1000 K the equilibrium concentrations of ammonia hydrogen and nitrogen are 0.105, 1.5 and 1.10 mol/lit respectively. Calculate Kc and Kp for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$.

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

a) Explain T-V diagram for a pure substance.

b) Draw the phase diagram for carbon dioxide system and explain.

c) For the reaction $2NaHSO_4 \rightleftharpoons Na_2S_2O_7 + H_2O$ $\Delta H$ at 298°K = 19800 cal, $\Delta G$ at 298 K = 9000 cal. Assuming $\Delta H$ to be constant. Calculate the dissociation pressure of the reaction at 700 k.