22406

22223

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

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers 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.

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

Marks

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

a) Define adiabatic process.

b) Define Isobaric process.

c) State the Law of conservation of energy.

d) State Joule-Thomson coefficient.

e) State the relation between Cp and Cv.

f) Define degree of freedom.

g) State second law of Thermodynamics.

Marks

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

a) Define Thermal and Chemical equilibrium.

b) Give the equation for calculating ΔU, Q and w for constant volume and constant pressure process.

c) Calculate ΔU and ΔH in KJ for 1 Kmol water as it is vapourised at the constant temperature of 373K and constant pressure of 101.3 KPa. The specific volumes of liquid and vapour at these conditions are 1.04×10^{-3} and 1.675 m^3/kmol respectively. 1030 KJ of heat is added to water for this change.

d) 10 kg of water at 375 k is mixed adiabatically with 30 kg water at 275 k. What is the change in entropy? Assume Sp. heat of water is 4.2 KJ/kgK and is independent of temperature.

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

a) Define extensive and intensive property with example.

b) Show that Cp – Cv = R for and ideal gas.

c) State clausius inequality. Give the expression for reversible and irreversible process.

d) Determine the changes in entropy when 2 kg of gas at 277 k is heated at constant volume to a temperature of 368 k. Assume sp. heat at constant volume = 1.42 KJ/kg.K.

Marks

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

a) What is the change in entropy when 1 kmol of an ideal gas at 335 k and 10 bar is expanded irreversibly to 300 k and 1 bar? [p = 29.3 KJ/kmol.K.]

b) Give the Van der Waal's equation for real gases and give the volumes of constants.

c) Two perfectly insulated tanks each of capacity $1m^3$ are connected by means of a small pipelines fitted with a valve. Initially the first tank contain's an ideal gas at 300 k and 200 KPa and the second tank is completely evacuated. The valve is opened and the pressure and the temperature are equalised. Determine the change in total entropy.

d) Derive the relation between K_p, K_c and K_y

e) Calculate the equilibrium constant at 298 k of the reaction.
$N_2O_{4(g)} \rightarrow 2NO_{2(H)}$
given that the standard free energies of formation at 298 k are 97.54D J/mol for N_2D_4 and 51310 J/mol for NO_2.

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

a) Explain Joule Thomson Porous plug experiment.

b) Describe T-S diagram.

c) Describe temperature dependance of equilibrium constant for exothermic and endothermic reaction based on Vant Hoff equation.

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

a) Describe P-V diagram for a pure substance.

b) Describe phase diagram for water system with neat sketch.

c) Describe relation between conversion and thermodynamic equilibrium constant for second order reversible reaction.