Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-IV Examination-Nov/Dec-2011

Subject code: 140502 **Date: 28/11/2011**

Subject Name: Chemical Engineering Thermodynamics – I

Time: 02.30 pm -5.00 pm **Total marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q – 1 (a) Answer the followings: [07]

(i) Discuss reversible and irreversible processes with suitable examples.

(ii) Write short note on "Gibb's phase rule".

Q – 1 (b) Write short note on van der Waals equation of state. [07]

Q – 2

(a) An adiabatic process for which there is no heat transfer between system and its surrounding. Establish the relation between P, V and T for the same. [07]

(b) Reported values for the virial coefficients of isoproponal vapor at 200 ^{0}C are:

$$B = -388 \text{ cm}^3 / \text{mol and } C = -26000 \text{ cm}^6 / \text{mol}^2$$

Calculate V and Z for isoproponal vapor at 200 ^{0}C and 10 bar by the following equations.

(i) Ideal gas equation (ii) the truncated virial equation of state considering two terms on right hand side.

(iii) the truncated virial equation of state considering three terms on right hand side. [07]

OR

(b) Calculate V and Z for ethane at 50 ^{0}C and 12 bar by the following equations:

(i) The truncated virial equation of state with a value of B from the generalized Pitzer correlation.

(ii) The Redlich / Kwong equation of state. Data given for ethane are: T_C = 305.4 K, P_C = 48.8 bar, V_C = 148 cm^3 / mol, Z_C = 0.285, ω = 0.098. [07]

Q – 3

(a) One mole of an ideal gas at 0.5 MPa and 300 k is heated at constant pressure till the volume doubles and then it is allowed to expand reversibly and adiabatically till the temperature is reduced to 300 K. calculate the heat and work interaction if it is desired to restore the system from final state to its initial state by reversible isothermal process. Determine the amount of work to be done on the system. [07]

(b) Write short note on Carnot cycle as an ideal gas temperature scale and also derive the equation of efficiency for the same. [07]

OR

Q – 3

(a) An ideal gas is heated at constant volume till its temperature double then it is allow expanding isothermally till it reaches the original pressure. Finally the gas is cooled at constant pressure till it is restored to its initial position. Determine the net work done per mole of gas. [07]

(b) Discuss the Gibb's paradox and mathematical statement of second law of thermodynamics with necessary equations and diagrams. [07]

Q – 4

(a) Discuss the vapor compression cycle with neat sketch and temperature – entropy as well as pressure – enthalpy diagrams. [07]

(b) Discuss the Linde process for gas liquefaction. [07]

OR

Q – 4

(a) Explain the air refrigeration cycle in detail with advantage and disadvantage. Also derive the equation for coefficient of performance in terms of temperature. [07]

(b) Write short note on throttling process or Joule – Thomson expansion. [07]

Q – 5

(a) Using the different form of Maxwell equation, discuss the various form of differential equation for entropy calculation. [07]

(b) The equation of state of a certain substance is given by the expression: $V = \frac{RT}{P} - \frac{C}{T^3}$ and the specific heat is given by the relation $C_P = A + BT$ where A, B and C are constants. Derive an expression for change in U, H and S for (i) Isothermal (ii) isobaric process. [07]

OR

Q – 5

(a) Discuss the procedure for evaluation of enthalpy and entropy as a function of temperature and pressure for an ideal gas . [07]

(b) Develop equations for evaluating the change in internal energy and enthalpy for the process involving ideal gas as working fluid. [07]

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