B.Tech. Sixth Semester (Polymer (Plastic) Technology) (CGS)

11129 : Polymer Engineering Thermodynamics : 6 PP 04

P. Pages : 2 **AU - 2810**

Time : Three Hours Max. Marks : 80

Notes :
1. All question carry marks as indicated.
2. Answer **three** question from section A and **three** question from section B.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Diagrams and Chemicals equations should be given wherever necessary.
6. Illustrate your answer necessary with the help of neat sketches
7. Discuss the reaction, mechanism wherever necessary.
8. Use of cellphone is not allowed in exam.
9. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Explain the cyclic rule in detail. 7

b) Derive the relationship between coefficient of thermal expansion (α) and compressibility factor (β). 7

OR

2. a) Prove that magnitude of the work done by the system in a reversible expansion process is maximum and the work done by the surroundings on the system in a reversible compression is minimum. 7

b) Find the expression for w, q and ΔE in an isothermal reversible expansion of a gas that obeys the equation of state $PV = \eta RT$ 7

3. a) Derive the Gibbs-Duhem equation and show that $G = \Sigma\, n_i \mu_i$ 7

b) Explain chemical potential in an ideal gas mixture. 6

OR

4. a) Derive the Clausius Clapeyron equation. 6

b) Consider the physical equilibria of one component. 7

$$\underset{(\alpha)}{\text{Phase Crystalline}} \rightleftharpoons \underset{(\beta)}{\text{Phase Amorphous}}$$

Derive the relationship showing variation of equilibrium melting temperature with pressure.

5. a) Explain in detail how does the colligative properties are useful in determining the molecular weight of polymer. 6

b) Derive an expression for thermodynamic equilibrium of multicomponent single phase system in terms of excess free energy. 7

OR

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6. a) Calculate the free energy of mixing ΔG_{mix}, enthalpy of mixing ΔH_{mix} and ΔS_{mix} at 25 °C and 1 atm. 7
when:-
i) 10 moles of H are mixed with 10 moles of Ne.
ii) 10 moles of H are mixed with 20 moles of Ne.

b) The boiling point elevation of a solute is observed to be 2.3 °K when 13.8 gm of solute of molar mass of 154 gm/mole is added. 6
Calculate K_b and ΔH_{vap} of the solvent.

SECTION - B

7. a) Discuss and state the curve for polymer-solvent phase equilibria with neat sketch. 7

b) Explain Flory Huggins theory and derive expression for the entropy of polymer solvent mixing. 7

OR

8. a) Discuss the criteria for polymer solvent miscibility and sketch the curves showing Binodal and spinodal points. 7

b) Explain the thermodynamics of fusion of pure polymer. 7

9. a) Explain in detail U.C.S.T and L.C.S.T curves. 7

b) Discuss dissolution and swelling of polymers. 6

OR

10. a) Derive the expression for entropy of mixing on formation of an athermal solution using Flory Huggins Theory. 7

b) Explain the concept of extent of reaction and chemical affinity. 6

11. a) Discuss the relationship between K_p, K_c and K_x..... 7

b) What is the feasibility of any chemical reaction? Develop thermodynamic expression for homogeneous reaction to calculate reaction equilibrium constant from enthalpy, entropy, heat of formation data. 6

OR

12. a) Derive appropriate expression for the rate of reaction for the following cases:- 7

i) First order Reaction
ii) Second order Reaction.
iii) Third order Reaction.

b) Prove that $K_c = K_p (RT)^{\Delta x}$ for reaction equilibrium constant. 6

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