Seat No: _____________ Enrollment No: ___________________

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Winter 2019 – 20 Examination

Semester: 5 **Date: 28/11/2019**
Subject Code: 03103303 **Time: 10:30am to 01:00pm**
Subject Name: CET II **Total Marks: 60**

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (All are compulsory) (Each of one mark) **(15)**

1. In maximum boiling azeotropes, the solution exhibits**………**deviation from ideality.
2. The activity coefficient (γ_i) in a solution is related to the chemical potential as μ^E=**……**
3. For an ideal solution, enthalpy changes of mixing are **……….. .**
4. As pressure approaches zero, fugacity coefficient value tends to…………
5. For a chemically reacting system at equilibrium at constant temperature and pressure, the Gibbs free energy is **………. .**
6. Compressibility factor (Z) of a gas is
   A. The ratio of fugacity in the given state to fugacity in the standard state
   B. The ratio of actual volume to the volume of the gas if it were ideal
   C. The change in volume with temperature at constant pressure
   D. The difference between actual volume and ideal gas volume
7. Chemical potential is
   A. An extensive property
   B. An intensive property
   C. A path property
   D. A reference property
8. Real gases behave ideally at **…….** Pressures and**………** temperatures**.**
9. The change in Gibbs free energy for vaporisation of a pure substance is **……. .**
10. The extent of reaction is
    A. different for reactants and products
    B. dimensionless
    C. dependent on the stoichiometric coefficients
    D. all of the above
11. The change in free energy when a real gas undergoes an isothermal change in state is
    A. $\Delta G = RT \ln (V_2/V_1)$
    B. $\Delta G = RT \ln (P_2/P_1)$
    C. $\Delta G = RT \ln (f_2/f_1)$
    D. $\Delta G = RT \ln (\mu_2/\mu_1)$
12. The number of degrees of freedom for an azeotropic mixture in a two component vapour-liquid equilibria is/are
    A. 2
    B. 1
    C. 0
    D. 3
13. Henry's law becomes identical to Raoult's law, when the Henry's law constant is equal to ………..
14. For positive deviation from ideality, total pressure of the system at equilibrium is …… than the ideal value.
15. Vapour pressure of a 40% gas in a system with 0.4 mm Hg of partial pressure **……....**

Q.2 Answer the following questions. (Attempt any three) **(15)**

A) Explain azeotrope. Give any two examples.
B) Definefugacity and fugacity coefficient.
C) Explain Excess Properties. Derive expression for excess chemical potential (μ^E) of component with activity coefficient of that component.
D) Derive an expression for the fugacity coefficient of a gas obeying the equation of state $P(V - b) = RT$ and estimate the fugacity of ammonia at 10 bar and 298 K, given that $b = 3.707 \times 10^{-5}$ m^3/mol.

Q.3 A) State Raoult's Law. A mixture of *A* and *B* conforms closely to Raoult's law. The pure component vapour pressures P_A^S and P_B^S in kPa at *T* K are given by; **(07)**

$$\ln P_A^S = 14.27 - \frac{2945}{T - 49}$$

$$\ln P_B^S = 14.20 - \frac{2973}{T - 64}$$

If the bubble point of a certain mixture of A and B is 349 K at a total pressure of 80 kPa, find the composition of the first vapour that forms.

B) Define activity coefficient. Derive expressions for effect of temperature and pressure on activity coefficient. **(08)**

OR

B) Prove that if Henry's law is obeyed by component 1 in a binary solution overcertain concentration range, Lewis–Randall rule (Raoult's law) will be obeyed by component 2 over the same concentration range. **(08)**

Q.4 A) The Two suffix- Margules equation is the simplest expression for excess Gibbs free energy that is obeyed by chemically similar materials. **(07)**

$$G^E = Ax_1x_2$$

where A is an empirical constant independent of composition. Derive the expressions for the activity coefficients that result from this expression.

OR

A) Define maximum and minimum boiling azeotropes. Draw neat diagram of temperature and pressure with mole fractions of component (T-x-y & P-x-y) for maximum and minimum boiling azeotropes. **(07)**

B) Explainbubble point and dew point temperatures with neat diagram of temperature with mole fractions of component (T-x-y) and also effect of increasing pressure on T-x-y diagram. **(08)**