A   Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code: R5901S

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Fifth Semester

CHEMICAL ENGINEERING

R21UCH501 – CHEMICAL ENGINEERING THERMODYNAMICS-II

(Regulations R2021)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Chemical potential is an   CO1- U

    (a) Extensive property   (b) Intensive property

    (c) Specific property   (d) Derived property

2. For an ideal gas   CO1- U

    (a) Fugacity is equal to pressure   (b) Fugacity coefficient is equal to pressure

    (c) Fugacity id always equal to 1   (d) None of the above

3. What is the name of the phase transition that occurs when a solid is   CO1- U
    converted directly into a gas (without going through the liquid phase)?

    (a) Melting   (b) Boiling   (c) Condensing   (d) Sublimation

4. Which of the following statements is NOT true in relation to a system   CO1- U
    that has reached the critical temperature?

    (a) The system must a closed system

    (b) The system can be described as a homogenous fluid

    (c) Substances can have more than one critical temperature

    (d) A surface between the liquid and vapour phases is no longer present

5. A binary system consisting of two phases and a vapour phase is _____   CO1- U
    according to the phase rule

    (a) univariant   (b) multivariant   (c) diavariant   (d) thermovariant

6. The A-rich phase is known as the raffinate and the B-rich phase is known as   CO1- U

    (a) intract   (b) extract

    (c) both a & b   (d) diathermic

7. Prediction of free energy data for a reaction can be done using   CO1- U

    (a) Hess's Law and standard free energies of formation

    (b) Dalton's Law of Partial Pressures

    (c) Raoult's Law

    (d) Boyle's Law

8. Which factor does not affect the equilibrium constant of a chemical potential?   CO1- U

    (a) Temperature

    (b) Pressure

    (c) Nature of the reactants and products

    (d) Standard Gibbs free energy change

9. In liquefaction of gases, the Joule–Thomson effect is used in: CO1- U

    (a) Linde process   (b) Carnot cycle

    (c) Reverse Brayton cycle   (d) Bell-Coleman cycle

10. For a given refrigeration effect, if COP increases, the work input   CO1- U

    (a) Increases   (b) Decreases

    (c) Remains constant   (d) Cannot be predicted

PART – B (5 x 2= 10 Marks)

11.	State Excess Gibbs Free energy.	CO2 U
12.	Define liquid-liquid equilibrium.	CO2 U
13.	Define dew point equilibria.	CO2U
14.	What is the effect of temperature on the equilibrium constant of an exothermic reaction?	CO4 AN
15.	Mention two common methods of producing refrigeration.	CO2 U

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PART – C (5 x 16= 80 Marks)

16. (a) Explain all forms of Gibbs-Duhem equations   CO2- U   (16)

    Or

    (b) Derive the equation for molar excess property of a solution and   CO2- U   (16)
        excess Gibbs free energy.

17. (a) Explain in detail about effect on temperature and pressure for   CO2- U   (16)
        azeotrope composition.

    Or

    (b) Explain Gibbs' Phase Rule and its application to multicomponent   CO2- U   (16)
        systems.   Using   suitable   examples   discuss:
        (a) Vapor–liquid equilibrium (VLE) phase diagrams for
        homogeneous systems.
        (b) Phase diagrams for systems with a miscibility gap.
        Include the significance of tie lines and binodal curves.

18. (a) Derive the   Gibbs–Duhem equation   and explain its role in   CO2-U   (16)
        verifying the thermodynamic consistency of phase equilibrium
        data. Demonstrate the consistency test for a binary VLE data set,
        showing all necessary steps and interpretation

    Or

    (b) Describe the methodology for correlating and predicting phase   CO2-U   (16)
        equilibria using experimental data. Discuss how temperature,
        pressure, and composition data are incorporated, and illustrate the
        process using a binary mixture relevant to chemical engineering.

19. (a) Derive the relationship between the standard Gibbs free energy   CO2-U   (16)
        change ($\Delta G°$) and the equilibrium constant (K) for a chemical
        reaction. Explain how this relation is used to determine the
        direction and extent of the reaction.

    Or

    (b) Explain the method for calculating equilibrium compositions for a CO2-U   (16)
        homogeneous reaction system using the extent of reaction.
        Illustrate the procedure with an example.

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20. (a) Describe different methods of producing refrigeration with CO2-U   (16)
       examples.

                                    Or

    (b) Explain the principle of refrigeration with the help of reversed CO2-U   (16)
       Carnot cycle. Compare its COP with that of a vapour compression
       cycle.

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