

**2025/TDC(CBCS)/ODD/SEM/
CHMHCC-303T/434**

TDC (CBCS) Odd Semester Exam., 2025

**CHEMISTRY
(3rd Semester)**

Course No. : CHMHCC-303T

**[Physical Chemistry—III
(Phase Equilibria and Chemical Kinetics)]**

Full Marks : 50

Pass Marks : 20

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

UNIT—I

1. Answer any *two* questions : 2×2=4

(a) Explain why $\text{KCl-NaCl-H}_2\text{O}$ is a 3-component system, whereas $\text{KCl-NaBr-H}_2\text{O}$ is a 4-component system.

(b) Calculate the number of degrees of freedom in an aqueous solution of glucose.

(c) State and explain the reduced phase rule.

2. Answer any *one* question : 6
- (a) (i) Derive Clausius-Clapeyron equation for liquid-vapour equilibrium. 4
- (ii) Explain metastable equilibrium giving suitable example. 2
- (b) (i) Draw the labelled phase diagram of sulphur system and discuss its salient features. 4
- (ii) Discuss about congruent melting point by considering two-component system. 2

UNIT—II

3. Answer any *two* questions : 2×2=4
- (a) State lever rule. Give one example.
- (b) Apply Gibbs-Duhem-Margules equation to a non-ideal solution.
- (c) State the principle of steam distillation.

4. Answer any *one* question : 6
- (a) Derive distribution law from thermodynamic considerations and mention two applications of distribution law. 4+2=6

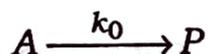
(3)

- (b) Draw boiling temperature—composition curve for liquid and vapour phases in binary solutions of different types and define constant boiling mixture.

UNIT—III

5. Answer any *two* questions : 2×2=4

- (a) For a zero-order reaction



show that half-life period $t_{1/2}$ is equal to $[A]_0 / 2k_0$.

- (b) Define and explain temperature coefficient of a reaction.
- (c) Write two limitations of collision theory of bimolecular gaseous reactions.

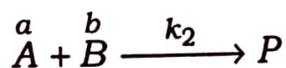
6. Answer any *one* question : 6

- (a) Write 5-step mechanism for H_2-Br_2 chain reaction and derive expression for rate of formation of HBr, using steady-stage approximation. 2+4=6

(4)

- (b) Derive rate constant expression for the following second-order reaction :

At $t = 0$



At $t = t$ x

Show that if $a \gg b$ or $b \gg a$, then the reaction will follow first-order kinetics.

4+2=6

UNIT—IV

7. Answer any *two* questions : 2×2=4

(a) "A catalyst provides an alternate path of lower activation energy." Explain the statement.

(b) What is auto-catalysis? Give one example.

(c) Define catalytic promoter and catalytic poison, giving one example each.

8. Answer any *one* question : 6

(a) (i) Derive Michaelis-Menten equation. 4

(ii) Give the mechanism of heterogeneous catalyzed reactions at solid surfaces. 2

- (b) (i) A hydrogenation reaction is carried out at 500 K. If the same reaction is carried out in presence of a catalyst at the same rate, the temperature required is 400 K. Calculate the activation energy of the reaction, if the catalyst lowers the activation energy of the reaction by 20 kJ. 4
- (ii) Derive an expression for the rate of an acid catalyzed reaction. 2

UNIT—V

9. Answer any *two* questions : 2×2=4

- (a) Why is Freundlich isotherm fail at higher pressure?
- (b) "Chemisorption is irreversible but physisorption is reversible." Explain why.
- (c) Write two factors which influence adsorption.

10. Answer any *one* question : 6

- (a) Give the main points of Langmuir theory of adsorption and hence deduce the Langmuir adsorption isotherm equation. Show that Freundlich isotherm is a special case of Langmuir isotherm. 1+3+2=6

(6)

- (b) (i) What do you understand by positive and negative adsorption. 2
- (ii) Show different types of adsorption isotherm with the help of diagram. 4

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