R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous Institute U/s UGC Act 1956)

B.Tech. SEMESTER-I, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 2CH101   **DATE: 22-12-2025**
SUBJECT NAME: FUNDAMENTALS OF CHEMICAL
                                    ENGINEERING
TIME: 11:00 AM to 01:30 PM   **TOTAL MARKS: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

			Marks	BL	CO
Q.1	(a)	Differentiate between unit operation and unit process.	03	U	1
	(b)	Explain batch, semi-batch, and continuous operations in terms of operation and application.	04	U	1
Q.2	(a)	Define (i) Molarity (ii) Normality (iii) Weight percent	03	R	2
	(b)	A force of 19.635 kgf is applied on a piston of diameter 5 cm. Find the pressure exerted on the piston in KPa.	04	A	2
	(c)	Explain the different ways to express concentration of solutions with examples and conversion relations between them.	07	U	2

OR

			Marks	BL	CO
Q.2	(a)	What are fundamental and derived units? Give two examples of each.	03	R	2
	(b)	Define and derive the expression for average molecular weight of a mixture.	04	A	2
	(c)	Describe how composition of solids, liquids, and solutions is expressed and used in chemical process calculations.	07	U	2
Q.3	(a)	What is the significance of the Reynolds number in fluid flow?	03	U	3
	(b)	Explain the classification of fluids with suitable examples.	04	U	3
	(c)	Discuss in detail the importance of fluid flow operations in the chemical industry, including examples of its applications in different unit operations.	07	U	3

Q.3 **(a)** State difference between pipe and tube.   03   U   3

(b) Explain Newton's law of viscosity and define the unit of viscosity.   04   U   3

(c) Explain in detail Newtonian and non-Newtonian fluids, their flow behavior, and examples from the chemical and polymer industries.   07   U   3

SECTION B

			Marks	BL	CO
Q.4	**(a)**	Define chemical engineering thermodynamics and mention its scope in process industries.	03	R	4
	(b)	Write short note on	04	U	4

       1. First law of thermodynamics

       2. Zeroth law of thermodynamics

Q.5 **(a)** State the importance of heat transfer in chemical process industries.   03   R   5

(b) Explain the difference between evaporation, boiling, and condensation processes.   04   U   5

(c) Explain in detail the modes of heat transfer and derive the laws governing each mode.   07   U   5

OR

Q.5 **(a)** What is thermal conductivity? How does it vary for solids, liquids, and gases?   03   R   5

(b) Explain the importance of thermal insulation in process plants and list the properties of a good insulating material.   04   U   5

(c) Explain with diagrams the heat transfer processes between two fluids in a counter-flow and parallel-flow heat exchanger.   07   U   5

Q.6 **(a)** State Fick's first law of diffusion and explain its significance.   03   R   6

(b) Explain the terms mass flux (N) and diffusion flux (J) with suitable expressions.   04   U   6

(c) A tube 1 cm in inside diameter that is 20 cm long is filled with CO_2 and H_2 at a total pressure of 2 atm at 0°C. The diffusion coefficient of the $CO_2 – H_2$ system under these conditions is 0.275 cm^2/s. If the   07   A   6

partial pressure of CO_2 is 1.5 atm at one end of the tube and 0.5 atm at the other end, determine flux for:

1. steady state equimolar counter diffusion
2. steady state diffusion of CO_2 through stagnant H_2

OR

Q.6	**(a)**	State the importance of mass transfer operations in the chemical process industry.	**03**	**R**	**6**
	(b)	Explain the laws governing mass transfer — Fick's law, Raoult's law, and Henry's law also discuss their practical significance.	**04**	**U**	**6**
	(c)	Oxygen (A) is diffusing through carbon monoxide (B) under steady state condition with carbon monoxide non-diffusing. The total pressure is 1×105 N/m^2 and temperature is 0^0C. The partial pressure of oxygen at two planes 2.0 mm apart is respectively 13000 and 6500 N/m^2. The diffusivity for the mixture is 1.87×10^{-5} m^2/s. Calculate the rate of diffusion of oxygen in kmol/s through each square meter of the two planes.	**07**	**A**	**6**

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