



**K. K. Wagh Institute of Engineering Education & Research, Nashik**  
(An Autonomous Institute From A.Y. 2022-23)

InSem Examination-II Summer 2025	
Exam Seat No.:	
Academic Year: 2024-2025	Semester: VI
Class: TY	Program: B.Tech
Branch Code: CHE	Pattern: 2022
Name of Course: Chemical Reaction Engineering II	Course Code: CHE223012
Max. Marks: 30	Duration: 1.15 Hrs.

**Instructions:** Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 02 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome .

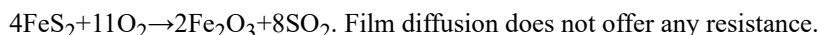
**Marks CO**

**Question No. 1**

- 1 a) Derive expression relating time and conversion for unreacted core model when chemical reaction controls. (7) CO1

**Question No. 2**

- 2 a) Spherical particles of iron pyrite ( $\text{FeS}_2$ ) with a radius of 1.5 mm are roasted in a 10% oxygen stream at  $850^\circ\text{C}$  and 1 atm. The reaction follows the shrinking-core model (SCM): (8) CO1



Given Data: Density of  $\text{FeS}_2$ :  $\rho_B = 5.0 \text{ g/cm}^3 = 0.052 \text{ mol/cm}^3$ , Rate constant ( $k''$ ):  $2.5 \text{ cm/s}$

Effective diffusivity of  $\text{SO}_2$  in ash layer ( $D_e$ ):  $0.06 \text{ cm}^2/\text{s}$

Find: 1. Time required for complete conversion of a single  $\text{FeS}_2$  particle

2. Relative resistance of ash layer diffusion.

**OR**

- 2 b) Spherical solid particles containing B are roasted at constant temperature in an oven by gas at constant composition. Solids are converted to product according to shrinking core model. From the following data, determine the rate controlling mechanism for the transformation of solid. (8) CO1

$d_p$ (mm)	$X_B$	t (sec)
3	0.875	1
1.5	1	1

**Question No. 3**

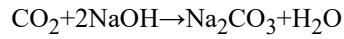
- 3 a) Discuss the types of fluid-fluid reactions with examples, and explain the reasons for carrying out fluid-fluid reactions. (7) CO2

**Question No. 4**

- 4 a) Derive the rate equation for straight mass transfer without chemical reaction. (8) CO2

**OR**

- 4 b) CO<sub>2</sub> is to be removed from air. We plan to use a NaOH solution to speed up the removal of CO<sub>2</sub> from air at 25°C (instead of pure water). The reaction between CO<sub>2</sub> and NaOH is instantaneous: (8) CO2



(i) Suggest a form of rate equation that we would use when  $P_{\text{CO}_2} = 1000 \text{ Pa}$  and the solution is 2N.

(ii) How much can absorption be speeded up compared to physical absorption using water?

Given Data:  $k_g a = 0.80 \text{ mol}/(\text{h} \cdot \text{m}^3 \cdot \text{Pa})$ ,  $k_l a = 25 \text{ h}^{-1}$ ,  $H = 3000 \text{ (Pa} \cdot \text{m}^3)/\text{mol}$

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