QP Code: R261B013 | Reg. No | | | | | | | | | | | AY 25

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur (GIET University)

M.Tech. (Second Semester - Regular) Examinations, May – 2026

24MCHPC12002 – Advanced Reaction Engineering

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions		CO #	Blooms Level
a.	Differentiate between space time and space velocity.	CO1	K2
b.	On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order.	CO2	K2
c.	Reaction with high activation energies are very temperature sensitive. Show in the diagram.	CO3	K2
d.	What is the significance of the Damkohler number?	CO4	K2
e.	Differentiate between a catalyst promoter and deactivator.	CO5	K2

PART – B **(10 x 5 = 50 Marks)**

<u>Answer ***ALL*** the questions</u>		Marks	CO #	Blooms Level
2. a.	Explain the concept of ideal reactors. Compare batch reactor, CSTR, and PFR in terms of design assumptions, flow pattern, and performance.	5	CO1	K2
b.	A first-order irreversible reaction is carried out in a batch reactor. The initial concentration of A is 2 mol/L, and the rate constant is 0.3 min^{-1}. Calculate the time required for 80% conversion.	5	CO2	K3
	(OR)			
c.	Derive the design equation for a Continuous Stirred Tank Reactor (CSTR) for a first-order reaction. State the assumptions involved	5	CO2	K4
d.	A liquid-phase reaction A → B is carried out in a plug flow reactor with rate law $-r_A = kC_A$, k = 0.5 min^{-1}. Feed concentration = 1 mol/L, flow rate = 2 L/min. Calculate the reactor volume for 75% conversion	5	CO2	K3
3.a.	Define yield and selectivity. Explain their importance in multiple reactions	5	CO1	K2
b.	For a reaction A → B → C, initial concentration of A = 2 mol/L, k_1 = 0.4 min^{-1}, k_2 = 0.2 min^{-1}. Calculate concentration of B at t = 5 min.	5	CO2	K3
	(OR)			
c.	Derive the general reactor energy balance equation and explain each term.	5	CO4	K4
d.	A reactor operates with heat generation rate of 5000 J/min and heat removal rate of 3000 J/min. Calculate the net heat accumulation and comment on reactor temperature.	5	CO4	K3
4.a.	Define Residence Time Distribution (RTD). Explain its significance in non-ideal reactor analysis.	5	CO1	K2
b.	Explain the segregated flow model and Zwietering's maximum mixedness model.		CO4	K4
	(OR)			

c.	Classify the heterogeneous reactions based on phases.	5	CO2	K2
d.	For a reversible exothermic elementary catalytic reaction of the type. $A \underset{K_2}{\overset{K_1}{\rightleftarrows}} R$, find the optimum operating reaction temperature at a conversion level, $X_A = 0.8$. Data: $K_1 = e^{(10 - 5000/T)}$, $K_2 = e^{(40 - 15000/T)}$ Maximum allowable temperature = 300 K.	5	CO3	K4
5.a.	Explain the kinetics of gas–solid catalytic reactions. Distinguish between reactions with and without diffusion limitations.	5	CO1	K2
b.	Describe the effectiveness factor and its significance in catalytic reactions.	5	CO1	K4
	(OR)			
c.	Discuss the design and hydrodynamics of fluidized bed reactors.	5	CO3	K2
d.	In a packed bed reactor, inlet concentration = 2 mol/L and outlet concentration = 0.5 mol/L. If volumetric flow rate = 1 L/min and rate law is $-r_a = kC_a$ ($k = 0.5$ min^{-1}), calculate the reactor volume.	5	CO2	K3
6.a.	Explain the basic theories of mass transfer with chemical reaction in gas–liquid systems (film theory, penetration theory).	5	CO5	K2
b.	Discuss the effect of reaction kinetics on mass transfer in gas–liquid systems (slow vs fast reactions).	5	CO4	K4
	(OR)			
c.	Discuss model systems and model reactors used for studying gas–liquid reactions.	5	CO6	K4
d.	Explain the design and working of mechanically agitated reactors for gas–liquid systems	5	CO6	K4

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