

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019****Subject Code: 2173514****Date: 28/11/2019****Subject Name: Environmental Reaction Engineering****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

											MARKS
Q.1	(a)	Differentiate order and molecularity of a reaction									03
	(b)	On doubling the concentration of reactant, rate of reaction triples. Find the reaction order.									04
	(c)	Explain how different theories predict temperature dependency of reaction rate									07
Q.2	(a)	Discuss Integral method for analysis of rate data.									03
	(b)	Derive the integrated form of rate expression for Irreversible unimolecular type Second order reactions.									04
	(c)	The half life period for a certain first order reaction is 2.5×10^3 sec. How long will it take for $1/4^{\text{th}}$ of reactant to be left behind.									07
OR											
	(c)	A polymerization reaction occurs at constant temperature in a homogeneous phase. For initial monomer concentrations of 0.3, 0.5 and 0.9 mol/l, 30% of monomer reacts in 40 minutes. Find the reaction rate.									07
Q.3	(a)	How overall order of a reaction can be estimated from half-life method?									03
	(b)	What is variable volume reactor									04
	(c)	Prove that for a first order reaction N-CSTRs connected in series will approximate to the behavior of PFR.									07
OR											
Q.3	(a)	Specify how holding time and space time varies for flow reactors.									03
	(b)	In an isothermal batch reactor 70% of reactant A is converted in 13 minutes. Find the space time and space velocity to effect this conversion in a plug flow reactor assuming first order kinetics.									04
	(c)	Discuss the case of qualitative product distribution and concentration levels to be maintained in case of parallel competing unimolecular reactions of desired and undesired reactions considering their order.									07
Q.4	(a)	Specify the differences between ideal and non-ideal reactors									03
	(b)	How E curve can be determined through pulse input experiments?									04
	(c)	Calculate the mean residence time for a reactor from following data									07
		t, min	0	1	2	3	4	5	6	7	8
		E, min ⁻¹	0	0.02	0.10	0.16	0.20	0.12	0.08	0.03	0
OR											
Q.4	(a)	What should be essential properties a catalyst?									03
	(b)	Write the steps involved in a Catalytic reaction.									04
	(c)	Synthesize a rate law for the decomposition of Cumene to form benzene and propylene considering that surface reaction is rate limiting step.									07

- Q.5 (a) Mention Fick's first law of diffusion. Specify the contributions of a liquid mixture to its total flux **03**
- (b) What is meant by Mass transfer boundary layer thickness? **04**
- (c) Calculate the mass flux of reactant A to a single catalyst pellet of 1 cm in diameter suspended in a liquid. The reactant is placed in dilute concentrations and reaction is considered to take place instantaneously at external pellet surface. The bulk concentration of reactant is 1 M and free system liquid velocity is 0.1 m/s. The kinematic viscosity is 0.5 cS and the liquid diffusivity is $10^{-10} \text{ m}^2/\text{s}$.

OR

- Q.5 (a) What is Thiele Modulus? Specify the importance of this factor in a catalytic reaction. **03**
- (b) Discuss the correlation between Effective diffusivity and tortuosity **04**
- (c) Correlate the time needed for complete conversion of a spherical particle considering that chemical reaction is rate governing step in shrinking core model. **07**

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