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GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, December – 2020

(Fifth Semester)

BCHPC 5030 – Chemical Reaction Engineering-I

(Chemical Engineering)

Time: 2 hrs

Maximum; 50 Marks

The figures in the right hand margin indicate marks.**PART – A: (Multiple Choice Questions)****(1 x 10 = 10 Marks)**Q.1. Answer ALL questions

- a. Name the type of reaction, when the rate of reaction is affected only by temperature, pressure & composition.
- | | |
|-------------------|---|
| (i) Homogenous | (ii) Heterogeneous |
| (iii) Both i & ii | (iv) Only catalytic heterogeneous reactions |
- b. All radioactive reactions are of type of
- | | |
|--------------------|------------------|
| (i) Zero order | (ii) First order |
| (iii) Second order | (iv) Third order |
- c. A batch reactor is suitable for
- | | |
|---|-----------------------------|
| (i) Gas phase reactions at large scale | (ii) Liquid phase reactions |
| (iii) To obtain uniform polymer products in highly exothermic reactions | (iv) None of the above |
- d. With the decrease in space time of an irreversible isothermal reaction being carried out in an ideal flow reactor, the conversion will.....
- | | |
|--------------------|----------------|
| (i) Decreases | (ii) Increases |
| (iii) Remains same | (iv) None |
- e. Non-catalytic reaction of particles with surrounding fluids can be represented by
- | | |
|----------------------------------|---------------------------|
| (i) Progressive conversion model | (ii) Unreacted core model |
| (iii) Either (i) or (ii) | (iv) None |
- f. Which of the following statement is wrong?
- | | |
|--|---|
| (i) Catalysts can accelerate a chemical reaction | (ii) Catalyst can start a chemical reaction |
| (iii) Catalyst can retard the rate of reaction | (iv) Catalyst can hasten and retard the rate of a chemical reaction |
- g. During deactivation of porous catalyst the decay reaction can be occurred by
- | | |
|---------------------------------|---------------------------|
| (i) Parallel deactivation | (ii) Series deactivation |
| (iii) Side by side deactivation | (iv) Any one of the above |
- h. Kinetics of a homogeneous catalysed system can be studied in
- | | |
|-----------------------------|----------------------------------|
| (i) Fixed bed reactor | (ii) Plug flow catalytic reactor |
| (iii) Fluidised bed reactor | (iv) Any one of the above |
- i. Which of the following is an autocatalytic reaction
- | | |
|---------------------------|------------------------------|
| (i) Fermentation reaction | (ii) Combustion of fuel |
| (iii) Both (i) & (ii) | (iv) Photochemical reactions |
- j. A semi batch reactor
- | | |
|---|---|
| (i) Is same as plug flow reactor | (ii) Employs mixing in axial direction only |
| (iii) In which velocity of reaction can be controlled | (iv) In which residence time is constant |

PART – B: (Short Answer Questions)**(2 x 5 = 10 Marks)**Q.2. Answer ALL questions

- Why activation energy is important in a reaction? What do you understand by promoter in a chemical reaction?
- Explain equilibrium constant and half-life period.
- Phosphine decomposes when heated according to the following reaction.
 $4\text{PH}_3 \rightarrow \text{P}_4 (\text{g}) + 6\text{H}_2 (\text{g})$ at a given instant, the rate at which phosphine decomposes is 2.4×10^{-3} mol/l.s. What is the rate of formation of P₄ and H₂?
- Explain recycle reactor and recycle ratio.
- What is the importance of selectivity during designing of multiple reactions?

PART – C: (Long Answer Questions)**(6 x 5 = 30 Marks)**Answer ANY FIVE questions

Marks

- At 500 K the rate of a bimolecular reaction is 10 times the rate at 400 K. find the activation energy for the reaction (a) from Arrhenius law, (b) Collision theory, (c) what is the % difference in the rate of reaction at 600 K predicted by these two methods? (6)
- On doubling the concentration of the reactant, the rate of reaction triples. Find the order of the reaction. (6)
- GIET is a person of habit. For instance, his Friday evening are all alike-into the joint with his week's salary of Rs. 180, steady gambling for 2 h and then home to his family leaving Rs. 45 behind. The betting pattern is predictable. He always bets in amounts proportional to his cash in hand and his losses are also predictable at a rate proportional to his cash in hand. This week GIET received a raise, so he played for three h, but as usual went home with Rs. 135. How much was his raise? (6)
- It is stated that the half-life method for finding reaction order can be extended to any fractional life date. Do this defining $t_{1/2}$ as the time required for the reactant concentration to drop to $1/n^{\text{th}}$ of its original value. (6)
- Do the material and energy balance of CSTR, PFR, Batch reactor. (6)
- Discuss about the batch reactor, semibatch reactor and their advantages, drawbacks and applications. (6)
- A first order homogeneous gas phase reaction $\text{A} \rightarrow 3\text{R}$, is first studied in a constant pressure batch reactor. At a pressure of 2 atm and starting with pure A, the volume increase by 75 % in 15 min. If the same reaction is carried out in constant volume reactor and the initial pressure is 2 atm, how long is required for the pressure to reach 3 atm. (6)
- A liquid phase elementary reaction $\text{A} + \text{B} \rightarrow \text{R} + \text{S}$ is carried out in a plugflow reactor. For equimolar amount of A and B ($C_{\text{A}0} = C_{\text{B}0} = 0.9$ mol/l), 94 % conversion is achieved. If a CSTR, 10 times as larger as the plug flow reactor is arranged in series with the existing unit, which unit needs to be arranger first (in series) to enhance the production rate. (6)

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