M.Tech. Second Semester (Membrane & Separation Tech.) (F.T.)

13036 : Advanced Reactor Design : 2 MST 4

P. Pages : 1 | **AV - 3382**

Time : Three Hours | Max. Marks : 80

Notes :
1. Answer **any six** questions.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and chemical equations should be given wherever necessary.
5. Illustrate your answer necessary with the help of neat sketches.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) What are the parameters to be considered while designing a reactor? Discuss in details. **7**

b) How are the reactors classified and discuss the factors affecting mass transfer rate in a chemical reactor. **7**

2. Discuss the characteristics of catalyst in chemical reaction and how to evaluate the effectiveness of a catalyst. **13**

3. When should isothermal reactors and adiabatic reactors be used? A catalytic reaction $A \rightarrow 3R$ is carried out in a packed bed reactor at 3.5 atm. Pressure and 115°C. I: is desired to treat 1450 mol/hr of pure reactant A and fractional conversion to be achieved is 32%. The reaction rate – concentration data is available **13**

C_A mol/lit	0.04	0.06	0.075	0.09
$\left(-r_A \frac{\text{mol A}}{\text{hr} \cdot \text{kg cat.}}\right)$	3.5	5.7	7.2	8.8

Calculate the weight of catalyst bed needed for the reaction. Gas constant $R = 0.082$ lit · atm/mol · k .

4. What are the advantages of recycle reactor and how to evaluate the performance of plug flow recycle reactor? Also discuss the two important limiting cases. **13**

5. What are fixed bed reactors? Discuss in details the design parameters and how to decide positional temperature (T) in fixed bed reactor for a specific conversion x_A. **13**

6. Develop model equations for the design of a trickle bed reactor and how to determine catalyst weight, when mass transfer and reaction of the liquid reactant A is limiting and controlling? **13**

7. What are fluidized bed reactors? Discuss their advantages and propose a model for pressure drop in such reactor. **13**

8. What are slurry reactors? Discuss the various rate equations to be developed for such reactors. **13**

9. For a vapour phase first order reaction $A \rightarrow R$, The size of plug flow reactor needed for 96% conversion is 30 litres. In reality, the reaction stoichiometry is $A \rightarrow 3R$. Calculate the size of plug flow reactor with this corrected stoichiometry. **13**

10. Explain the following. **14**

i) Residence time distribution and factors affecting dispersion in a reactor.

ii) Catalyst preparation and poisoning of a catalyst.

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