May 17, 2024 02:30 pm - 05:30 pm 1T00536 - T.E.(Chemical Engineering)(SEM-VI)(Choice Base Credit Grading System) (R- 19) (C Scheme) / 89242 - Chemical Reaction Engineering-II QP CODE: 10055941

(3 Hours)   **[Total : 80]**

N.B. : (1) Question No. 1 is compulsory.
    (2) Solve any three questions from the remaining questions.
    (3) Assume suitable data wherever necessary.

Q 1. Answer the following questions: **(20)**

    (a) Write a short note on Shrinking core model and Progressive conversion model.

    (b) Explain Pulse input experiment for RTD measurement.

    (c) What is significance of Hatta number in fluid fluid reactions?

    (d) Write a short note on the Slurry reactor.

Q.2. (a) Develop Langmuir-Hinshelwood type of rate equation for

$$P + Q \rightleftarrows R + S$$
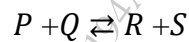
When the rate of desorption of R is rate controlling step.   **(10)**

    (b) Calculate the time required for complete burning of particles of graphite (radius 5 mm, bulk density 2.2 g/cc) in a 8 % oxygen stream at $900^{o}C$ and 1 atm. Assume gas film resistance to be negligible. Surface reaction rate constant = k" = 20 cm/s   **(10)**

Q.3. (a) Develop conversion time relationship for Shrinking spherical particles when resistance through the ash layer diffusion is controlling.   **(10)**

    (b) Explain in detail the contacting patterns in fluid- fluid reactions.   **(10)**

Q.4. a) Calculate the mean residence time and the variance for a vessel from the following data. These RTD data were obtained from pulse input.   **(10)**

t, min	0	1	2	3	4	5	6	7	8	9	10	12	14
E Min^{-1}	0	0.02	0.10	0.16	0.20	0.16	0.12	0.08	0.06	0.04	0.03	0.012	0

(b) A feed consisting of 20 % of 1 mm radius particles, 30 % of 2 mm particles & 50 % of 4 mm radius particles passes through a rotating tubular reactor where it reacts with gas to yield hard non friable solid product according to the shrinking core model with chemical reaction controlling. The time required for complete conversion is 4 mm particles is 4 h.
Determine the mean conversion of solids for the residence time of 15 min.   **(10)**

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Q.5. (a) A first order liquid phase reaction is carried out in a tubular reactor . The results of pulse tracer test on this reactor are tabulated below.

t, min	0	1	2	3	4	5	6	7	8	9	10	12	14
C $_{Pulse}$ g/m3	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

Find the conversion of this reaction. Using i) an ideal plug flow reactor

ii)an ideal mixed flow reactor

iii) Tank in series model

Reaction Rate constant= 0.25 min^{-1} **(10)**

(b) Write short notes on Fluidized Bed and Trickling Bed Reactor. **(10)**

Q.6. Answer the following questions. **(Any four):** **(20)**

a) What are the first, second and third moments of RTD

b) Differentiate between Physical adsorption & Chemical adsorption.

c) Explain Tank in series model in brief.

d) Write a short note on the packed bed reactor.

e) Define true, apparent and bulk density for a catalyst bed.

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