Registration No.

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B.Tech.

PCE5I103

5ᵗʰ Semester Regular Examination 2017-18
Chemical Reaction Engineering
BRANCH : CHEM
Time : 3 Hours
Max Marks : 100
Question Code : B232
Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

1. **Answer the following questions :** **(2x10)**

(a) In reaction $3A \rightarrow 2.5B \rightarrow 1.5C$, the relation between the rate of disappearance and appearance of the components is
  i. $3(-r_A) = 2.5(r_B)$
  ii. $2(r_C) = (-r_A)$
  iii. $(-r_B) = (r_C)$
  iv. None of these

(b) $A + inert(50\%) \rightarrow 2.5D + inert$. Fractional volume change (ϵ_A) is
  i. 0.5
  ii. 0.75
  iii. 1.0
  iv. 1.25

(c) For which order reaction, the reactant consumption is exponential decay?
  i. 0
  ii. 1
  iii. 2
  iv. -1

(d) First order rate constant has the unit of
  i. mole/lit.sec
  ii. 1/sec
  iii. lit.sec/mole
  iv. sec

(e) Dispersion number for PFR is
  i. 0
  ii. 1
  iii. ∞
  iv. None of these

(f) For all +ve order reaction the best flow reactor is
  i. PFR
  ii. MFR
  iii. Both
  iv. None of these

(g) A→B and R→T are
    i.   Series reaction
    ii.   Parallel reaction
    iii.   Independent reaction
    iv.   All of these

(h) A→B(1st order) and A→C(2nd order), where C is desired product. Maximum C will be produced is
    i.   by maintaining high C_A
    ii.   by maintaining low C_A
    iii.   independent of C_A
    iv.   None of theses

(i) Half life ($t_{1/2}$) of first order reaction is
    i.   0.693/K
    ii.   K/0.693
    iii.   1/K
    iv.   K

(j) Two CSTRs of 5 liter capacity each can be replaced by one 10 liter CSTR for same conversion for
    i.   Zero order reaction
    ii.   First order reaction
    iii.   Second order reaction
    iv.   Negative order reaction

2.   **Answer the following questions :**   **(2x10)**
(a) Define elementary and non-elementary reactions.
(b) Define order and molecularity.
(c) Classify different types of reaction.
(d) Define half life and fractional life.
(e) Name different types of intermediates for developing non-elementary reaction rate expression.
(f) Define homogenous catalytic reaction.
(g) Define Arrhenius equation.
(h) Define space time and space velocity.
(i) Recycle reactor is best for auto-catalytic reaction. Justify.
(j) Define instantaneous and overall fractional yield.

3. **(a)** Write the advantages and disadvantages of batch reactor.   **(4)**
    (b) Draw a neat sketch of batch reactor.   **(3)**
    (c) Derive the performance equation of a batch reactor for constant and varying volume systems.   **(8)**

4. **(a)** Derive the performance equation of plug flow reactor.   **(5)**
    (b) A homogeneous liquid phase reaction with the stoichiometry and the kinetics A→S, $-r_A = KC_A^2$, takes place with 50% conversion in a mix flow reactor. If this MFR is replaced by a PFR of the same size, find the conversion in PFR. All other conditions are remaining unchanged.   **(10)**

5. **(a)** Explain size comparison of single continuous reactors.   **(10)**
    (b) Explain how to obtain final concentration (C_A) or conversion in different size of MFRs in series from the $-r_A$ vs C_A plot.   **(5)**

6. **(a)** In a certain kinetic study, the rate constants were found to vary with temperature in the following manner. **(10)**

$K\times10^3(min^{-1})$	4.15	26.8	114	246
T (K)	573	600	623.5	635

Evaluate the activation energy and frequency factor.

(b) Explain differential analysis method for obtaining rate expression for elementary reactions. **(5)**

7. For $A \xrightarrow{K_1} R \xrightarrow{K_2} S$, derive an expression for C_{Rmax} by considering unimolecular type first order reaction. **(15)**

8. Derive the performance equation of recycle reactor in concentration term. Prove that it can be used as either PFR or MFR both analytically and graphically. **(15)**

9. **(a)** Discuss about integral analysis method. **(5)**
(b) Mention the advantages and disadvantages of MFR. **(5)**
(c) Discuss about rate of reaction. **(5)**