Q. Code: 699728

B.E./B.TECH. Degree Examination, December 2020

Fifth Semester

CH18502-Chemical Reaction Engineering-I

(Regulation-2018)

Time: Three hours   Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. Reactions in which rate expression corresponds to stoichiometry are called:
   a) Elementary
   b) Non-elementary
   c) Catalytic
   d) Homogenous
2. A first order reaction requires two equal sized CSTR. The conversion is
   a) More when they are connected in series.
   b) More when they are connected in parallel.
   c) Same whether they are connected in series or in parallel.
   d) Less when they are connected in series
3. Selectivity in parallel reactions is defined as the ratio of___
   a) Moles of desired product formed to the moles of undesired material formed
   b) Moles of undesired product formed to the moles of desired material formed
   c) Moles of product formed to the moles of reactant consumed
   a) Moles of reactant consumed to the moles of product formed
4. Equilibrium constant K >>1 indicates-----------
   a) Complete conversion
   b) can be considered as impossible reaction
   c) can be considered as irreversible reaction
   d) both a and c
5. The half life period for a certain first order reaction is 1.9×10^3 sec. How long will it take for ¼ of the reactants to be left behind?
6. List any two practical examples for multiple reactions.
7. Write the general rule on the influence of temperature on the relative rates of competing reactions.
8. Relate E and F curve.

PART B - (4 X16 = 64 marks)

09. (a) (i) Justify Arrhenius theory of determining rate constant is a good approximation of collision and transition theories. **(12)**

(ii) Discuss half life period of zero order reaction **(04)**

(OR)

(b) Liquid A decomposes with the kinetic orders given below in a batch reactor 50% of A is converted in a 5 minutes run. How much longer would it take to reach 65% conversion **(16)**

a) First order reaction

b) Second order reaction

10. (a) (i) Design a recycle reactor and discuss the performance equation with the first order reaction and second order reaction. **(12)**

(ii) Explain the extreme of negligible and infinite recycle stream in recycle reactor **(04)**

(OR)

(b) The laboratory measurements of the rate Vs conversion of the reactant A are given below. Compare the volume of the CSTR and PFR required to achieve 56% conversion. The feed conditions are the same in both the cases and molar flow rate of A entering the reactor is 10 mol/s. **(16)**

X_A	0	0.2	0.4	0.6	0.8
$-r_A$(mol/l.s)	0.182	0.143	0.1	0.0667	0.0357

11. (a) A first order liquid phase reaction is carried out in mixed flow reactor The concentration of reactant in feed is 2.5 kmol/ m^3 and volumetric flow rate is 60 x 10^{-6} m^3/s . The density and specific heat of reaction mixture are constant at 10^3 kg/m^3 and 4.19 x 10^3 J/kJ. K. The volume of reactor is 18 x 10^{-3} m^3. The reactor operates adiabatically. If feed enters at 298 K, What are steady state conversions and temperatures in the product streams?Given data: **(16)**

Standard heat of reaction = -2.09 x 10^8 J/kmol

Rate= 4.48 x 10^6 exp (-62800/RT) C, kmol/m^3.s

where C is the concentration of the reactant, T is in kelvin and E is in J/mol.

(OR)

(b) Determine the equilibrium conversion for the following elementary reaction between 0 °C and 100 °C. **(16)**

$A \rightleftarrows R$,

At 298 K; $\Delta G° = -14130$ J/mol, $\Delta H°_R = -75300$ J/mol, $C_{pA}=C_{pR}$=constant

a) Construct a plot of temperature v/s conversion

b) What restrictions should be placed on a reactor operating isothermally if conversion of 68% or higher is desired?

12. (a) (i) Describe Qualitative treatment of product distribution for the reactions in series in plug flow reactor. **(8)**

(ii) Describe Quantitative treatment of product distribution for the reactions in parallel in plug flow reactor. **(8)**

(OR)

(b) Plot the C and E curves and determine the fraction of materials leaving the vessel that has spent between 3 and 6 minutes in the vessel and the fraction of the material that has spent between 7 and 8 minutes in the vessel. Also Calculate the mean residence time. **(16)**

Time(minutes)	0	1	2	3	4	5	6	7	8	9	10	12	14
E (min^{-1})	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0