A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 95903

B.E./B.Tech. DEGREE EXAMINATION, NOV 2022

Fifth Semester

Chemical Engineering

19UCH503 - CHEMICAL REACTION ENGINEERING I

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The rate constant for a first order reaction CO1- R

   (a) depends on unit of time

   (b) has units of reciprocal time

   (c) does not change on changing the concentration units

   (d) all of the above.

2. A certain first order reaction is half completed in 23 minutes. The rate constant for the reaction must be CO2- App

   (a) 0.03 s^{-1} (b) 0.030 min^{-1} (c) 0.030 hr^{-1} (d) 0.110 min^{-1}

3. For identical feed composition ,flow rate , conversion and for zero order reactions the ratio of the volume of mixed reactor to the volume of PFR is CO1- R

   (a) 0 (b) 1 c) < 1 (d) >1

4. For identical feed composition and flow rate, N plug flow reactors in series with a total volume V gives the same conversion as a single CO1- R

   (a) plug flow reactor of volume V

   (b) CSTR of volume V

   (c) plug flow reactor of volume V/N

   (d) plug flow reactor of volume NV

5. For any reaction the maximum attainable concentration of desired product in a plug flow reactor is — CO1- R

(a) always lower than that in a MFR (b) always higher than that in a MFR

(c) always same that in a MFR (d) None of the above

6. For the desired product formation $r_R/r_S = k1/k2.C_A^a.C_B^b$, to maximize the r_R/r_S when a and b are positive we have to maintain the concentration of A and B as — CO3- Ana

(a) low respectively (b) high and low respectively

(c) high respectively (d) low and high respectively

7. Estimate equilibrium constant (k_2) for a reaction with k_1=30.8, ΔH_R^o= -10938 cal/mol, for T_1 and T_2 as 298 and 600 respectively — CO2- App

(a) $3.15*10^{-3}$ (b) $2.83*10^{-3}$ (c) $4.0*10^{-2}$ (d) $1.5*10^{-3}$

8. For an ideal gas, fugacity is equal to — CO1- R

(a) temperature (b) pressure (c) concentration (d) none of the above

9. In which reactor distribution of residence times of fluid within the reactor happens — CO1- R

(a) Batch reactor (b) MFR

(c) Plug flow reactor (d) all of the above

10. The total area under E curve $\int E\,dt$ = — CO3- Ana

(a) 0 (b) 2 (c) 1 (d) α

PART – B (5 x 2= 10 Marks)

11. Give the performance equation for a constant volume batch reactor. CO1- U

12. What are continuous reactors? Give examples. CO1- U

13. Give the expression for overall fractional yield for N mixed flow reactors in series. CO1- U

14. Define optimum temperature progression. CO1- U

15. What is residence time distribution in a reactor? CO1- R

PART – C (5 x 16= 80 Marks)

16. (a) Discuss in detail about integral and differential method used to analyze rate data. CO1- U (16)

Or

(b) Write short notes on: CO1- U (16)

(i) Reaction mechanism

(ii) Rate law and rate equation

(iii) Order of reaction

17. (a) Discuss in detail about transition state theory. CO1- U (16)

Or

(b) Following results are obtained for the decomposition of nitrous oxide in contact with gold surface at 900◦C. Show that the order of reaction is unity. CO2- App (16)

Time (min)	15	30	45	65	80
% N2O decomposed	17	32	44.5	57	65

18. (a) Describe in detail about constant volume batch reactor. CO3- Ana (16)

Or

(b) The half life for the conversion of ammonium cynate into urea at 303 K at initial concentration of ammonium cynate of 0.1 mol/l and 0.2 mol/l are 1152 min and 568 min respectively. What is the order of the reaction? CO2- App (16)

19. (a) Derive the performance equation of PFR with graphical representation. CO1- U (16)

Or

(b) For the elementary liquid phase reaction A reversibly reacts with R construct a plot of equilibrium conversion as a function of temperature and conversion when pure A at a temperature of 27 ^{O} C (300 K) is fed to the reactor. CO2- App (16)

Datas: $\Delta H_{f\,A}$ = -40000 cal/mol

$\Delta H_{f\,R}$ = - 60000 cal/mol

C_{PA} = 50 cal/(mol.k), C_{PR}= 50 cal/mol .k

K = 100000 at 298 K

20. (a) The standard heat of gas phase reaction at 25◦c (298k) CO2- App (16)

$A+B \rightarrow 2R$ is $\Delta H^{\circ}R = \Delta HR(298K) = -50000J$

Indicating that the reaction is strongly exothermic. it is planned to run this reaction at 1000◦c. what is the value of heat of temperature? is the reaction still exothermic at 1000◦c?

Data:

The mean/average Cp values between 25◦c and 1000◦c for the various reaction

Components are:

CpA=35J/(mol.k) , CpB= 45J/(mol.k) , CpR= 70J/(mol.k)

Or

(b) Discuss in detail about the adiabatic reactor. CO1- U (16)