Q. P. Code: 21943

1T00515 - T.E.(CHEMICAL)(Sem V) (CBSGS) / 30103 - CHEMICAL REACTION ENGINEERING-I

Duration: 3 hours **Total Marks: 80**

N. B. (i) Question number **one is compulsory.**

(ii) Answer any **three** questions from the rest.

(ii) Assume suitable data wherever necessary.

Q.1.a) Define Order, Molecularity and specific rate constant for a given reaction. (05)

b) Explain integral Method of analysis of rate data. (05)

c) After 8 minutes in a batch reactor, reactant (C_{AO} = 1 mol/liter) is 80% converted; after 18 minutes, conversion is 90%. Find a rate equation to represent this reaction. (05)

d) Derive complete design equation for Plug Flow Reactor (05)

Q.2.a) Experiment shows that the homogeneous decomposition of ozone proceeds with a rate (10)

$$-r_{O3}=k\,[O_3]\,[O_2]^{-1}$$

(a) What is the overall order of reaction?

(b) Suggest a two-step mechanism to explain this rate and state how you would further test this mechanism.

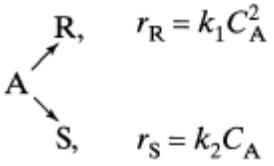
b) Describe type of Reactors used for autocatalytic reaction (10)

Q.3a) Find the first-order rate constant for the disappearance of A in the gas reaction $A \rightarrow 1.6\,R$ if the volume of the reaction mixture, starting with pure A increases by 50% in 4 min. The total pressure within the system stays constant at 1.2 atm, and the temperature is 25°C. (10)

b) Explain fractional Life Method of analysis. (10)

Q.4 a) Assuming a stoichiometry $A \rightarrow R$ for a first order gas phase reaction, the size of plug flow reactor required to achieve 99% conversion of a pure A is 32 lit. In fact, however, the stoichiometry of the reaction is $A \rightarrow 3R$. For this corrected stoichiometry, find the required size of the same type of reactor. (12)

b) Substance A in the liquid phase produces R and **S** by the following reactions: (08)



The feed *(C_{Ao} = 1.0, C_{Ro} = 0, C_{so} = 0.3)* enters two mixed flow reactors in series *(τ_1 = 2.5* min, τ_2 = 10 min). Knowing the composition in the first reactor *(C_{A1} = 0.4, C_{Rl} = 0.2, C_{S1}* = 0.7), find the composition leaving the second reactor.

Q.5) For the elementary liquid phase reaction A ⇔ R construct a plot of equilibrium conversion as a function of temperature and from this plot, determine the adiabatic equilibrium temperature and conversion when pure A at a temperature of 27°C is fed to the reactor. (20)

Data: ΔH^0_{fA} = - 40000 cal/mol, ΔH^0_{fR} = - 60000 cal/mol

C_{pA} = 50 cal/(mol.K), C_{pR} = 50 cal/(mol.K)

K = 100000 at 298 K

Q.6.a) Derive the expression for rate equation for First order reaction and show graphical representation to calculate order and rate constant of reaction (08)

b) Pure gaseous A at about 3 atm and 30°C (120 mmol/liter) is fed into a 1-liter mixed flow reactor at various flow rates. There it decomposes, and the exit concentration of A is measured for each flow rate. From the following data find a rate equation to represent the kinetics of the decomposition of A. Assume that reactant A alone affects the rate. $A \rightarrow 3R$ (12)

v_0 liter/min	0.06	0.48	1.5	8.1
C_A mmol/liter	30	60	80	105
