B.TECH SEM - VI (2007 COURSE) (CHEMICAL ENGG.) :
WINTER - 2017
SUBJECT: CHEMICAL REACTION ENGINEERING – I

Day: **Tuesday** Time: **10.00 AM TO 01.00 PM**
Date: **21/11/2017** **W-2017-2495** Max Marks.80

N. B.

1) **Q. No. 1** and **Q. No. 5** are **COMPULSORY**. Out of remaining attempt any **TWO** questions from each section
2) Answer to both the sections should be written in **SEPARATE** answer books.
3) Draw neat labeled diagrams **WHEREVER** necessary.
4) Figures to the right indicate **FULL** marks.
5) Assume suitable data wherever necessary.

SECTION –I

Q.1 **a)** Define molecularity and order of reaction **(04)**

b) For first order reaction with variable volume show that **(05)**

$$-\ln\left[1-\frac{\Delta V}{\epsilon_A V_0}\right]=kt$$

c) Derive the performance equation of batch reactor. **(05)**

Q.2 **a)** Explain the kinetic models for Non elementary reactions. **(05)**

b) The decomposition of nitrous oxide is found to proceed as **(08)**

$$N_2O \rightarrow N_2+\frac{1}{2}O_2, \quad -r_{N_2O}=\frac{k_1[N_2O]^2}{1+k_2[N_2O]}$$

What is the order of reaction with respect to N_2O and overall?

Q.3 The reaction is $CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$ **(13)**

Time (sec)	333	669	1010	1265
Moles of NaOH	0.4866	0.4467	0.4113	0.3879
Moles of $CH_3COOC_2H_5$	0.2342	0.1943	0.1589	0.1354

Initial moles of $CH_3COOC_2H_5$ is 0.3114 and initial moles of NaOH is 0.5638. The reaction is as shown above. The amounts of reactants have been found to vary as shown in the table. Find order and rate constant for reaction.

Q.4 **a)** At 650^0C phosphine vapor decomposes as follows: **(08)**
$4PH_3 \rightarrow P_{4(g)}+6H_2$, $-r_{phos} = (10hr^{-1})C_{phos}$
What size of plug flow reactor operating at 649^0C and 11.4 atm is needed for 75% conversion of 10 mol/hr of phosphine in a 2/3 phosphine -1/3 inert feed?

b) Derive the performance equation for steady state mixed flow reactor of constant volume for fist order reaction. **(05)**

P.T.O.

SECTION -II

Q.5 **a)** Explain which is the best arrangement of a set of ideal reactors for equal volume. **(06)**

b) What reaction schemes and conditions would you use to have maximum concentration of R for the following parallel reactions? **(06)**

$A + B \rightarrow R$ (desired) , $r_R = 15.e^{-273/T} C_A^{0.5} C_B$

$A + B \rightarrow S$ (undesired), $r_S = 200.\ e^{-2000/T} C_A C_B$.

c) Define equilibrium conversion **(02)**

Q.6 **a)** An aqueous reactant streams (4mol A/ lit) passes through a mixed flow reactor followed by a plug flow reactor. Find the concentration at the exit of the plug flow reactor if in the mixed flow reactor, $C_A = 1$ mol /l. The reaction is second order with respect to A. The volume of the plug flow reactor is three times that of the mixed flow reactor / CSTR. **(09)**

b) Write a note on "Autocatalytic reactions". **(04)**

Q.7 **a)** Explain quantitative treatment for batch reactor. **(09)**

b) Write a note on "Selectivity". **(04)**

Q.8 **a)** What is mean by chemical equilibrium? Explain in detail. **(07)**

b) Explain optimum temperature progression. **(06)**