B.Tech Sem - VI (2007 Course) (Chemical Engg.) : SUMMER - 2019
SUBJECT: CHEMICAL REACTION ENGINEERING-I

Day: Friday
Date: 24/05/2019

Time: 02.30 PM TO 05.30 PM
Max. Marks: 80

S-2019-3103

N.B.:

1) **Q. No.1** and **Q. No.5** are **COMPULSORY.** Out of the remaining attempt **ANY TWO** questions from each section.
2) Figures to the right indicate **FULL** marks.
3) Answer to both the sections should be written in **SAME** Answer book.
4) Assume suitable data if necessary.

SECTION-I

Q.1 **a)** Elaborate Arrhenius theory and collision theory for temperature dependency. **(06)**

b) Derive the equation for zero order reaction **(04)**

c) Discuss space time and space velocity. **(04)**

Q.2 The rule of thumb that the rate of reaction doubles for a 10^0C increase in temperature occurs only at a specific temperature for a given activation energy (ie for specific combination of temperature and activation energy), show that the relationship between activation energy and temperature for which the rule holds is **(13)**

$$T=\left[\frac{10(K)E}{R\ln 2}\right]^{1/2}$$

Q.3 Find the overall order of the irreversible reaction. **(13)**

$2H_2+2NO\rightarrow N_2+2H_2O$

From the following constant volume data obtained by using equimolar amounts/ quantities of hydrogen and Nitric oxide at T = 296K.

Half-life (seconds)	265	186	115	104	67
Total pressure (mmHg)	200	240	280	320	360

Q.4 **a)** Derive the performance equation for mixed flow reactor. **(06)**

b) Consider a feed with $C_{A0}=200$mol/lit, $C_{B0}=300$mol/lit *and* $C_{i0}=200$mol/lit enters a steady flow reactor in which isothermal gas phase reaction $A+3B\rightarrow 6R$ takes place. Determine C_B, X_B *and* X_A at the exit of the reactor if C_A at exit is 50 mol/lit. **(07)**

P.T.O.

SECTION-II

Q.5 **a)** Illustrate on "optimum recycle ratio for autocatalytic reactors". **(05)**

b) Elaborate on: i) Choice of reactor ii) Optimum yield iii) Conversion iv) Selectivity v) Reactivity **(06)**

c) Discuss on adiabatic operations for batch reactor. **(03)**

Q.6 **a)** Elaborate on determining best system for a given conversion in CSTR. **(08)**

b) The elementary reaction $A+B\rightarrow R+S$ is effected in a setup consisting of a mixed reactor into which two reactant solutions are introduced followed by a plug flow reactor. The component B is used in a large excess so that the reactions first order with respect to A various ways to increase the production are suggested one of which is to reverse the order of units. How would this change affect conversion? **(05)**

Q.7 **a)** What reaction schemes and conditions would you use to have maximum concentration of R for the following parallel reactions? **(08)**

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

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

b) Give difference between quantitative and qualitative treatment. **(05)**

Q.8 Discuss on: **(13)**

i) Optimum temperature progression rate.

ii) Energy balance for adiabatic and non-adiabatic operations.

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