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UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B.Tech, CE+RP **Semester – V**
Subject (Course): Chemical Reaction Engineering -I **Max. Marks : 100**
Course Code : CHEG333 **Duration : 3 Hrs**
No. of page/s:2

Note:

i) Exchange of calculators not allowed.
ii) Make necessary assumptions

Section A (attempt all) [6x10=60]

1. Define and explain the following terms.
   (i) Order of Reaction (ii) Elementary and non-elementary reactions
   (iii) Activation Energy (iv) Single and multiple reactions v) Space velocity
2. Consider a feed C_{AO}=100, C_{BO}=400, C_{iO}=100 to a steady flow reactor. The isothermal gas phase reaction is $A+3B \rightarrow 6R$. If C_A=40 at the reactor exit, what is C_B, X_A and X_B?
3. Find the 1st order rate constant for the disappearance of 'A' in the gas reaction mixture, starting with pure A increases by 55% in 5 min. The total pressure within the system stays constant at 2 atm and temperature at 25 ^{0}C.
4. Discuss the advantages and disadvantages of various types of reactors used to carry out the reactions.
5. A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = kC_A^2$ takes place with 50% conversion in a mixed reactor. What will be the conversion if the original reactor is replaced by a plug flow reactor of equal size, all else remaining unchanged?
6. Derive the performance equation for a slug flow reactor and sketch the graphical representation.

SECTION B (Attempt any Two Questions) [2×20=40]

7. Consider a municipal water treatment plant for a small community. Waste water, 32000 m^3/day flows through the treatment plant with a mean residence time of 8 hr, air is

bubbled through the tanks, and microbes in the tank attack and break down the organic material. A typical entering feed has a BOD of 200 mg O_2//lit, while the effluent has a negligible BOD. Find the rate of reaction, or decrease in BOD in the treatment tanks.

$$(Organic waste) + O_2 \xrightarrow{microbes} CO_2 + H_2O$$

8. (i) Derive the integral rate expression for reversible unimolecular type first order reaction. Where the forward and backward rate constants are k_1 and k_2. [12M]

   (ii)The first order reversible liquid reaction takes place in a batch reactor. After 8 min conversion of A is 33.3% while the equilibrium conversion is 66.7%. Find the rate equation to represent this reaction. Take C_{A0}=0.50 mol/L and C_{R0}=0. [08M]

9. At present the elementary liquid-phase reaction $A + B \rightarrow R + S$ takes place in a plug flow reactor using equimolar quantities of A and B. Conversion is 96%, C_{AO}=C_{BO}=1 mol/liter. If a mixed flow reactor ten times as large as the plug flow reactor were hooked up in series with the existing unit, which unit should come first and by what fraction could production be increased for that setup?