Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 713001N **Date: 13-06-2014**

Subject Name: Advance Reactor Design

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Describe briefly the heterogeneous reacting systems and write different rate expressions for the same. Explain linear and non-linear rate expressions with appropriate examples. **07**

(b) Explain basic types of multiple reactions and give industrial examples for each of them. **07**

Q.2 **(a)** Define and explain desired and undesired reactions, yield and selectivity. **07**

(b) The kinetic data for three parallel reactions are given below: **07**

$A \rightarrow R \quad r_R = 1 \quad$ gmol/lit.s

$A \rightarrow S \quad r_S = 2C_A \quad$ gmol/lit.s

$A \rightarrow T \quad r_T = C_A^2 \quad$ gmol/lit.s

For C_{Ao} = 2 gmol/lit, find the maximum expected C_S for the isothermal operation (S is the desired product). It is planned to provide a separator after reactor to separate unconverted A and return it to reactor with feed stream. For conversion of 120 tons of A per day, find the size of the reactor. Molecular weight of A, R, S and T is 30.

OR

(b) Obtain the expressions of τ_{opt} and C_{Bmax} for the series reactions, $A \rightarrow B \rightarrow C$, in a plug flow reactor. **07**

Q.3 For the elementary solid-catalyzed liquid phase reaction $A \leftrightarrow B$, make a plot of equilibrium conversion as a function of temperature. Determine the adiabatic equilibrium temperature and conversion when pure A is fed to the reactor at a temperature of 300 K. **14**

Data:-

H^o_A (298 K) = - 40000 cal/mol

H^o_B (298 K) = - 60000 cal/mol

C_{PA} = 50 cal/mol.K

C_{PB} = 50 cal/mol.K

K_e = 100000 at 298 K

OR

Q.3 **(a)** Derive design equations for steady-state tubular reactor with heat exchange. **07**

(b) Derive design equations for non-isothermal CSTR for first-order irreversible liquid-phase reaction when X, v_0, C_{A0} and F_{A0} are specified. **07**

Q.4 **(a)** With reference to multiple-steady state encountered in exothermic reaction, discuss ignition-extinction curve. **07**

(b) Discuss inter-stage cooling for exothermic reactions. **07**

OR

Q.4 **(a)** Derive the performance equation for a fluidized bed reactor. **07**

(b) What are moving bed reactors? Derive design equations for moving bed reactors with the help of neat diagrams. **07**

Q.5	**(a)**	Discuss mass balance and design equation for a bioreactor.	**07**
	(b)	What are slurry reactors? Derive performance equation for slurry reactors with the help of diagram.	**07**

OR

Q.5	**(a)**	Explain construction and working of monolithic reactors.	**07**
	(b)	Derive the equation for thickness of the film by vapour deposition in a LPCVD. Show how the deposition thickness varies along the length of the reactor.	**07**

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