Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1721606   **Date: 05-06-2013**
Subject Name: Chemical System Modeling and Simulation
Time: 10.30 am – 01.00 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)** Develop equation of continuity from Lagrangian point of view of a flow process. **07**

(b) Derive Kemser-Brown equation with usual notations for a continuous solvent **07** extraction by ÷Nø stages at steady state.

Q.2 **(a)** Formulate a model for temperature profile for fixed bed catalytic reactor with **07** usual notations. List all assumptions made.

(b) In some determination of the value ÷vø of carbon dioxide dissolved in a given **07** volume of water at different temperature ÷ ø the following pairs of values are obtained

	0	5	10	15
v	1.8	1.45	1.18	1.00

Obtain by method of least squares a relation of the form $v = a + b$ which best fits to these observations

OR

(b) Formulate a model for temperature profile along tubular gas preheater. Assume **07** flat velocity profile and heat transfer coefficient along the tube is given by $h = cx^{0.5}$ where ÷xø is distance from tube inlet and ÷cø is a constant. Also solve the model with appropriate method.

Q.3 **(a)** For consecutive reversible reactions in series at constant volume, **07**
A   B   and B   C
Derive relation for rate of disappearance of A, Number of moles of A and various rate constants

(b) N_o gm of a solid material was placed in W gm of water at time t=0. The liquid **07** was continuously stirred and maintained at constant temperature. At the end of very long time N_f gm of solid remains undissolved which can be taken as zero for practical purpose. The solid consisted of S sphere each of initial diameter D_o mt. Obtain variation of diameter of solid as function of time.

OR

Q.3 A still is purifying benzene and toluene from a small amount of essentially **14** nonvolatile impurity and is initially charged with 20 kg mole of feed stock of composition $X_F = 0.32$ mole fraction of benzene. Feed is supplied at the rate of 10 kg mole/hr and the heat input is adjusted so that the total moles of liquid in the still remains at 20. Estimate the time required for composition of overhead product to fall to 0.4 mole fraction of benzene. No liquid stock is removed from the still during this period. Assume relative volatility   = 2.36

Q.4 **(a)** Define & Explain: Signal flow graph, Successor digit **07**

(b) Using Kehat and Shacham algorithm for decomposition of network, find out the streams that are to be teared (i.e. cut- set) for a process having following details. **07**

Nodes	Input	Output
(1)	2	1, 3
(2)	6, 8	7
(3)	1, 5	4
(4)	7	5, 8
(5)	4, 3	2, 6

OR

Q.4 **(a)** With a neat flow chart explain Murthy & Hussain óI algorithm **07**

(b) Describe Barkley and Motard algorithm in detail. **07**

Q.5 **(a)** Using Newtonøs method, solve equation $x^3 \; ó \; 4x^2 + 6x - 5 = 0$, with an initial guess of x =4. **07**

(b) Discuss features, applications and limitations for any one professional simulation package **07**

OR

Q.5 **(a)** Write briefly about Maintaining Sparsity and sparse system **07**

(b) Discuss about sources and Databanks related to physical and thermodynamic properties. **07**

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