

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject Code: 2711608**Date: 06-01-2015****Subject Name: Chemical System Modeling and Simulation****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)** For a jacketed kettle heated through surface by condensing steam, develop an equation for variation of temperature with usual notations **07**
- (b)** Explain with examples: Boundary conditions, Initial conditions and Parameters **07**

- Q.2 (a)** W kg/h of fluid having density ρ , specific heat C_p is being cooled in two stages counter current cooler. Hot fluid at temperature T_0 is fed to tank No. 1 having cooling coil and stirrer. The continuous overflow from tank No. 1 at temperature T_{1s} is fed to tank No. 2 where it further cools to T_{2s} temperature. Cooling water flows counter currently. Both tanks are identical. If the cooling water is suddenly stopped due to failure of pump. Find the chronological temperature rise of exit fluid from tank No. 2 i. e T_2 with time " hr. **07**
- (b)** Develop temperature profile model on longitudinal triangular fin. List all assumptions made and also suggest suitable method for solving the model **07**

OR

- (b)** For a laminar flow of Newtonian fluid in a narrow slit formed by two parallel walls at a distance $2B$ apart, develop relation for momentum flux and velocity distribution with usual notations. **07**
- Q.3** A still is purifying benzene and toluene from a small amount of essentially 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 $\bar{U} = 2.4$ **14**

OR

- Q.3 (a)** A tank contains 30 m^3 of water. A stream of brine containing 3 kg/m^3 of salt is fed into the tank at a rate of $9.25 \times 10^{-4} \text{ m}^3/\text{s}$. Liquid flows out from tank at a rate of $6.5 \times 10^{-4} \text{ m}^3/\text{s}$. If the tank is well agitated, what is concentration of salt in tank when the tank contains 40 m^3 of brine? **07**
- (b)** Formulate temperature profile model for a Fixed bed catalytic reactor. List all assumption made for deriving the model. **07**

OR

- Q.4 (a)** Compare simultaneous modular approach with sequential modular approach. **07**
- (b)** With neat flow chart discuss Kehat and Shacham algorithm. **07**
- Q.4 (a)** In case of Murthy and Hussain's algorithm, discuss various innovation applied for decomposition of networks also state under which circumstances, these innovations are applied. **07**

- (b) A chemical process is represented by the following set of equation 07

$$X_1 X_4 + (X_6^2 / X_4) - 4 = 0$$

$$X_2 X_5 + 3X_6 = 0$$

$$X_1 / X_2 + \ln (X_3 / X_4) - 2 = 0$$

$$X_3^3 + (2X_3^2 / X_4) - 2X_3 = 0$$

$$X_2 + X_4 - 3 = 0$$

$$X_3(X_3 + X_6) - 7 = 0$$

Precedence order these equations using SWS algorithm along with Steward and Rudd algorithm.

- Q.5** (a) Discuss and compare various tearing algorithms in detail 07
 (b) Write briefly on Sparse system 07

OR

- Q.5** (a) With the aid of Newton's method discuss convergence promotion. 07
 (b) Write in brief about simulation software HYSIS 07
