Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT:PROCESS MODELLING AND SIMULATION[CHE 403]

REVISED CREDIT SYSTEM
(25 /11/2016)

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.
- Draw Information flow diagram wherever necessary.

1. A fluid at a velocity V is flowing through the unsteady state shell and tube heat exchanger of diameter D. The heat exchanger is steam heated. Neglect the wall resistance. Derive the explicit centered difference equations and develop a dynamic response for such exchangers. Briefly write the solution procedure. **20**

2A. Derive using the method of Newton –Raphson , the dew point temperature for Vapor liquid equilibrium calculation for multi component mixture. **06**

2B. The chlorination of benzene produces mono-chlorobenzene (C_6H_5Cl), di-chlorobenzene($C_6H_4Cl_2$) and tri-chlorobenzene($C_6H_4Cl_3$) with reaction rate of K_1, K_2, K_3 respectively. The reaction is exothermic and carried out in semi-batch reactor fitted with cooling coils and reflux condenser. Develop model equations for maximizing the yield of the products formed. **14**

3A. A water level in a municipal reservoir has been decreasing steadily during a dry spell, and there is a concern that the drought could continue for another 60 days. The local water company estimates that the consumption rate in the city is approximately 10^7 liters/day. The state conservation service estimates that the rainfall and stream drainage into reservoir coupled with evaporation from the reservoir should yield a net water input rate of $10^6\ e^{-t/100}$ liters /day, where t is the time in days from the beginning of the drought, at which time the reservoir contained an estimated 10^9 liters of water. Calculate the reservoir volume at the end of 60 days of continued drought. **08**

3B. Consider steady state laminar flow of fluid at constant density in a long tube of length, L and radius, R. The tube is inclined at an angle β from the horizontal. Derive the shear stress and velocity profile by performing shell balance on a thin cylindrical shell. State all the assumption. **12**

4A. Find the molar volume of CO_2 at 200K and 6.8 atm using Redlich-Kwong equation of state given by

$$P = \frac{RT}{(V-b)} - \frac{\alpha a}{V(V+b)}$$

12

Where a= 0.37 m^6.Pa/ mol^2

b = 2.97*10^{-5}

α = 1.34

Take R= 8.314 m^3.Pa/ mol.L (1 atm = 1.103 *10^5Pa)

Use Wegstein method. (three iteration only)

4B.	Develop the mathematical model of the steady state co-current and counter current flow heat exchange in a double pipe heat exchanger. List all the assumptions. Briefly explain the solution procedure.	**08**
5.	Derive the design equations for a multi component pipe line flasher. Discuss about the model for establishing temperature in the flasher and how the overall heat transfer coefficient is found. Draw the IFD.	**20**
6A	Write down the step by step procedure for modeling a process.	**10**
6B.	Classify the models based on variation of various independent variables, state of the process and type of the process.	**3**
6C.	What are the limitations of modeling.	**4**
6D.	Write briefly about degree of freedom.	**3**

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