Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

II SEMESTER M.TECH. (CHEMICAL ENGINEERING)

SEMESTER EXAMINATIONS, APRIL/MAY- 2017

SUBJECT:**PROCESS MODELLING ANALYSIS AND SIMULATION**[CHE 5202]

(22 /04/2017)

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer ALL questions.
- Missing data may be suitably assumed.
- Draw Information flow diagram wherever necessary.

1. Develop a mathematical model for dynamic response of the unsteady state one dimensional heat conduction through a rod. Derive the finite difference equations to determine the temperature distribution in the rod . List all the assumptions. Briefly write the solution procedure. **20**

2A. Write down the benefits of process modeling and simulation **10**

2B. Briefly explain about (i) Mechanistic model (ii) Empirical model (iii) Stochastic model (iv) Probabilistic model with examples. **10**

3A. An agitated $2m^3$ tank is initially filled with water at 25 ^oC. A steam coil with an area of 0.5 m^2 heats the water using steam condensing at 120^oC. The heat transfer coefficient for heating is 1140 $J/s.m^2.K$. The tank losses heat to the surrounding through the walls which have an area of 9 m^2. The heat transfer coefficient for heat losses is 10 $J/s.m^2.K$ and the surrounding temperature is 25^oC .How long will it take to heat the water to boiling point. Neglect the heat capacity of the tank walls. (Take water Cp = 4187 J/Kg.K) **10**

3B. Determine the dynamic response of components in a continuous stirred tank reactor when the volume of the tank is V , the inlet and outlet total volumetric flow rate is F_o and F, the inlet concentration of A is $C_{Ao,}$ for the following two cases

Case 1: A gives B and C with rate constants K_1 & K_2 respectively.(parallel reaction)

Case 2: A→B→C with reaction rate K_1 and K_2 respectively(series reaction) **10**

4A. Find the roots of the following equations

$3x^2 – 2y^2 = 1$

$x^2 - 2x + y^2 + 2y = 8$

Assume $x_o = -1$ and $y_o = 1$, for three iteration. **12**

4B. Derive using the method of Newton –Raphson , the Dew point temperature for Vapor- liquid equilibrium calculations, for multi component mixture. **08**

5. A gaseous mixture of components A and B is separated by permeating this mixture through a semi-permeable material. The apparatus used for this operation consists of a thin walled glass tube enclosed in a larger tube, through which the gaseous mixture flows at a high pressure. Gas permeates from the shell side, flows through the wall of the inner tube and out, while the remaining gas on the shell side flows out at the other end . This arrangement allows the gases on the shell side and the tube side to flow counter-currently. Suppose that gas A permeates through the wall of the glass tube much faster than gas B, the gas flowing out of the inner tube will be greatly enriched in component A. Set up the model equations to compute the flow rates and pressure inside the tube **20**

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