Scheme of Evaluation

Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH(CHEMICAL) END SEMESTER EXAMINATIONS - DEC, 2020

SUBJECT: PROCESS MODELLING AND SIMULATION [CHE 4101]

REVISED CREDIT SYSTEM
(23/12/2020, AN)

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer ALL questions.
- Missing data may be suitably assumed.

1A Write the general modeling equations for a ternary equilibrium column of five stages including condenser and reboiler for a multi-component distillation column. List all the assumptions. **05**

1B. Draw a neat information flow diagram for feed tray , reboiler and Condenser for a ternary equilibrium column of five stages including condenser and reboiler for a multi-component distillation column **05**

2A. Determine the dynamic response of component A in a continuous stirred tank reactor when the volume of the tank is V , the inlet and outlet total volumetric flow rate is F , the inlet concentration is constant at Co , and the initial concentration of component A in the tank is zero. Component A undergoes a first-order reaction in the tank and the rate constant K varies with temperature i.e $K = K_o - at^2 \quad (sec^{-1})$ **05**

2B. An electric heating coil is immersed in a stirred tank. Solvent at 15°C with heat capacity 2.1 kJ kg^{-1} $°C^{-1}$ is fed into the tank at a rate of 15 kg h^{-1}. Heated solvent is discharged at the same flow rate. The tank is filled initially with 125 kg of cold solvent at 10°C. The rate of heating by the electric coil is 800 W. Calculate the time required for the temperature of the solvent to reach 60°C. **05**

3A. Solve the following system of equations using Newton- Raphson method

$x^3 - 5x^2 + 2x - y + 13 = 0$

$x^3 + x^2 - 14x - y - 19 = 0$

Take x_o=8 and y_o=10 . Perform 2 iteration **05**

3B. Write down the step by step procedure for modeling any process in chemical engineering. **05**

4A. Derive Finite difference method for solving Heat equation. **05**

4B. Develop the mathematical model of the steady state counter current and co-current flow heat exchange in a double pipe heat exchanger. Give brief solution procedure. **05**

5. Consider an enclosed tank where the following reversible reaction takes place:

$$A+B <=> C+D.$$

K_1 and K_2 are rate constant for forward and backward reaction respectively. The inflow F_1 passes through a fixed inlet valve from a pressure source P_1 and the pressure downstream side is P_2. Whereas the pressure, upstream and downstream side of the outlet valve is P_2 and P_3 respectively with a flow rate of F_2. The flow is influenced by level Z and the pressure.

5A. Derive the relation for flow rate and Pressure across one of the valve. **3**

5B. Obtain a relation between temperature of compression and volume of the entrapped gas in the tank **3**

5C. Write the component balance equations. **2**

5C. Draw the information flow diagram. **2**

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