Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH(CHEMICAL) END SEMESTER EXAMINATIONS - March, 2021

SUBJECT: PROCESS MODELLING AND SIMULATION [CHE 4101]

REVISED CREDIT SYSTEM
(17/03/2021, AN)

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

Instructions to Candidates:

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

1A	Derive the center difference technique and develop the mathematical model for the dynamic response of an unsteady state counter current shell and tube heat exchanger for a change in inlet tube temperature. Briefly explain the solution procedure.	**08**
1B.	Write any four disadvantage of modelling.	**02**
2	Solve the following system of equations using Newton- Raphson method $U^2 - 2U + V^2 - W + 1 = 0$ $UV^2 - U - 3V + VW + 2 = 0$ $UW^2 - 3W + VW^2 + UV = 0$ The initial value of U = 1, V = 2, W = 3 Perform 3 iteration	**10**
3A.	A three-component fluid mixture is to be partially separated by batch distillation in a still. The still is heated by a jacket maintained at temperature T_j by a jacket pressure controller. The heat flux from the jacket to the batch still is Q= UA(T_j-T).The liquid mixture is non-ideal. Construct a mathematical model to calculate the temperature and composition of the batch and distillate vapor during the first hour of operation. **Draw the information flow diagram**	**08**
3B.	Write briefly about degree of freedom.	**02**
4A.	What are lumped parameter and distributed parameter models? Explain with examples. What are the type of equations you get for steady state and unsteady state systems?	**04**
4B.	A tank containing 1000 kg water at 25 ˚C is heated using saturated steam at 130 ˚C. The heat transfer area provided by the coil is 0.3 m^2 , and the heat transfer coefficient is 220 (kcal)/m^2 h ˚C. The condensate leaves the coil as saturated steam. The tank has a surface area of 0.9 m^2 exposed to the ambient air. The tank exchanges heat through this exposed surface. For heat transfer to or from the surrounding air, the heat transfer coefficient is 25 (kcal)/m^2 h ˚C. If the air temperature is 20 ˚C, calculate the time required to heat the water to 80 ˚C.	**06**

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. The gas A permeates through the wall of the glass tube much faster than gas B and 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. Give briefly the solution procedure.**Draw the information flow diagram.**	**10**

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