Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH(CHEMICAL) END SEMESTER EXAMINATIONS - May, 2023

SUBJECT: PROCESS MODELLING ANALYSIS AND SIMULATION [CHE 5252]

(24/05/2023, FN)

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

Instructions to Candidates:

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

1A.	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.	**8**
1B.	Define the following (i) Model (ii) simulation (iii) white box model (iv) black box model	**2**
2A.	The auto catalytic thermal decomposition of a single compound A into two product B and C of which B is autocatalytic agent is given by $A \xrightarrow{K_1} B+C$, $A+B \xrightarrow{K_2} AB$, $AB \xrightarrow{K_3} 2B + C$. The reaction is carried in a batch reactor. Set up a model to calculate the concentration of A, B,C as a function of time. List the assumptions. Draw the IFD.	**7**
2B.	Differentiate between lumped and Distributed parameter model with examples	**3**
3A.	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 2 iteration	**5**
3B.	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.	**5**
4.	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	**10**

5A.	Write down the step by step procedure for modeling a process	**5**
5B.	Derive Rachford-Rice equation.	**5**

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