

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

### V SEMESTER B.TECH( CHEMICAL) END SEMESTER EXAMINATIONS - DEC, 2021

# SUBJECT: PROCESS MODELLING AND SIMULATION [CHE 3153]

REVISED CREDIT SYSTEM(OPE) (21 /12/2021, FN)

#### Time: 75 min

#### MAX. MARKS: 20

## **Instructions to Candidates:**

- ✤ Answer ALL questions.
- Missing data may be suitably assumed.
- ✤ Do not draw IFD
- 1A Develop the mathematical model of the steady state counter current flow heat exchange in a double pipe heat exchanger. Give brief solution 04 procedure.
- **1B.** Derive Finite difference method for solving Heat equation.
- **1C.** It is desired to produce substance B from raw material A in a CSTR of effective volume of  $V(m^3)$ , If  $q(m^3/min)$  of solution of A of concentration Co , is fed to the empty reactor and the chemical reaction in which all the reactions are first order.

 $A \stackrel{\kappa_1}{\underset{\kappa_2}{\leftarrow}} B \stackrel{\kappa_3}{\to} C$ 

Show that the number of moles of B in the initial discharge from the reactor is given by the solution of differential equation.

$$\frac{d^2 N_B}{dt^2} + P \frac{d N_B}{dt} + R N_B = C$$

Where  $P = K_1 + K_2 + K_3$ ;  $R = K_1 \times K_3$ ;  $C = q_o C_o K_1$ 

**2A.** Consider a tank where 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. Write the model equations. Derive the relation of Flow rate and Pressure across one of the valve.

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2B.	Solve the following system of equations using Newton- Raphson method $x^3 - 5x^2 + 2x - y + 13 = 0$ $x^3 + x^2 - 14x - y - 19 = 0$	n method 03
	Take $x_0 = 8$ and $y_0 = 10$ . Perform 2 iteration	
2C.	Write down the characteristics of model. (6 points)	

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