BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: B.TECH. **SEMESTER : VII**
BRANCH: CHEMICAL ENGINEERING **SESSION : MO/2025**

SUBJECT: CL407 PROCESS MODELING, SIMULATION AND OPTIMIZATION

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	For a non-ideal distillation column, consider the feed tray that receives two feed streams – one liquid and one vapour. In addition, there are two side-stream draw-offs, one from the liquid phase and another from the vapour phase. (a) write the total continuity equation for the tray, (b) write the component continuity equation, (c) Write the energy balance for the tray.	[2.5]	1	3
Q.1(b)	The flow rate of oil in two perfectly mixed tanks in series is constant at 2.55 m^3/min. The density of the oil is 640 kg/m^3, and its heat capacity is 2.5 kJ/(kg.K). The volume of the first tank is constant at 13 m^3, and the volume of the second tank is kept constant at 2.5 m^3. The temperature of the oil entering the first tank is 65 °C. The initial temperature in the two tanks is 120 °C. The oil is heated in the first tank using steam. The rate of heat transferred to first tanks is equal to 15 000 kJ/min. Develop a transient mathematical model to describe the behavior of the temperature profile in both tanks as a function of time, and find the temperature of both tanks after 30 min.	[5]	1	3
Q.2	XYZ corporation located in Jharkhand has one production facility to produce liquid medical oxygen and it can meet the demand of several hospitals in the state. The estimated demand for liquid medical oxygen for the next four months is 10000 MT, 8000 MT, 12000 MT, and 9000 MT respectively. The plant has a regular time capacity of 8000 MT per month and an overtime capacity of 2000 MT per month. The cost of regular production is Rs 2 per MT, and the cost of overtime production is Rs 2.5 per MT. The plant can carry inventory to the next month, and the holding cost is Rs 3/MT/month. The demand must be met every month. Formulate a linear programming problem for the above situation (do not solve it).	[5]	2	5,6
Q.3	Given a multivariable function $$f(x,y) = x^2 + 4xy - y^2$$ determine if the function is concave or convex based on the eigen values of the Hessian matrix.	[2.5]	2	3
Q.4	Formulate a pseudocode for the Golden Section Search Method for minimization of a single variable unimodal function.	[5]	3	5
Q.5	Use the dichotomous search method to find the minimum of $$f(x) = 4x^3+x^2-7x+14$$ on the interval [0,1]. Perform two iterations of the dichotomous method and report the estimated minimizer (x*) after those two iterations. Use δ = 0.001.	[5]	3	3

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