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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**

Branch: Chemical Engineering **Duration: 3 hrs.**

Course Code: 23CH6PCPMS **Max Marks: 100**

Course: Process Modelling and Simulation

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	**Marks**
1	a)	What is mathematical modelling? Explain the classification of mathematical models in detail.	*CO1*	*PO2*	**15**
	b)	Briefly explain the principles of formulation.	*CO1*	*PO2*	**05**
		OR			
2	a)	Define modeling, and brief about its importance.	*CO1*	*PO2*	**06**
	b)	Explain briefly the fundamental laws involved in model building.	*CO1*	*PO2*	**14**
		UNIT - II			
3	a)	Derive the dynamic energy balance for a non-isothermal CSTR with a perfectly mixed cooling jacket. Clearly state all assumptions.	*CO3*	*PO4*	**10**
	b)	Develop the mathematical model for a gas-phase pressurized CSTR undergoing a first-order reaction A→B. Assume ideal gas behaviour and constant volume.	*CO3*	*PO4*	**10**
		OR			
4	a)	Explain the modeling of two heated tanks in series. Derive the governing equations for temperature variation in each tank and discuss the impact of heat input.	*CO3*	*PO4*	**10**
	b)	Write the model equations for a bioreactor involving Monod kinetics. Explain how substrate consumption and biomass growth are related. What is the significance of the yield coefficient?	*CO3*	*PO4*	**10**
		UNIT - III			
5	a)	Two long concentric cylindrical metallic shells of radii r_1 and r_2 are separated by a solid insulating material. The inner and outer cylindrical surfaces are maintained at constant temperatures T_1 and T_2, respectively. Develop the steady-state temperature distribution in the radial direction assuming no internal heat generation.	*CO3*	*PO4*	**10**

		b)	Derive an expression for the effectiveness of heat transfer through a fin (extended surface) of finite length, assuming one-dimensional steady-state conduction, constant thermal conductivity, and negligible heat generation.	CO3	PO4	**10**
			OR			
	6	a)	A closed vessel of total surface area 40 m^2 is heated through this surface by condensing steam at a temperature of 100 °C. The vessel is charged with 600 kg of liquid having a heat capacity of 2512 J/kg K at a temperature of 25°C. If the process is controlled by a heat-transfer coefficient of 142 W/m^2K. Find out the temperature of the liquid after 1 h.	CO3	PO4	**05**
		b)	Develop a mathematical model for the unsteady-state steam heating of a liquid contained in a perfectly mixed tank. Assume no heat losses, constant steam temperature, and constant properties.	CO3	PO4	**15**
			UNIT - IV			
	7	a)	Develop a mathematical model for a multicomponent adiabatic flash drum in which a high-pressure, high-temperature feed stream is flashed to a lower pressure. Assume steady-state operation, constant molar overflow, and thermodynamic equilibrium between vapor and liquid phases. Write the necessary mass and energy balance equations along with vapor-liquid equilibrium (VLE) relations.	CO 2	PO3	**12**
		b)	Explain the importance of any three activity co-efficient models in simulating the chemical process with the relevant equations.	CO1	PO2	**10**
			OR			
	8	a)	Write the equations describing an ideal distillation column used to separate binary component mixture. List the assumptions and nomenclature used clearly.	CO2	PO3	**10**
		b)	Derive the total continuity and energy balance equations for a single-component vaporizer, assuming negligible vapor-phase dynamics. Discuss the assumptions made.	CO2	PO3	**10**
			UNIT - V			
	9	a)	Explain the various tools used in process simulation. Discuss their features, advantages, and limitations. Give at least two examples of commercial simulation software.	CO6	PO12	**10**
		b)	Differentiate between the Modular Approach and the Equation Solving Approach in process simulation. Highlight their advantages and typical applications.	CO6	PO12	**10**
			OR			
	10	a)	What is flowsheeting in process simulation? Describe its role and importance in modelng complex chemical processes.	CO6	PO12	**10**
		b)	Explain the concept of dynamic simulation and its applications. How does it differ from steady-state simulation? Discuss its role in process optimization.	CO6	PO12	**10**

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