Q. Code: 993880

Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, DEC 2019

First Semester

CL18103 – PROCESS MODELING AND SIMULATION

(Chemical Engineering)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	Distinguish between steady state and unsteady state model.	1	U
2.	Write unsteady state mass balance equation for isothermal CSTR.	1	U
3.	Give the importance of precedence ordering while simulating a chemical process.	2	U
4.	What does flow-sheeting mean in analysis of chemical processes?	2	U
5.	Write the velocity profile equation for a laminar flow of an incompressible Newtonian fluid through a pipe.	2	AP
6.	State the importance of degree of freedom analysis.	3	U
7.	Mention the numerical methods used for solving ordinary differential equations.	3	AP
8.	Write general energy balance equation.	3	R
9.	What is stochastic modeling?	4	U
10.	Mention the Hierarchy in model development.	4	U

PART B - (5 X16 = 80 Marks)

11.	(a)		Explain in detail about the classification of mathematical models with examples.	(16)	1	U
			(OR)			
	(b)	(i)	Discuss briefly about the Conservation laws and auxiliary relations used in mathematical modeling of chemical process.	(10)	1	U
		(ii)	Write the limitations for process simulation.	(6)	1	U
12.	(a)	(i)	List the structural components of general purpose of sequential modular and equation oriented approach for steady state simulation.	(10)	2	AP
		(ii)	Discuss why modeling assumptions are important in the building of a model.	(6)	2	AP

(OR)

	(b)	(i)	Develop a mathematical model for Non-isothermal CSTR in Which an exothermic reaction A $\longrightarrow$ B takes place. The reactor is provided with a Cooling jacket for the removal of heat. Assume constant holdup in the reaction vessel.	**(10)**	**2**	**AP**
		(ii)	Derive a mathematical model for a batch reactor.	**(6)**	**2**	**AP**
13.	(a)		Derive the mathematical model for an ideal binary distillation column. The feed is at liquid state. Clearly state all the assumptions involved if any. Perform the degrees of freedom analysis.	**(16)**	**3**	**AN**
			(OR)			
	(b)		Develop the steady state, liquid phase dynamics, liquid and vapour phase dynamics and thermal equilibrium model for a LPG Vapourizer.	**(16)**	**3**	**AN**
14.	(a)		Consider a tubular reactor in which the following reaction takes place. Component A reacts irreversibly and at a specific reaction rate k to form product, component B.	**(16)**	**3**	**AP**

$$A \xrightarrow{k} B$$

As a slice of material moves down the length of the reactor the concentration of the reactant C_A decreases as A is consumed. Density ρ, velocity v, and concentration CA can all vary with time and axial position z. Assume plug flow conditions so that there are no radial gradients in velocity, density or concentration. Develop a mathematical model to simulate the tubular reactor. Clearly specify the various assumptions used in deriving the model.

(OR)

	(b)		Discuss the unsteady state distributed model for mass transfer in packed bed absorption column.	**(16)**	**3**	**AP**
15.	(a)		Write short notes on following i) Empirical modeling with an example ii) Parameter estimation.	**(16)**	**4**	**U**
			(OR)			
	(b)		Explain in detail about Population balance approach in mathematical modeling using an example.	**(16)**	**4**	**U**