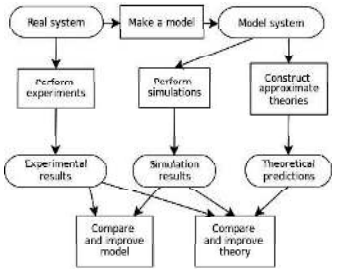
16CH308 PROCESS MODELING AND SIMULATION



Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
15	45	-	5	5	5

Course Description and Objectives:

This course deals with understanding physical systems in chemical engineering and to develop their mathematical models. The objective of this course is to train the student on the modeling and simulation techniques and their applications in chemical engineering systems.

Course Outcomes:

The student will be able to :

- develop model equations for a given system.
- solve models of various processes and unit operations using numerical methods.
- use process simulation as a tool for understanding a chemical process.

SKILLS:

- ✓ *Model development for a given engineering system.*
- ✓ *Write programs using Matlab.*
- ✓ *Solve process model equations using numerical techniques.*

ACTIVITIES:

- *Simulate modeling equations for a given system.*

UNIT - 1 **L-9**

FUNDAMENTALS : Mathematical models for chemical engineering systems, Fundamentals, Introduction to fundamental laws.

EXAMPLES OF MATHEMATICAL MODELS OF CHEMICAL ENGINEERING SYSTEMS : Constant and variable volume CSTRs in series, Two heated tanks.

UNIT - 2 **L-9**

EXAMPLES OF MATHEMATICAL MODELS OF CHEMICAL ENGINEERING SYSTEMS : Gas phase pressurized CSTR, Non-isothermal CSTR, Batch reactor, Reactor with mass transfer, Ideal binary distillation column.

UNIT - 3 **L-9**

NUMERICAL METHODS : Newton–Raphson method, False position method.

NUMERICAL INTEGRATION OF ODES : Euler method, Runge-Kutta fourth order method.

CLASSIFICATION OF MATHEMATICAL MODELING : Independent, Dependent variables and parameters, Classification based on variation of independent variables, Classification based on the state of the process, Classification based on type of the process, Boundary conditions.

UNIT - 4 **L-9**

MODELS IN REACTION ENGINEERING : Chemical reaction with heat transfer in a packed bed reactor.

MODELS IN HEAT TRANSFER OPERATIONS : Steady state heat conduction through a hollow cylindrical pipe, Unsteady state heat transfer by conduction.

UNIT - 5 **L-9**

COMPUTER SIMULATION EXAMPLES : Gravity flow tank, Three CSTRs in series, Batch reactor, Non-isothermal CSTR, VLE dew point, Bubble point calculations.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS: Total Hours-30

1. Simulation of gravity flow tank system.
2. Simulation of three constant holdup CSTRs in series.
3. Simulation of three variable holdup CSTRs in series.
4. Bubble point calculations.
5. Dew point calculations.
6. Simulation of interacting two tank liquid level systems.
7. Simulation of non – interacting two tank liquid level system.
8. Simulation of cone shaped tank.
9. Simulation of non-isothermal C.S.T.R.
10. Simulation of counter-current heat exchanger.

TEXT BOOKS:

1. W. L. Luyben, “Process Modeling, Simulation and Control for Chemical Engineers”, 2nd edition, McGraw-Hill, 1990.
2. B. V. Babu, “Process Plant Simulation”, Oxford University Press, 2004.

REFERENCE BOOKS:

1. K.Balu and K.Padmanabhan, “Modeling and Analysis of Chemical Engineering Processes”, IK International Private Limited, 2007.
2. Santosh.K. Gupta, “Numerical Methods in Engineering”, 2nd edition, New Age International (P) Ltd., 2003.