

Simulation and Modeling (3-1-3)

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Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objective:

- To introduce the details of modeling and simulation technologies to the students.
- To provide the students with the knowledge of discrete and continuous systems, generation of random variables, and analysis of simulation output and simulation languages.

Course Contents:

1. Introduction to Modeling and Simulation

(4 hrs)

- 1.1 System concept
- 1.2 System Environment
- 1.3 Stochastic Activities
- 1.4 Continuous and Discrete System
- 1.5 System Modeling
- 1.6 Types of Models
- 1.7 Principles of Modeling
- 1.8 Area of application
- 1.9 Verification and Validation of model

2. System Simulation

(8 hrs)

- 2.1 The Techniques of Simulation-Monte Carlo Method
- 2.2 Problems Depicting Monte Carlo Method
- 2.3 Comparison of simulation and analytical methods
- 2.4 Experimental nature of simulation
- 2.5 Types of system simulation
- 2.6 Distributed Lag Models
- 2.7 Cobweb Models
- 2.8 Steps of Simulation Study
- 2.9 Time advancement Mechanism
- 2.10 Queuing Models and its Characteristics
- 2.11 Queuing Discipline
- 2.12 Measures of queues, Single Server Queuing System

3. Continuous System

(8 hrs)

- 3.1 Continuous system simulation and system dynamics
- 3.2 Continuous system models
- 3.3 Differential equations-Linear differential equation
- 3.4 Non linear differential equation



- 3.5 Partial differential equation
- 3.6 -Analog computers
- 3.7 Components of analog computers
- 3.8 Analog methods
- 3.9 Hybrid computers
- 3.10 Digital analog simulators
- 3.11 Continuous system simulation language
- 3.12 CSMP III
 - 3.12.1 Structure Statements
 - 3.12.2 Data Statements
 - 3.12.3 Control Statements
 - 3.12.4 Hybrid Statements
- 3.13 Feedback System
- 3.14 Interactive system
- 3.15 Real time simulation
- 3.16 Predator pray model

4. Discrete System Simulation

(8 hrs)

- 4.1 Discrete system simulation
- 4.2 Representation of time
- 4.3. Generation of arrival patterns
- 4.4 Simulation of telephone system
- 4.5 Gathering statistics
- 4.6 Counters and summary statistics
- 4.7 Measuring Utilization and Occupancy
- 4.8 Recording distribution and transit time
- 4.9 Discrete simulation languages

5. Probability Concepts and Random Number Generation

(5 hrs)

- 5.1 Probability concepts in simulation- Stochastic variable
- 5.2 Discrete Probability function
- 5.3 Continuous Probability function
- 5.4 Random numbers
- 5.5 Properties of random numbers
- 5.6 Pseudo random number
- 5.7 Technique for generation of random number
- 5.8 Test for Random number generation
 - 5.8.1 Uniformity test (K-S test and Chi-square test)
 - 5.8.2 Independence test (Runs test and Auto Correlation test)

6. Simulation languages

(6 hrs)

- 6.1 Types of simulation languages
- 6.2 Discrete systems modeling and simulation with GPSS
- 6.3 GPSS programs applications
- 6.4 SIMSCRIPT -Organization of a SIMSCRIPT program
- 6.5 SIMSCRIPT programs.



7. Analysis of Simulation Output -

(6 hrs)

- 7.1 Nature of the Problem
- 7.2 Estimation methods
- 7.3 Simulation run statistics
- 7.4 Replication of run
- 7.5 Elimination of Initial Bias

Laboratory:

Develop a simulation model, the topic could be either initiated by the student or selected from a list provided by the instructor. An oral presentation with a demonstration should be part of the laboratory project report.

Text Books:

- 1. G. Gordon, *System Simulation*, Prentice Hall of India.
- 2. A.M. Law and W.D. Kelton, *Simulation Modeling and Analysis*, McGraw Hill, 1991

References:

- 1. J.A. Priest and G.C. Vansteenkiste, *Computer-Aided Modeling and Simulation*, Academic Press.
- 2. A.M. Law and R.F. Parry, *Simulation: A Problem-solving approach*, Addison Wesley Publishing Company.
- 3. Narsingh Deo, "System Simulation with Digital Computer"

