Simulation and Modeling

Course Title: Simulation and Modeling   **Full Marks:** 60 + 20 + 20
Course No: CSC328   **Pass Marks:** 24 + 8 + 8
Nature of the Course: Theory + Lab   **Credit Hrs:** 3
Semester: V

Course Description: The syllabus consists of introduction to system, modeling and simulation of different types of systems. It includes the modeling of systems, its validation, verification and analysis of simulation output. It comprises the concept of queuing theory, random number generation as well as study of some simulation languages.

Course Objective: To make students understand the concept of simulation and modeling of real time systems.

Course Contents:
Unit 1: Introduction to Simulation (6 Hours)
System and System Environment, Components of System, Discrete and Continuous System, System Simulation, Model of a System, Types of Model, Use of Differential and Partial differential equations in Modeling, Advantages, Disadvantages and Limitations of Simulation, Application Areas, Phases in Simulation Study

Unit 2: Simulation of Continuous and Discrete System (7 Hours)
Continuous System Models, Analog Computer, Analog Methods, Hybrid Simulation, Digital-Analog Simulators, Feedback Systems
Discrete Event Simulation, Representation of time, Simulation Clock and Time Management, Models of Arrival Processes - Poisson Processes, Non-stationary Poisson Processes, Batch Arrivals; Gathering statistics, Probability and Monte Carlo Simulation

Unit 3: Queuing System (6 Hours)
Characteristics and Structure of Basic Queuing System, Models of Queuing System, Queuing notation, Single server and Multiple server Queueing Systems, Measurement of Queueing System Performance, Elementary idea about networks of Queuing with particular emphasis to computer system, Applications of queuing system

Unit 4: Markov Chains (2 Hours)
Features, Process Examples, Applications

Unit 5: Random Numbers (7 Hours)
Random Numbers and its properties, Pseudo Random Numbers, Methods of generation of Random Number, Tests for Randomness - Uniformity and independence, Random Variate Generation

Unit 6: Verification and Validation (4 Hours)
Design of Simulation Models, Verification of Simulation Models, Calibration and Validation of the models, Three-Step Approach for Validation of Simulation Models, Accreditation of Models

Unit 7: Analysis of Simulation Output (4 Hours)
Confidence Intervals and Hypothesis Testing, Estimation Methods, Simulation run statistics, Replication of runs, Elimination of initial bias

Unit 8: Simulation of Computer Systems (9 Hours)
Simulation Tools, Simulation Languages: GPSS, Case Studies of different types of Simulation

Models and Construction of sample mathematical models

Laboratory Work:
Practical should include the simulation of some real time systems (continuous and discrete event systems), Queuing Systems, Random Number generations as well as study of Simulation Tools and Language

Text Book:
1. Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicole, "Discrete Event system simulation", 5th Edition, Pearson Education

Reference Books:
1. Geoffrey Gordon: System Simulation
2. Law, "Simulation Modeling and Analysis", 5th Edition, McGraw-Hill