NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. Computer Science and Engineering
Course Code:	2CSDE88
Course Title:	Simulation and Mathematical Modeling
Course Type:	Departmental Elective
Year of Introduction:	2021-22

Credit Scheme

L	T	Practical Component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. illustrate the need of simulation and mathematical modeling in Computer Science
2. demonstrate system activities through simulation
3. apply mathematical modelling to different real life applications
4. analyze behaviour of the system under various circumstances

Syllabus: **Total Teaching hours: 30**

Unit	Syllabus	Teaching hours
Unit-I	**System Models & System Studies:** the concepts of a system, System environments, System modeling, types of models, Monte Carlo Method, Random Walks, types of system simulation, mathematical modeling cycle	03
Unit-II	**Probability Concepts in Simulation:** Stochastic variables, discrete/continuous probability functions, measures of probability, uniform random number generator, generating discrete distributions, non-uniform distributed random numbers, rejection methods	05
Unit-III	**Arrival Patterns & Service Times:** Congestion in systems, Arrival patterns, Poisson arrival patterns, Erlang/hyper-exponential/normal distribution, queuing disciplines & measures, mathematical solutions of queuing, utilization as a design factor	04
Unit-IV	**Discrete System Simulation:** Discrete events, generation of arrival patterns, simulation of a telephone system, delayed calls, simulation programming tasks, gathering statistics, counters & summary statistics, measuring utilization & occupancy, recording distribution & transit times, discrete simulation languages	04
Unit-V	**Analysis of Simulation Output:** Nature of the problem, estimation methods, simulation run statistics, replication of runs, elimination of	04

	initial bias, batch means, regenerative techniques, time series analysis, spectral analysis, autoregressive process	
Unit-VI	**Simulation Tools and Software:** Study of FSM and Harel's state charts: describing a system as a state machine, developing state charts using Matlab/Simulink tool, Synchronous reactive model building using Esterel	04
Unit-VII	Optimization techniques, Applications in different domains such as biology, sports, economics etc.	06

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings/ References:

1. Sheldon Ross,Simulation , Academic Press.
2. Law & Kelton, Simulation Modeling & Analysis, Tata Mcgraw Hill
3. Vahid & Givargis, Embedded Systems Design-A Unified Hardware/Software Approach, Wiley Productions
4. Geoffrey Gordon, System Simulation, PHI
5. Kai Velten, Mathematical Modeling and Simulation: Introduction for Scientists and Engineers, Wiley.

Suggested List of Experiments:

Sr. No.	Practical Title	Hours
1	To implement a Monte Carlo simulation for estimating the value of Pi.	02
2	To implement a random number generator (random variate) following a specific distribution.	02
3	To simulate a single server queuing model.	02
4	To simulating a multi-server queuing model and calculate its performance parameters.	02
5	To implement discrete event system simulation for telephone example.	04
6	To simulate an elevator system using Harel's statecharts	04
7	To simulate Esterel based synchronous events.	04
8	To simulate an inventory management system.	04
9	To simulate an optimized resource allocation technique.	04
10	To analyse an auto regressive model for time series data.	02

Suggested Case List: -NA-