NIRMA UNIVERSITY
Institute of Technology
B Tech, Computer Science and Engineering
Semester-VI
Department Elective-III

L	T	P	C
2	0	2	3

Course Code	2CSDE73
Course Title	Stochastic Processes and Simulation

Course Outcomes:

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

1. define basic concepts in the theory of stochastic processes
2. solve simple problems on stochastic processes
3. implement simple stochastic simulation using computer programs.

Syllabus

Teaching Hours: 30

Unit I **08**

Principles of Monte Carlo Methods: Introduction, Strong law of large numbers, Examples of Monte Carlo methods, Almost sure convergence, Buffon's needle, Neutron Transport Simulations, Stochastic numerical methods for partial differential equations, Simulation algorithms for simple probability distributions, Uniform distributions, Discrete distributions, Gaussian Distributions, Cumulative distribution function inversion, Exponential distributions, Rejection method, Discrete-time martingales,

Unit – II **04**

Non-asymptotic Error Estimates for Monte Carlo Methods: Convergence in law and characteristic functions, Central limit theorem, Asymptotic confidence intervals, Logarithmic sobolev inequalities, Concentration inequalities, Absolute confidence intervals, Elementary variance reduction techniques, Control variate, Importance sampling.

Unit – III **08**

Poisson Processes as Particular Markov Processes: Quick introduction to Markov processes, Some issues in Markovian modelling, Rudiments on processes, Sample paths and Laws, Poisson properties: Characterization, Properties, Point processes and poison processes, Simple and strong Markov property, Superposition and decomposition, Simulation and approximation, Simulation of inter-arrivals, Simulation of independent Poisson processes, Long time or large intensity limit, Applications.

Unit-IV **10**

Variance Reduction, Girsanov's Theorem, and Stochastic Algorithms: Variance Reduction and Stochastic Differential Equations, Importance of Sampling Method, Stochastic Algorithms, Study in an Idealized Framework, Variance Reduction for Monte Carlo Methods

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.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings^:

1. Carl Graham, Denis Talay, Stochastic Simulation and Monte Carlo Methods, Springer
2. Liliana Blanco Castaneda, Viswanathan Arunachalam and S. Dharmaraja, Introduction to Probability and Stochastic Processes with Applications, Wiley

L=Lecture, T=Tutorial, P=Practical, C=Credit

^this is not an exhaustive list