Discipline Specific Core (DSC) Course 2b: Stochastic Processes

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (15 Hours)	Practical (00 Hours)		
DSC 2b: Stochastic Processes	4	3	1	0	NIL	NIL

Course objectives:

- To develop awareness for the use of stochastic models for representing random phenomena evolving in time such as inventory or queueing situations or stock prices behavior

Course Learning Outcomes: After successful completion of this course, student will be able to:

- Use notions of long-time behaviour including transience, recurrence, and equilibrium in applied situations such as branching processes and random walk.
- Construct transition matrices for Markov dependent behaviour and summarize process information
- Use selected statistical distributions for modeling various phenomena.
- Understand the principles and objectives of model building based on Markov chains, Poisson processes and Brownian motion.

Unit I (12 Hours)

Review of Basic Probability Concepts. Introduction to Stochastic Processes. Deterministic and Stochastic Exponential Growth Models. Stationary and Evolutionary Processes. Poisson Processes: Poisson distribution and Poisson Process. Arrival, Interarrival and Conditional Arrival Distributions. Nonhomogeneous Processes. Law of Rare Events and Poisson Process. Poisson Point Process. Distributions associated with Poisson Process. Compound Poisson Processes.

Unit II (12 Hours)

Markov Chains: Transition Probability Matrices, Chapman- Kolmogorov equations, Some Examples and Classification of States, Regular Chains and Stationary Distributions, Periodicity, Limit theorems. Some Applications. Patterns for recurrent events: One-dimensional, two-dimensional and three-dimensional random walks.

Unit III (11 Hours)

Brownian Motion: Limit of Random Walk, Its Defining Characteristics and Peculiarities. Its Variations: Standard Brownian Motion, Brownian Bridge, Brownian Motion Reflected at Origin, Geometric Brownian Motion, Brownian Motion with Drift. Reflection Principle. Some Applications.

Unit IV (10 Hours)

Renewal Processes: Preliminaries, Elementary Renewal Theorem, Delayed Renewal Processes. Limit Theorems. Martingales: Definitions and Some Examples, Stopping Times, Martingale Stopping Theorem, Wald Equation.

Tutorial:

Tutorial sessions will include at least one activity such as group discussion/presentation/ problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

Essential Readings:

1. Medhi, J. (2009). *Stochastic Processes*, New Academic Science.
2. Ross, S.M. (1996). *Stochastic Processes*, John Wiley & Sons.
3. Taylor, H.M. and Karlin, S. (1998). An Introduction to Stochastic *Modelling*, Academic Press.

Suggested Readings:

1. Bhat, B.R. (2000). *Stochastic Models-Analysis and Applications*, New Age International Publishers.
2. Feller, William (1968). *An Introduction to Probability Theory and its Applications*, Vol. 1, John Wiley & Sons.
3. Karlin, S. and Taylor, H.M. (1975). *A first course in Stochastic Processes*, Academic Press.
4. Prabhu, N.U. (2007). *Stochastic Processes: Basic Theory and its Applications*, World Scientific.