Discipline Specific Elective (DSE) Course 4c: Applied Stochastic Processes

Structure 1: PG Curricular Structure with only Course Work
Structure 2: PG Curricular Structure with Course Work + Research
Structure 3: PG Curricular Structure with Research only

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)		
DSE 4c: Applied Stochastic Processes	4	3	1	0	NIL	Basic knowledge of probability

Course Objectives:

1. To provide understanding of mathematical challenges from a purely applied perspective for a majority of random processes in terms of sequence of event-time pairs.

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

- Make assumptions about the way in which scenarios based on random processes develop.
- Create realistic models for real time situations and to seek solutions to systems-oriented problems.
- Construct approximate theoretical solutions and simulation analysis.
- Theoretical derivations and results based on theorems are exhaustively dealt with.

Unit I (11 Hours)

Discrete Time Markov Chain: Deterministic and Stochastic approach to SIS Epidemic Model, Chain Binomial Greenwood and Reed-Frost Models. Determination of size and Duration. Review of Mathematical expectation, Generating Functions, Central Limit Theorem. Poisson Process: Generator Matrix, Kolmogorov Differential Equations, Stationary Probability Distribution.

Unit II (11 Hours)

General Birth and Death Process, Simple Birth and Simple Death with Immigration, Population Extinction, First Passage Times, Logistic Growth Processes.

Unit III: (13 Hours)

Continuous Time Markov Chain: Deterministic and Stochastic approach to SIR Epidemic Model. Determination of size and Duration. Deterministic and Stochastic approach to Competition Process. Deterministic and Stochastic approach to Predator-Prey Process.

Unit IV: (10 Hours)

Diffusion Process and Stochastic Differential Equations. Some Applications.

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. Bailey, N.T.J. (1964). *The Elements of Stochastic Processes*, John Wiley & Sons.
2. Renshaw, Eric (2015). *Stochastic Population Processes: Analysis, Approximations, Simulations*, Oxford University Press.
3. Ross, S. M. (1996). *Stochastic Processes*, John Wiley & Sons.

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. I, John Wiley & Sons.
3. Karlin, S. and Taylor, H.M. (1975). *A first course in Stochastic Processes*, Academic Press.
4. Lange, K. (2010). *Applied Probability*, Springer.
5. Prabhu, N.U. (2007). *Stochastic Processes: Basic Theory and its Applications*, World Scientific.
6. Taylor, H.M. and Karlin, S. (1998). *An Introduction to Stochastic Modelling*, Academic Press.