Category IV

BSc. Physical Sciences/ Mathematical Sciences with Operational Research as one of the three Core Disciplines
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

DISCIPLINE SPECIFIC CORE COURSE – 5: STOCHASTIC MODELLING AND APPLICATIONS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Stochastic Modelling and Applications (DSC-5)	4	3	0	1	Class XII with Maths	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To make the students familiar with the concept of stochastic modeling and its applications in the field of queueing theory, reliability theory and inventory management.
- To provide students a rigorous mathematical framework to develop mathematical models for different queueing systems.
- To introduce students with the concept of system reliability and make them learn to evaluate reliability of various system configurations.
- To make students learn how to model uncertainties in demand in inventory management problems.
- To provide students hands-on experience of analyzing queueing, reliability and inventory models through practical sessions using certain software.

Learning Outcomes

Students completing this course will be able to:

- Learn the concepts of stochastic processes, Markov processes, Markov chains and apply these mathematical models in real-life problems.
- Understand the concepts and mathematical theory related to queuing systems & system reliability required to understand, analyse and solve any real-world problem.
- Evaluate the performance metrics of any queuing system.

- Compute the system reliability of any type of system-configuration.
- Understand and develop stochastic inventory models.
- Make use of software for problem analysis.

Syllabus of DSC-5

Unit I: Introduction **(9 Hours)**

Basics of random variables, Probability distributions and their moments, Some standard probability distributions: Binomial, Poisson, Normal, Exponential, Random (stochastic) processes, Lack of memory property of exponential distribution, Markov process, Pure-birth process, Pure-death process.

Unit II: Introduction to Queueing Systems **(12 Hours)**

Characteristics of a queueing system, Kendall's notation, Performance measures of a queueing system, Markovian queueing models with single & multiple servers, and finite & infinite system capacity – M/M/1, M/M/c.

Unit III: System Reliability **(12 Hours)**

Introduction to reliability, Reliability function and related concepts like hazard rate, mean time to failure (MTTF), and mean time before failure (MTBF), Classes of lifetime distributions, Hazard rate of exponential and Weibull distributions, Reliability of various system configurations- series, parallel, mixed configuration, k out of n system and stand-by systems.

Unit IV: Stochastic inventory models **(12 Hours)**

Introduction to stochastic inventory models, Single period probabilistic inventory models with discrete and continuous demand.

Practical component (if any) [30 Hours]:

Practical/Lab to be performed using OR/Statistical packages

- Finding measures of performance for deterministic queuing system.
- Finding measures of performance for M/M/1 queuing system with infinite capacity.
- Finding measures of performance for M/M/1 queuing system with finite capacity.
- Finding measures of performance for M/M/c queuing system with infinite capacity.
- Measuring reliability of different types of system configuration.
- Measuring reliability, hazard rate and MTSF of different types of system configuration.
- Finding optimal inventory policy for probabilistic inventory model with discrete demand.
- Finding optimal inventory policy for probabilistic inventory model with continuous demand.

Essential/recommended readings

- Gross, D., Shortle, J. F, Thompson J. M., & Harris, C. M. (2008), *Fundamentals of Queuing Theory* (4th edition), New Jersey, John Wiley & Sons, inc.
- Rausand, M. & Hoyland, A. (2003), *System Reliability Theory: Models, Statistical Methods & Applications* (2nd edition), New Jersey, John Wiley & Sons, Inc.

- Rau, John G. (1970), *Optimization and Probability in Systems Engineering,* New York, Van Nostrand Reinhold Inc., U.S.
- Ross, S.N. (2008), *Stochastic Processes* (2nd edition), Wiley India Pvt. Ltd.
- Water, D. (2008). *Inventory control and management.* (2nd Edition). John Wiley & Sons.

Suggestive readings

- Hadley, G. and Whitin, T. M. (1979), *Analysis of Inventory Systems*, D. B. Taraporevala and Sons, Published by arrangement with Prentice Hall Inc.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.