| **Devi Ahilya University, Indore, India Institute of Engineering & Technology** | | | | **III Year B.E. (Electronics and Telecommunication)** | | | |
|---|---|---|---|---|---|---|---|
| **Subject Code & Name** | **Instructions Hours per Week** | | | **Credits** | | | |
| **ETR6E5** | **L** | **T** | **P** | **L** | **T** | **P** | **Total** |
| **MODELING AND SIMULATION** | **3** | **1** | **2** | **3** | **1** | **1** | **5** |
| **Duration of Theory Paper: 3 Hours** | | | | | | | |

## Learning Objectives:

- To give exposure of stochastic processes and to show their importance in engineering education and research
- To develop skills to identify a process, its inputs and outputs. Then to develop a model and quantify the results.
- To give an hands on experience in MATLAB to be used as a simulation tool for the stochastic processes
- To develop an orientation towards research in electronics and computer engineering.

**Prerequisites:** Fundamental knowledge of Probability Theory

## COURSE CONTENTS

**UNIT –I**

Introduction to Probability Theory -Relative Frequency and Classical Definitions, Sample Space and Events, Conditional Probabilities, Independent Events, Bayes Formula, Bernoulli Trials.

**UNIT –II**

Random Variables- Definition, Discrete Random Variables, Probability mass Function , Distrribution Functions: Bernoulipmf, Bionomialpmf, Geometric pmf, Poisson pmf, ContinuousRandom Variables, Cumulative Distribution Function(CDF), Probability Density Function (PDF), Exponential Distribution, Reliability and failure rate, Normal Distribution, Uniform Distribution. Mean, Variance and Moments of Random Variables, Function of a Random Variable and it's Expectation, Jointly Distributed Random Variable.

**UNIT –III**

Markov Chains- Classification of stochastic process, Introductionto Markov chains, Classification of States, Transition Probabilities, Limiting State Probabilities, HigherTransition Probabilities, Concept of Transient States and Absorption Probabilities, Solution of Problems Based on Markov Chains.

**UNIT –IV**

Markov Processes -Introduction to Continues Time Markov Chains, Birthand Death Processes, The Transition Probability Function, Limiting Probabilities, Exponential Distribution & Poison Process. Solution of Problems Based on Continuous Time Markov Chains, Introduction to Queuing Theory and M/M/1 Queuing Systems.

**UNIT –V**

Simulation- Simulation of Queues, Statistical Inference and FewExamples on Simulation
Estimation of Mean and Variance, Confidence Interval, Regression and Correlation analysis

## Learning Outcomes:

Upon Completing the Course, Student will able to:

- Describe basic characteristics of systems, and illustrate these descriptions using simple examples.
- Distinguish between modelling methods that are suitable for continuous-time, discrete-time, discrete-event, and hybrid systems, and apply these methods to simple systems.
- Build performance metrics into a system model and interrogate these metrics to appraise the performance of different system configurations or designs.
- Use industry-relevant simulation tools to model the performance of semi-realistic case study systems.
- Organise a modelling and simulation workflow, and apply a workflow to address performance questions related to a system.

## BOOKS RECOMMENDED:

[1]. S.M. Ross, "Introduction to Probability Models, 9th Edition, Elsevier Publication", 2007.
[2]. K.S.Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition , A Wiley-Interscience Publication.
[3]. Averill M. Law,W. David Kelton, "Simulation Modeling and Analysis", 3rd Edition, Tata McGraw-Hill Publication.
[4]. A Papoulis, S.VPillai, "Probability Random Variables and Stochastic Processes", 4th Edition, TMH Publication, 2002.

## List of Practical Assignments:

- To become familiar with the MATLAB and Simulink environments.

- To learn to construct state space, transfer function and block diagram models of dynamical systems and to simulate these models in MATLAB and Simulink.