II Year: ODD SEMESTER

INTERDISCIPLINARY ENGINEERING SCIENCE COURSE-1 (ESC)
EC201- PROBABILITY AND RANDOM PROCESSES

Details of course: -

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Probability and Random Processes	3	1	0	Basic engineering Mathematics, basics of Signals and Systems

Course Objective:
To introduce the principles of probability theory and random processes for their application in electronics and communication engineering, signal processing, machine intelligence and Natural language Processing.

Course Outcomes:

1. Demonstrate the basic principles of probability and use of axioms of probability to prove basic theorems
2. Calculate the probability density functions, Cumulative distribution function and statistical averages of continuous, discrete and mixed random variables
3. Compute the correlation and Covariance of random vectors and estimate the unknown parameters
4. Analyze the spectral analysis of stochastic random process through LTI systems and explore its statistical Parameters
5. Apply the special classes of random process and apply the same to solving realistic situation

S. No.	Content	Contact Hours
Unit 1	Introduction to the Theory of Probability, Axioms of Probability, Repeated Trials, Introduction to Random Variables (RVs), Probability Distributions and Density Functions, Conditional Distribution and Density Functions, Function of one Random Variable, Statistical Averages: Mean, Variance and Moments and Characteristic Functions. Specific RVs: Uniform Distribution, Exponential Distribution, Gaussian Distribution, Rayleigh RV, Chi-Square, Rician Distribution, Nakagami-m Distribution, Bernoulli RV, Binomial RV, Poisson RV.	10
Unit 2	Two Random Variables, Joint Density and Distribution Function of Two Random Variables, Marginal Density and Distribution function,	8

	Correlation, Covariance, Vector Space of Random Variables, Joint Moments, Joint Characteristic Functions, Joint Conditional Densities, Sequences of Random Variables.	
Unit 3	Correlation Matrices, Covariance Matrices and their Properties, Conditional Densities of Random Vectors, Characteristic Functions and Normality, Markov Inequality, Tchebycheff Inequality and Estimation of an Unknown Parameter and Cauchy-Schwarz Inequality, Central Limit Theorem, Law of Large Numbers (LLN).	8
Unit 4	Introduction to Stochastic Process, Statistical Averages for Random Processes: Mean, Autocorrelation, Cross correlation, Autocovariance and Cross covariance. Stationary Processes, Wide-sense stationary Processes, Time average, Ergodicity and Ergodic Processes, Classification of Random processes: uncorrelated, orthogonal, statistically independent, Cyclo stationary Processes. Introduction to Spectral Analysis: Power Spectral Density. Transmissions of Random Processes through LTI Systems: System Response, Mean and Autocorrelation of the Output, PSD of the output.	8
Unit 5	Random walks: Introduction, random walks on graphs, modelling stochastic process and random walk analysis in biology. Probabilistic Forecasting techniques: Montecarlo simulations, Bayesian forecasting, Time series analysis and applications of forecasting techniques in Finance weather etc. Markov Chains: Introduction, Markov chain applications in Natural language processing.	8
Total		42

Books: -

S. No.	**Name of Authors /Books / Publishers**
1.	Probability, Random Variables and Stochastic Processes by Athanasios Papoulis and S. Unnikrishna Pillai, MGH, India Edition, 4th Edition
2.	Probability and Random Processes with applications to Signal Processing, H. Stark and J. W. Woods, Pearson Education, 3rd Edition
3.	Probability and Random Processes: With Applications to Signal Processing and Communications, Scott L. Miller and Donald G. Childers, 2nd Edition
4.	Probability and random processes for electrical engineers, Alberto leon-Garcia, 3rd dition
5.	Principles of Forecasting: A hand book for researchers and practitioners, 1st edition