JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

COLLEGE OF ENGINEERING (Autonomous) PULIVENDULA

II B.Tech II Sem (E.C.E) **L – T – P – C** **3 – 0 – 0 – 3**

PROBABILITY THEORY AND STOCHASTIC PROCESSES

COURSE OBJECTIVES:

1. To study the probability theory and operations on single random variable.
2. To understand multiple random variables and operations on them.
3. To gain knowledge of random processes and their temporal characteristics.
4. To describe spectral characteristics of random processes.
5. To analyze the linear systems with stationary random process as input.

UNIT I

Probability: Probability introduced through sets and relative frequency**:** experiments and sample spaces, discrete and continuous sample spaces, events, probability definitions and axioms, mathematical model of experiments, probability as a relative frequency, joint probability, conditional probability, total probability, Bayes' theorem, independent events, problem solving.

The Random Variable: Definition of a random variable, conditions for a function to be a random variable, discrete, continuous, mixed random variable, distribution and density functions, binomial, Poisson, uniform, Gaussian, exponential, Rayleigh, conditional distribution, conditional density, properties. Expectation of a random variable, moments-moments about the origin , central moments, variance and skew, Chebyshev's inequality, moment generating function, characteristic function, problem solving.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the concept of probability theory and random variables.
- Solve problems related to single random variable and operations on them.

UNIT II

Multiple Random Variables: Vector random variables, joint distribution function, properties of joint distribution, marginal distribution functions, conditional distribution and density – point conditioning, interval conditioning, statistical independence, sum of two random variables, sum of several random variables, central limit theorem, (proof not expected), unequal distribution, equal distributions.

Operations on Multiple Random Variables: Expected value of a function of random variables, joint moments about the origin, joint central moments, joint characteristic functions, jointly Gaussian random variables: two random variables case, n random variable case, properties of Gaussian random variables, transformations of multiple random variables.

Learning Outcomes:

At the end of the unit, the student will be able to

- Gain knowledge on multiple random variables.
- Evaluate statistical properties of multiple random variables.

UNIT III

Random Processes-Temporal Characteristics: The random process concept, classification of processes, deterministic and nondeterministic processes, distribution and density functions, concept of stationarity and statistical independence, first-order stationary processes, second-order and wide-sense stationarity, n-order and strict-sense stationarity. Time averages and Ergodicity, mean-Ergodic processes, correlation-Ergodic processes, autocorrelation function and its properties, cross-correlation function and its properties, covariance functions, Gaussian random processes, Poisson random process.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand the concept of random processes and Ergodic random processes.
- Analyze the concepts and properties of auto correlation and cross correlation.

UNIT IV

Random Processes-Spectral Characteristics: The power density spectrum and its properties, relationship between power spectrum and autocorrelation function, the cross-power density spectrum and its properties, relationship between cross-power spectrum and cross-correlation function.

Learning Outcomes:

At the end of the unit, the student will be able to

- Understand and analyze spectral characteristics of random processes.
- Learn the relationship between power spectrum and correlation.

UNIT V

Random Signal Response Of Linear Systems: System response – convolution, mean and mean squared value of system response, autocorrelation function of response, cross- correlation functions of input and output, spectral characteristics of system response: power density spectrum of response, cross-power density spectrums of input and output, band pass, band limited and narrowband processes, properties.

Noise Definitions: White Noise, colored noise and their statistical characteristics, Ideal low pass filtered white noise, RC filtered white noise.

Learning Outcomes:

At the end of the unit, the student will be able to

- Analyze the response of linear systems for random inputs.
- Understand the concepts of noise and their statistical characteristics.

TEXT BOOKS:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4th Edition, TMH,2002.

2. Athanasios Papoulis and S. UnnikrishnaPillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI,2002.

REFERENCES:

1. Simon Haykin, "Communication Systems", 3rd Edition, Wiley,2010.
2. Henry Stark and John W.Woods, "Probability and Random Processes with Application to Signal Processing," 3rd Edition, Pearson Education,2002.
3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis," 3rd Edition, Oxford,1999.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

1. Understand the probability theory and operations on single random variable.
2. Perform operations on multiple random variables.
3. Gain knowledge of random processes and their temporal characteristics.
4. Describe spectral characteristics of random processes.
5. Analyze the linear systems with stationary random process as input.