PROBABILITY THEORY AND STOCHASTIC PROCESSES

UNIT I -PROBABILITY AND RANDOM VARIABLE

Probability - Introduction of probability, Set definitions, Operations on sets, Laws of algebra of sets.**Experiments and sample spaces -** Introduction of experiments and sample spaces. **Discrete and Continuous sample spaces -** Introduction of discrete and continuous sample spaces. **Events -** Introduction of events.**Probability definitions and axioms -** Introduction to probability Definitions and Axioms,Theorems on probability. **Mathematical model of experiments -** Mathematical (or) classical definition of probability, Example problems, Mathematical tools, Example problems. **Probability as a relative frequency -** Introduction to probability as a relative frequency. **Joint Probability -** Joint probability, Example. **Conditional probability -** Introduction of conditional probability, Example problems. **Total probability and bay's theorem -** Theorem of total probability,Baye's theorem, Example problems. **Independent Events -** Independent events (multiplication law of probability), Example problems. **Random variable -** Introduction of random variable, Definition of random variable, Discrete, continuous and mixed random variable, Conditions for a function to be a random variable. **Discrete Random Variable -** Probability distribution function, Probability of mass function, Properties of discrete random variable, Example problems. **Continuous random variable -** Probability distribution function, Probability density function, Properties of continuous random variable, Example problems.

UNIT II -DISTRIBUTION AND DENSITY FUNCTION AND OPERATION ON ONE RANDOM VARIABLE – EXPECTATIONS

Binomial distribution - Introduction to binomial Distribution, Mean of binomial distribution, Variance of binomial distribution, Moment generating function, Example problems. **Poisson distribution -** Introduction to poisson distribution, Mean of poisson distribution, Variance of poisson distribution, Moment of generating function, Properties of poisson distribution 1, Properties of poisson distribution 2, Example problems. **Uniform Distribution -** Introduction to uniform distribution, Moment generating function of uniform distribution, Example problems. **Normal/Gaussian Distribution** - Introduction to gaussian/Normal distribution, Application of gaussian distribution, Characteristics of the gaussian distribution, Normal distribution as a limiting form of binomial distribution, Example problems. **Exponential distribution -** Introduction to exponential distribution, Exponential distribution, Example problems, Memoryless property of the exponential distribution, Example problems. **Rayleigh density function -** Introduction to rayleigh density function. **Conditional distribution -** Introduction to conditional distribution, Properties of conditional distribution. **Conditioning event -** Introduction to conditioning event. **Conditional density function -** Conditional density Function, Conditional density properties, Example. **Introduction of a random variable -** Introduction, Expected value of a random variable, Properties, Example problems. **Moments -** Moments about the origin, Central moments. **Variance and Skew -** Introduction of variance, Properties of variance,Example problems, Introduction of Skew. **Chebychev's inequality -** Chebychev's inequality,Example problems. **Characteristic function -** Introduction of characteristic function,Properties of characteristic function, Example problems.

Moment generating function - Introduction of moment generating function,Property of moment generating function,Example problems. **Transformation of a random variable -** Introduction,Monotonic transformation of a continuous random variable,Nonmonotic transformation of a continuous random variable, Transformation of a discrete random variable.

UNIT III -MULTIPLE RANDOM VARIABLES AND OPERATIONS

Random vector concept - Random vector concept, Sum of two random variables. **Joint Distribution Function –** Introduction, Properties, Example problems. **Joint Density Function –** Introduction, Properties, Example problems.**Conditional Distribution and Density Function -** Introduction of conditional distribution function, Properties of conditional distribution function, Introduction of conditioning event, Introduction of conditional density function, properties of conditional density function, Point conditioning, Internal conditioning, Example problems.**Statistical independence of random variables –** Introduction, Example problems.**Sum of random variables –** Introduction, Two random variables, Multiple random variables, Example problems. **Central limit theorem –** Introduction, Unequal distribution, Equal distribution. **Expected value of a function of random variable -** Expected value of a function of random variable, Example problems. **Joint moments -** Joint moment about origin, Properties of correlation, Joint central moments, Properties of correlation, Example problems. **Joint characteristic function -** Introduction of joint characteristic function, Properties of joint characteristic function, Theorem, Example problems. **Gaussian random variable -** Two random variables, N random variables, Example, Properties of gaussian random variables. **Transformation of random variable -** Transformation of random variables,Example **.Linear transformation of a gaussian random variable -** Linear transformation of a gaussian random variable,Example problems.

UNIT IV - STOCHASTIC PROCESS - TEMPORAL CHARACTERISTICS

Random Processes - Introduction, Classification of random process, Distribution and density functions, Statistical averages. **Stationary random process -** Stationary random process, Example problems. **Ergodic random process -** Ergodic random process, Time averages and ergodicity, Mean ergodic process, Example problems. **Auto correlation function -** Correlation techniques, Auto covariance, Properties Auto-correlation. **Cross correlation function -** Cross correlation, Properties of Cross Correlation, Example problems. **Linear systems -** Introduction, Linear and time invariant systems, Impulse response of the linear systems, Linear time invariant systems, Transfer function of LTI system, Causal systems, Stable systems, Ideal systems, Example problems. **Linear system with random inputs -** Introduction, System response, Mean value of output response, Mean square value of output response, Auto - correlation function of response, Cross - correlation function of input and output, Properties, Example problems. **Gaussian random process -** Gaussian random process. **Poisson random process -** Introduction, Steady state and transient state systems, Poisson process, Arrival theorem, Example problems.

UNIT V - STOCHASTIC PROCESSES - SPECTRAL CHARACTERISTICS

Power spectral density - Power Density Spectrum, Average Power of the Random Process, Auto correlation Function(ACF) of a Random Process, Example problems, Properties of the Power Density Spectrum, Wiener Khinchine Theorem (Property 6), Example problem, Bandwidth of the Power Density Spectrum, Example problems. **Cross-power density spectrum -** Cross power density spectrum, Average cross power, Properties of cross power density spectrum, Example problems, Relationship between cross power spectrum and cross correlation function, Example problems. **Spectral Characteristics of System Response -** Introduction, Power Spectral Density of Y(t), Cross Spectral Density of Input X(t) and Output Y(t), Example problems.