Course Code	Course Title	L	T	P	J	C
ECE2005	PROBABILITY THEORY AND RANDOM PROCESSES	3	0	0	0	3
Prerequisite:	ECE1004 – Signals and Systems					

Course Objectives:

- To discuss the concepts of discrete and continuous random variables and to calculate the parameters such as mean and variance.
- To apply vector space concepts in random signal processing.
- To classify various types of probability distributions that occurs frequently in communication and signal processing.
- To associate the concept of strong law of large numbers and the role of Central limit theorem in the convergence of the random variables.
- To illustrate the concept of random process in WSS and SSS with the importance of Ergodicity and its real time applications.
- To estimate the power spectral density for a given random signal

Expected Course Outcome

The students will be able to

1. Obtain probability law (distribution) for a set of output random variables.
2. Identify a specific distribution to be used for a particular random data.
3. Interpret the concept of convergences in random signals from different applications.
4. Describe the random signals in terms of its average properties such as average power in the random signal and its spectral distribution.
5. Model and analyze the effect of noise in electronic circuits used in communication systems

Student Learning Outcomes (SLO): 1, 9 , 18

Module:1	Multiple Random Variables:	6 hours	SLO: 1

Introduction to Random Variables – Vector Random Variables- Joint Distribution and its Properties-Joint Density and its Properties – Conditional Distribution and Density-Statistical Independence –Distribution and Density of a Sum of a Random Variables – Central Limit Theorem.

Module:2	Operations on Multiple Random Variables:	4 hours	SLO: 1

Joint Moments – Joint Central Moments – Joint Characteristics Function – Jointly Gaussian Random Variables – Transformations of Multiple Random Variables – Linear Transformation of Gaussian Random Variables – Complex Random Variables

Module:3	Random Processes – Temporal Characteristics:	4 hours	SLO: 9

Random Process-Stationarity-Independence-Correlation Functions and its Properties -

Measurement of Correlation functions-Gaussian Random Processes- Poisson Random Processes-Complex Random Processes			
Module:4	**Random Processes – Spectral Characteristics:**	**2 hours**	**SLO: 9**
Power Density Spectrum and its Properties-Cross PSD and its properties, Relationship between Correlation and Power Spectrum-Power Spectrum for Discrete Time Processes and Sequences Power Spectrum of Complex Processes.			
Module:5	**Linear Systems with Random Inputs:**	**4 hours**	**SLO: 1**
Linear system Fundamentals-Random Signal Response of Linear Systems-Product Device response to a Random Signal- Spectral Characteristic of System Response.			
Module:6	**Noise:**	**4 hours**	**SLO: 1**
Definitions-System Evaluation using Random noise-Spectral Characteristic of System Response for Noise-Noise Bandwidth – Band pass – Band limited – Narrow Band Processes			
Module:7	**Modelling of Noise Sources:**	**4 hours**	**SLO: 18**
Resistive Noise Sources – Arbitrary Noise Sources – Effective Noise Sources-Noise Temperature-Noise Figure-Incremental Modelling of Noisy Networks- Modelling of Practical Noisy Networks Signal to Noise Ratio – Mean Square Error- Optimization by Parameter Selection- Matched Filter for Colored Noise- Matched Filter for White Noise-Practical Applications			
Module:8	**Contemporary Issues**	**2 hours**	
	Total Lecture Hours:	**30 hours**	

Text Book(s):	
1.	P.Z. Peebles, "Probability, Random Variables and Random Signal Principles", 2017, 4th edition, McGraw Hill, New Delhi, India.
Reference Books:	
1.	Papoulis and S.U. Pillai, "Probability, Random variables and stochastic processes", 2017, 4th edition, McGraw Hill, New Delhi, India.
2.	Hwei Hsu, "Probability, Random variables, Random Processes", 2017, Schaums outline series, McGraw Hill, New Delhi, India.
3.	Robert M. Gray, Lee D. Davisson, "An Introduction to Statistical Signal Processing", 2011, Cambridge University Press, India.
4.	H. Stark and J.W. Woods, "Probability and Random Processes with Applications to Signal processing", 2012, International Edition, Pearson Education, India.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).