Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC504	Random Signal Analysis	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECC504	Random Signal Analysis	20	20	20	80	03	25	--	125

Course Pre-requisite:

ECC401- Engineering Mathematics IV
ECC404 - Signals and Systems

Course Objectives:

1. To strengthen the foundations of probability
2. To teach continuous and discrete random variables.
3. To explain statistical behavior of one dimensional and two dimensional random variables.
4. To describe the concept of random process which is essential for random signals and systems encountered in Communications and statistical learning.
5. To develop problem solving skills and explain how to make the transition from a real world problem to a probabilistic model.

Course Outcomes:

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

1. Apply theory of probability in identifying and solving relevant problems.
2. Differentiate continuous and discrete random variables and their distributions.
3. Analyze mean, variance, and distribution function of random variables and functions of random variables.
4. Define a random process, determine the type of the process and find the response of LTI system for WSS process.
5. Explain linear regression algorithms and apply for predictive applications.

Module No.	Unit No.	Topics	Hrs.
1.0		**Basic Concepts in Probability**	**04**
	1.1	Definitions of probability, joint, conditional, and total probability, Bayes' theorem, independence of events, binary symmetric communication channel analysis using Bayes' theorem.	
2.0		**Introduction to Random Variables**	**08**
	2.1	Continuous, discrete, and mixed random variables, probability density function, probability distribution function, and probability mass function, properties of PDF and CDF	
	2.2	Special distributions- Binomial, Poisson, Uniform, Gaussian and Rayleigh Distributions Mean, variance and moments of random variables	
3.0		**Operations on One Random Variable**	**08**
	3.1	Function of a random variable and their distribution and density functions.	
	3.2	Expectation, variance, moments, and characteristic function of random variable.	
	3.3	Transformation of a random variable, Markov and Chebyshev inequality, characteristic functions, moment theorem.	
4.0		**Multiple Random Variables and Convergence**	**08**
	4.1	Pairs of random variables, joint CDF and joint PDF.	
	4.2	One function of two random variables; joint moments, covariance and correlation-independent, uncorrelated and orthogonal random variables.	
	4.3	Central limit theorem and its significance	
5.0		**Random Processes**	**06**
	5.1	Definitions, statistics of stochastic processes, n^{th} order distribution, second-order properties: mean and autocorrelation, Poisson process, normal processes, SSS, WSS.	
	5.2	Mean and correlation ergodic processes, transmission of WSS through LTI system, introduction to Markov process.	
6.0		**Introduction to Statistical Learning and Applications**	**05**
	6.1	Regression and model building, simple linear regression, multiple linear regression, least square estimation of the coefficients, residual calculations.	
	6.2	Applications of simple linear regression in prediction of new observations.	
		Total	**39**

Text Books:

1. T. Veerarajan, "Probability, Statistics and Random Process", Tata McGraw Hill Education, Third Edition (2018).
2. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables, and Stochastic Processes", Tata McGraw Hill Education
3. Henry Stark & John Woods, "Probability, Statistics, and Random Processes for Engineers, 4th Edition, Pearson Education, 2012

4. Douglas C. Montgomery, Elizabeth A. Peck and G. Geoffrey Vining, "Introduction to linear regression Analysis", student edition, Wiley publications.

Reference Books

1. Scott Miller and Donald Childers, "Probability and Random Processes with Applications to Signal Processing and Communications", Elsevier Publication.
2. Hwei Hsu, "Theory and Problems of Probability, Random Variables, and Random Processes", Schaum's Outline Series, McGraw Hill, 1997.
3. P. Ramesh Babu, "Probability Theory and Random Process", Tata McGraw Hill Education.
4. Alberto Leon Garcia, "Probability and Random Processes for Electrical Engineering", second edition , Pearson education.
5. Daniela Witten, Trevor Hastie , Robert Tibshirani, "An Introduction to Statistical Learning by Gareth James", 7th Edition, Springer 2017.
6. Ronald Walpole, et. al., "Probability and Statistics for Engineers and Scientists", 8th edition, Pearson Education.
7. P. Kousalya, "Probability, Statistics, and Random Processes", Pearson Education.

NPTEL / Swayam Course:

1. Introduction to probability and Statistics, Prof. G. Srinivasan (IIT Madras); https://onlinecourses.nptel.ac.in/noc21_ma01/preview
2. Probability and Probability Distributions By Dr. P.Nagesh: https://onlinecourses.swayam2.ac.in/cec21_ma02/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Term Work (25-Marks):

At least 08 Tutorials covering entire syllabus must be given during the "Class Wise Tutorial". Term work assessment must be based on the overall performance of the student with every tutorial graded from time to time. The grades will be converted to marks as per "Credit and Grading System" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.