INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**PROBABILITY THEORY AND STOCHASTIC PROCESSES**			
Course Code	A30405			
Regulation	**R13 – JNTUH**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	5	-	-	4
Course Coordinator	Ms. Mary Swarnalatha, Associate Professor, Department of ECE			
Team of Instructors	Mr. G. Anil Reddy, Assistant Professor, Department of ECE			

I. COURSE OVERVIEW:

The course addresses the concepts, principles and techniques of sets and probability and random variable and random process. The course teaches the fundamentals of probability applying the concepts of mean and variance and development techniques. This course forms the basis for the study of advanced subjects like signals and systems. Students will learn probability concepts and difference between random variable and random process and estimation of power spectral density.

PREREQUISITE(S):

Level	Credits	Periods/ Week	Prerequisites
UG	4	5	M1, M2

II. MARKS DISTRIBUTION:

Sessional Marks	University End Exam marks	Total marks
Midterm Test There shall be two midterm examinations. Each midterm examination consists of essay paper, objective paper and assignment. The essay paper is for 10 marks of 60 minutes duration and shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective paper is for 10 marks of 20 minutes duration. It consists of 10 multiple choice and 10 fill-in-the blank questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Assignments are usually issued at the time of commencement of the semester. These are of problem solving in nature with critical thinking. Marks shall be awarded considering the average of two midterm tests in each course.	75	100

III. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

4. COURSE OBJECTIVES:

1. To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering.
2. To introduce students to the basic methodology of randomness in nature and to apply it to problems
3. To understand basic concepts of probability theory, random variables, multiple random variables, Conditional probability, joint distribution stastical independence between random variables and expectation including mean square estimation.
4. To understand the difference between time averages and statistical averages.
5. Analysis of random process and application to the various fields.
6. To teach students how to apply sums and integrals to compute probabilities, means, and expectations.

V. COURSE OUTCOMES:

At the end of the course the students are able to:

1. Understand probabilities and able to solve using an appropriate sample space.
2. Compute various operations like expectations from probability density functions (pdfs) and probability distribution functions
3. Perform Likelihood ratio tests from pdfs for statistical engineering problems.
4. Mean and covariance functions for simple random variables.
5. Understand Auto-correlation and cross correlation properties between two random variables.
6. Explain the concept of random process, differentiate between stochastic and ergodic processes.
7. Explain the concept of power spectral density and power density spectrum of a random process.
8. Apply the principles of a random process in system concepts.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	An ability to apply knowledge of basic sciences, mathematical skills, engineering and technology to solve complex electronics and communication engineering problems (Fundamental Engineering Analysis Skills).	H	Assignments, Tutorials
PO2	An ability to identify, formulate and analyze engineering problems using knowledge of Basic Mathematics and Engineering Sciences. (Engineering Problem Solving Skills)	H	Hands on Practice Sessions
PO3	An ability to provide solution and to design Electronics and Communication Systems as per social needs (Social Awareness)	H	Lab Sessions
PO4	An ability to investigate the problems in Electronics and Communication field and develop suitable solutions (Creative Skills)	H	Hands on Practice
PO5	An ability to use latest hardware and software tools to solve complex engineering problems (Software and Hardware Interface).	H	Design Exercises

Program Outcomes		Level	Proficiency assessed by
PO6	An ability to apply knowledge of contemporary issues like health, Safety and legal which influences engineering design (Social Awareness).	S	Hands on Practice
PO7	An ability to have awareness on society and environment for sustainable solutions to Electronics & Communication Engineering problems (Social awareness).	S	Lab session
PO8	An ability to demonstrate understanding of professional and ethical responsibilities (Engineering impact assessment skills).	N	Presentation
PO9	An ability to work efficiently as an individual and in multidisciplinary teams (Team Work).	S	Design Exercises
PO10	An ability to communicate effectively and efficiently both in verbal and written form (Communication Skills).	N	Document Preparation, Presentation
PO11	An ability to develop confidence to pursue higher education and for life-long learning (Continuing education awareness)	S	Seminars, Discussions
PO12	An ability to design, implement and manage the electronic projects for real world applications with optimum financial resources (Practical engineering analysis skills).	H	Exercises

N - None S - Supportive H - Highly Related

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		LEVEL	PROFICIENCY ASSESSED BY
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	H	Lectures and Assignments
PSO 2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials

N - None S - Supportive H – Highly Related

VIII. SYLLABUS:

UNIT I

PROBABILITY and RANDOM VARIABLE:

Probability introduced through Sets and PROBABILITY: 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, and Independent Events.

RANDOM VARIABLE: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable.

UNIT II

Distribution and Density functions and OPERATION ON ONE RANDOM VARIABLE – EXPECTATIONS: Distribution and Density functions: Distribution and Density functions and Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties.

OPERATION ON ONE RANDOM VARIABLE – EXPECTATIONS : Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Nonmonotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable.

UNIT III

MULTIPLE RANDOM VARIABLES and OPERATIONS:

MULTIPLE RANDOM VARIABLES : Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – 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, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT IV

STOCHASTIC PROCESSES – TEMPORAL CHARACTERISTICS: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationary and Statistical Independence. First-Order Stationary Processes, Second-Order and Wide-Sense Stationary, (N-Order) and Strict-Sense Stationary, 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.

UNIT V

STOCHASTIC PROCESSES – SPECTRAL CHARACTERISTICS: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output of a linear system

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4th Edition, 2001.
2 Probability and random process- Scott Miler,Donald Childers,2 Ed,Elsevier,2012

REFERENCES:

1. Probability, Random Variables and Stochastic Processes – Athanasius Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.
2.Theory of probability and stochastic processes Pradeep kumar gosh, university press
3. Probability and Random Processes with Application to Signal Processing – Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
4. Probability Methods of Signal and System Analysis. George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition, 1999.
5. Statistical Theory of Communication - S.P. Eugene Xavier, New Age Publications, 2003.

IX. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes.

Subject: PTSP

Branch& Year: ECE-II **Semester: I** **Academic Year: 2015-201**

Lecture No	Learning Objective	Topics to be covered	Reference
L1	To know basic concepts of Probability and random variables	Probability and Random variables :Introduction	T1
L2	To know the basics about sets and relative frequency	Probability introduced through Sets and relative frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces	T1
L3	Introduction about events and probability	Events, Probability Definitions and Axioms, Mathematical Model of Experiments and Probability as a Relative Frequency	T1
L4	To know the concepts of joint and conditional probability	Joint Probability, Conditional Probability	T1
L5	Introduction to total probability and bayes theorem, the concept of independent events	Total Probability, Bayes' Theorem, Independent Events	T1
L6	Problems on events and probability	Problems	T1
L7	Problems on conditional and joint probability	Problem	T1,T2
L8	Problems on baye's theorem	Problems	T1,T2
L9	To know the basic concepts and definition of random variable	Random Variable,: definition, Conditions and its types	T1
L10	To know Conditions for a Function to be a Random Variable	Conditions for a Function to be a Random Variable	T1
L11	Introduction to distribution and density functions To know the concept of density function and properties	distribution and Density functions, properties	T1
L12	Understanding the problems on density and distribution functions	Problems on density and distribution functions	T1
L13	To know the concept of binomial distribution, Poisson distribution, uniform distribution	Binomial Distribution	T1
L14	To know the concept of Gaussian and Exponential distribution	Gaussian and Exponential Distribution	T1
L15	To know the concept of Rayleigh and conditional distribution	Rayleigh Distribution, Conditional Distribution	T1
L16	Introduction to methods of conditional event	Methods of defining Conditional Event	T1
L17	Introduction to conditional density and properties	Conditional Density, properties	T1
L18	To know the concept of moments about origin and central moments	Moments about the Origin, Central Moments	T1
L19	To know the concepts of variance and skew	Variance and Skew	T1
L20	Introduction to chebychev's inequality, characteristic function	Chebychev's Inequality, Characteristic Function	T1
L21	To know the concepts of moment generating function	Moment Generating Function	T1
L22	Problems and characteristic and moment generating functions, conditional density and variance and skew	Problems	T1
L23	To know the concepts of transformation of a random variable	Transformations of a Random Variable: Monotonic Transformations for a Continuous	T1

		Random Variable	
L24	To know the concepts of non monotonic transformations of continuous random variable	Non monotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable	T1
L25	Problems on monotonic and non monotonic transformation	Problems	T1
L26	To know the concepts of multiple random variables and operations	Multiple Random Variables and Operations: Vector Random Variables, Joint Distribution Function	T1
L27	To know the concepts of joint distribution properties	Properties of Joint Distribution	T1
L28	To know the concept of marginal distribution functions and conditional distribution	Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning	T1
L29	To understand the concept of Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables	Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables	T1
L30	Problems on conditional distribution and density function	Problems	T1
L31	Understand the concept of central limit theorem	Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal Distributions	T1
L32	Problems on central limit theorem	Problems	T1
L33	To understand the concept of operation on multiple random variables	Operations On Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin	T1
L34	To know the concepts of joint central moments to understand the concept of joint characteristic functions	Joint Central Moments Joint Characteristic Functions	T1
L35	To understand the concepts of jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case	Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case	T1
L36	To understand the properties and transformation of multiple random variables	Properties, Transformations of Multiple Random Variables	T1
L37	To understand the concepts of linear transformation of Gaussian random variables	Linear Transformations of Gaussian Random Variables	T1
L38	Problems on joint central moments Problems on joint characteristic functions and jointly Gaussian random variables	Problems	T1
L39	Problems on linear transformation of Gaussian random variables jointly Gaussian random variables	Problems	T1
L40	Understand the concept of The Random Process Concept,	The Random Process Concept	T1
L41	Classification of Processes, Deterministic and Nondeterministic Processes	Classification of Processes, Deterministic and Nondeterministic Processes	T1
L42	Understand the concept of Distribution and Density Functions, concept of Stationary and Statistical Independence	Distribution and Density Functions, concept of Stationarity and Statistical Independence	T1
L43	Understand the concept of First-Order Stationary Processes, Second- Order and Wide-Sense Stationary, (N-Order) and	First-Order Stationary Processes, Second-Order and Wide-Sense Stationary, (N-Order) and Strict-Sense Stationary	T1

	Strict-Sense Stationary		
L44	Understand the concept of Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes	Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes	T1
L45	Understand the concept of Autocorrelation Function and Its Properties	Autocorrelation Function and Its Properties	T1
L46	Understand the concept of Cross-Correlation Function and Its Properties	Cross-Correlation Function and Its Properties	T1
L47	Understand the concept of Covariance Functions	Covariance Functions	T1
L48	Understand the concept of Linear system response of mean and mean square value	Linear system response of mean and mean square value	T1
L49	Understand the concept of Gaussian Random Processes, Poisson Random Process	Gaussian Random Processes	T1
L50	Understand the concept of Poisson Random Process	Poisson Random Process	T1
L51	Problems on first and second order stationary process	Problems	T1
L52	Problems on wss and sss and time averages and ergodicty	Problems	T1
L53	Problems on auto-correlation and cross-correlation	Problems	T1
L54	To understand the concept of power spectrum	The Power Spectrum: Properties	T1
L55-56	Understand the relationship between power spectrum and acf	Relationship between Power Spectrum and Autocorrelation Function	T1
L57	Understand the concept of cross-pdf	The Cross-Power Density Spectrum, Properties	T1
L58	Understand the relationship between cross-pdf and ccf	Relationship between Cross-Power Spectrum and Cross-Correlation Function	T1
L59	Understand the concept of spectral characteristics and system response	Spectral Characteristics of System Response: Power Density	T1
L60	Understand the concept of spectrum response	Power Spectrum of Response	
L61-62	Understand the concept of cross-pdf of I/O linear system	Cross-Power Density Spectrums of Input and Output of a Linear System	T1
L63	Probems on power spectrum and cross-ps and pds	Problems	T1
L64	Problems on cross-pdf and ccf	Problems	T1

X. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Objectives	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
I	H	H				S					S		H	S	
II	S	H				H					S		H	S	
III		H				H					H		H	S	
IV	H	S				S					H		S	H	
V						S					H		S	H	
VI		H				S					H		S	H	

S - Supportive **H - Highly Related**

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
1	H	S		S		S					S		H	S	
2	H			S		S					H		H	S	
3				S									S		
4	S	H		H		H					S		S		
5	H	S		H		H					H		S	S	
6	H			S		S					S		H	S	
7	S			H		S					H		H	S	
8	S	H		H		H					S		S	S	

S - Supportive **H - Highly Related**

Prepared by: Ms G.Anilkumar Reddy, Assistant Professor

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