INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

Course Name	:	PROBABILITY THEOTY AND STOCHASTIC PROCESSES
Course Code	:	A30405
Class	:	II B. Tech I Sem
Branch	:	ECE
Year	:	2016 – 2017
Course Faculty	:	Ms.G.Mary swarna latha,G.Anilkumar reddy

OBJECTIVE : 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. This subject introduces students to the basic methodology of “probabilistic thinking” and to apply it to problems. And to understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation

S.No	QUESTION	BLOOMS TAXONOMY LEVEL	COURSE OUTCOME
	UNIT-1 **Probability and Random Variable** **SHORT ANSWER TYPE QUESTIONS**		
1	Define probability?	Remember	1
2	Explain probability with axioms?	Understand	1
3	Define conditional probability?	Remember	1
4	Define joint probability?	Remember	1
5	Define total probability?	Remember	1
6	Define bayes theorem?	Remember	1
7	Explain how probability can be considered as relative frequency?	Understand	1
8	Define a random variable?	Remember	1
9	Define a sample space?	Remember	1
10	Define multiplication theorem ?	Remember	1
	LONG ANSWER QUESTIONS		
1	State and prove bayes theorm	Remembering	1
2	State and prove total probability theorem?	Remembering	1

3	A man wins in a gambling game if he gets two heads in in five flips of a biased coin. The probability of getting a head with the coin is 0.7. 1. Find the probability the man will win. Should he play this game? 2. What is the probability of winning if he wins by getting at least four heads in five flips? Should he play this new game?	Analysis	1
4	In the experiment of throwing two fair dice, let A be the event that the first die is odd, B be the event that the second die is odd, and C is the event that the sum is odd. Show that events A, B and C are pair wise independent, but A, B and C are not independent.	Analysis	1
5	A certain large city averages three murders per week and their occurrences follows a Poisson distribution 1. What is the probability that there will be five or more murders in a given week? 2. On the average, how many weeks a year can this city expect to have no murders? 3. How many weeks per year (average) can the city expect the number of murders per week to equal or exceed the average number per week?	Remembering	2
6	A man matches coin flips with a friend. He wins 2 Rs if coins match and loses 2 Rs if they do not match. Sketch a sample space showing possible outcomes for this experiment and illustrate how the points map onto the real line x that defines the values of the random variable X=”dollars won on a trial”. Show a second mapping for a random variable Y=”dollars won by the friend on a trial”	Understanding	1
7	Explain total probability and conditional probability theorems with properties?	Understanding	2
8	Explain total probability theorem and bayes theorem with properties	Understanding	1
9	Spacecraft are expected to land in a prescribed recovery zone 80% of the time. Over a period of time, six spacecrafts land. 1. Find the probability that none lands in the prescribed zone 2. Find the probability that at least one will land in the prescribed zone	Understanding	2
10	Two cards are drawn from a 52 Cards 1. Given the first card is a queen, what is the probability that the second is also a queen? 2. Repeat part a) for the first card a queen and the second card a 7 3. What is the probability that both cards will be a queen?	Understanding	1
	ANALYTICAL QUESTIONS		

1	If a box contains 75 good diodes and 25 defective diodes and 12 diodes are selected at random, find the probability that at least one diode is defective.	Analyze	1
2	A box with 15 transistors contains five defective ones. If a random sample of three transistors is drawn, what is the probability that all	Analyze	2
3	A coin is to be tossed until a head appears twice in a row. What is the sample space for this experiment? If the coin is fair, what is the probability that it will be tossed exactly four times?	Apply	2
4	We are given a box containing 5000 transistors, 1000 of which are manufactured by company X and the rest by company Y. 10% of the transistors made by company X are defective and 5% of the transistors made by company Y are defective. If a randomly chosen transistor is found to be defective, find the Probability that it came.from company X.	Analyze	2
5	A batch of 50 items contains 10 defective items. Suppose 10 items are selected a random and tested. What is the probability that exactly 5 of the items tested are defective?	Analyze	1

UNIT II

Distribution & Density Functions and Operation on One Random Variable – Expectations

SHORT ANSWER TYPE QUESTIONS

1	Define probability density function?	Remember	2
2	Define probability distribution function?	Remember	2
3	Write any two properties of density function?	Remember	2
4	Write any two properties of distribution function?	Remember	2
5	Define uniform density function?	Remember	2
6	Define uniform distribution function?	Remember	2
7	Define Gaussian density function?	Remember	2
8	Define Gaussian distribution function?	Remember	2
9	Define Poisson distribution function	Remember	2
10	Define mean and mean square values?	Remember	3

LONG ANSWER QUESTIONS

1	Derive expressions for mean and variance for uniform random variable?	Analysis	4

2	Two Gaussian random variables X and Y have a correlation coefficient The standard deviation of X is 1.9A linear transformation (coordinate rotation of) is known to transform X and Y to new random variables that are statistically independent. What is variance of Y?	Evaluate	4
3	Explain density function with four properties	Remember	3
4	State and prove any four properties of distribution function?	UNDERSTAND	2
5	Derive expressions for mean and variance for Gaussian variable?	UNDERSTAND	2
6	Derive expressions for mean and variance for Poisson random	UNDERSTAND	2
7	Derive expressions for mean and variance for binomial random	UNDERSTAND	2
8	Derive expressions for mean and variance for exponential random variable?	UNDERSTAND	2
9	Derive expressions for mean and variance for Raleigh random variable?	UNDERSTAND	2
10	Explain characteristic function and moment generating function?	UNDERSTAND	2
	ANALYTICAL QUESTIONS		
1	A random variable X has probability density function $f_X(x) = \begin{cases} Cx(1-x) & ; \quad 0 \le x \le 1 \\ 0 & ; \quad else\ where \end{cases}$ i) Find C ii) Find $P\left[\frac{1}{2} \le X \le \frac{3}{4}\right]$ iii) Find $F_X(x)$	Apply	3
2	The characteristic function for a Gaussian random variable X, having a mean value of 0, is $\Phi_X(\omega)$ =EXP(-sigma ^{2}/w ^{2}) Find all the moments of X using Φ_X (w)	Apply	3
	UNIT III **Multiple Random Variables and Operations** **SHORT ANSWER TYPE QUESTIONS**		
	PART-A		
1	Define probability density function for two random variables?	Remember	2
2	Define probability distribution function for two random variables?	Remember	2
3	Give properties of probability density function?	Remember	2
4	Give properties of probability distribution function?	Remember	2
	PART-B		
5	If X and Y are orthogonal what is the value of co-variance?	Remember	2
6	Define the relation between joint moments and joint central moments for n random variables?	Remember	2
7	Define skew for two random variables?	Remember	2

8	Define correlation?	Remember	2
9	Define joint central moments for x and y random variables with n=4,k=5?	Remember	2
10	What is the expected value of 2x in the interval -10<x<10?	Remember	2
11	Define marginal density function $f_Y(y)$ function for joint Gaussian random variable?		
12	If x and y are orthogonal what is the value of Rxy?		
13	Define joint moments about the origin for n=4,k=5?		
14	If x and y are un-correlated what is relation between co-relation between x and y and individual expectations?		
15	What is the min and max value of co-relation co-efficient?		
16	Define joint central moments for x and y random variables?		
17	Define covariance?		
18	Define joint characteristic function for x and y random variables?		
19	Define the relation between joint moments and joint central moments for two random variables x and y?		
20	Define mean square value for two random variables?		
21	Define Gaussian random variables for two random variables x and y?		
22	Define joint Gaussian for n-random variables?		
23	Define the Jacobin matrix for n-random variables?		
24	Define the concept of transformation of multiple random variables?		
25	Write any two properties of joint Gaussian random variables?		
26	Define linear transformation of Gaussian random variables?		
27	Define second order central moments?		
28	Define first order central moments for two random variables x and y?		
29	If co-variance is 0 what it means?		
30	Define co-relation co-efficient?		
31	Define third order central moments for two random variables x and y?		

LONG ANSWER QUESTIONS

1	State and explain probability density function for two random variables?	Remember	2
2	State and explain probability distribution function for two random variables?	Remember	2
3	State any four properties of probability density function?	Remember	2
4	State any four properties of probability distribution function?	Remember	2
5	A random process X(t)=A ,where A is a random variable find the time average of the process.	Analysis	5
6	Explain briefly about time average and Ergodicity.	Understand	5
7	Explain how random processes are classified with neat sketches.	Understand	5
8	A random process is given as X(t)=At ,where A is an uniformly distributed random variable	Creating	5
9	State and prove any four properties of auto correlation function.	Remember	2
10	State and prove any four properties of cross correlation function.	Remember	2
ANALYTICAL QUESTIONS			
1	The joint PDF of X and Y is $f_{(X,Y)}(x, y) = 5y/4 \quad -1 \le x \le 1,\ x^2 \le y \le 1$, 0 otherwise. Find the marginal PDFs $f_X(x)$ and $f_Y(y)$	Analysis	2
2	The joint probability density function of random variables X and Y is $f_{X,Y}(x, y) = 6(x + y^2)/5 \quad 0 \le x \le 1,\ 0 \le y \le 1$, = 0 otherwise.	Analysis	2
3	X and Y have joint Pdf $f_{X,Y}(x, y) = -1/15 \quad 0 \le x \le 5,\ 0 \le y \le 3$, 0 otherwise. Find the PDF of W = max(X, Y)	Analysis	2

UNIT IV

Stochastic Processes – Temporal Characteristics:

SHORT ANSWER TYPE QUESTIONS

1	Define random process?	Remember	2
2	Define ergodicity?	Remember	2
3	Define mean ergodic process?	Remember	2
4	Define correlation ergodic process?	Remember	2
5	Define first order stationary process?	Remember	2
6	Define second order stationary process?	Remember	2

7	Define wide sense stationary random process?	Remember	2
8	Define strict sense stationary random process?	Remember	2
9	Define auto correlation function of a random process?	Remember	2
10	Define cross correlation function of a random process?	Remember	2
LONG ANSWER QUESTIONS			
1	Explain classification of random process	Understand	6
2	Explain wide sense stationary random process?	Understand	6
3	State and prove any four properties of cross correlation function.	Remember	2
4	State and prove any four properties of auto correlation function.	Remember	2
5	(a) State and prove the properties of Autocorrelation function. (b) Show that the process X(t)= A Cos (w_0t+θ) is wide sense stationery if it is assumed that A and w_o are constants and θ is random variable which is uniformly distributed over interval [0,2π].	Remember	2
6	(a) State and prove the properties of Cross correlation function. (b) Find the mean and auto correlation function of a random process X(t)=A , where A is continuous random variable with uniform distribution over (0,1).	Remember	2
7	(a) Write the conditions for a Wide sense stationary random process. (b) Let two random processes X(t) and Y(t) be defined by X(t) = A Cos(w_0t) + B Sin(w_0t) and Y(t) = B Cos(w_0t) - A Sin(w_0t). Where A and B are random variables and w_0 is constant. Show that X(t) and Y(t) are jointly wide sense stationery, assume A and B are uncorrelated zero- mean random variables with same variance.	Remember	2
ANALYTICAL QUESTIONS			
1	The power Spectral density of X(t) is given by S_{xx}(w)=1/1+w^2 for w>0 Find the autocorrelation function	Analysis	5
2	A random process is defined by Y(t)=X(t).cos(wt+ θ) where X(t)= Asin(wt+θ) is a wide sense stationary random process that amplitude modulates a carrier of constant angular frequency w with a Random phase θ independent of X (t) and uniformly distributed on (-π ,π).	Analysis	5
3	Show that the process X(t)= A Cos(w_0t+θ) is wide sense stationery if it is assumed that A and w_0 are constants and θ is uniformly distributed random variable over the interval (0,2π).	Analysis	5

UNIT V

Stochastic Processes – Spectral Characteristics:

SHORT ANSWER TYPE QUESTIONS

1	Define wiener khinchinen relations?	Remember	2
2	State any two properties of cross-power density spectrum.	Remember	2
3	Define cross –spectral density and its examples.	Remember	2
4	State any two uses of power spectral density.	Remember	2
5	Write any two properties of power spectral density?	Remember	2
6	Define Spectral density?	Remember	2
7	Write power spectral density of system response?	Remember	2
8	Write Cross power spectral density of input and output of system?	Remember	2
9	Prove that $S_{XY}(W) = S_{YX}(-W)$?	Remember	2
10	Prove that real part of S_{XY}(W is an even function?	Remember	2

LONG ANSWER QUESTIONS

1	A random processes X(t)= Asin(wt+θ) , where A , w are constants and θ is a uniformly distributed random variable on the interval (-π ,π) .find average power?	Understand	5
2	Prove wiener khinchinen relation?	Remember	2
3	Derive the expression for power spectral density ?	Remember	2
4	Derive the expression for average power of a random process x(t)?	Remember	2
5	Derive the expression for cross average power of a random process x(t) and y(t)?	Remember	2
6	Derive the Relationship b/w power density spectrum and auto co-relation function?	Remember	2
7	Derive the Relationship b/w cross power density spectrum and cross co-relation function?	Remember	2

ANALYTICAL QUESTIONS

1	Let the auto correlation function of a certain random process X (t) be given by $R_n(\tau) = (A^2/2)(\cos(\omega\tau))$ Obtain an expression for its power spectral density $S_n(\omega)$.	Analysis	7
2	A wide sense stationary process X(t) has autocorrelation function $R_X(\tau) = Ae^{-b\|\tau\|}$ where b > 0. Derive the power spectral density function	Analysis	7

Prepared by: G.Mary Swarna latha,Asst Professor, Dept of ECE

G.Anil Reddy, Asst Professor, Dept of ECE