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VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) IV-Semester Advanced Supplementary Examinations, Aug./Sept.-2023

Probability Theory and Stochastic Process

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO/PSO
1.	What are mutually exclusive events? Give an example. How it is different from independent events?	2	1	1	1/2
2.	A problem in statistics is given to 3 students A, B, C whose chances of solving it are $\frac{1}{2}, \frac{3}{4}$, and $\frac{1}{4}$ respectively. Find the probability that the problem is solved?	2	2	1	2/2
3.	Let X be a random variable. Describe the significance of the following with an example. (i) Standard deviation of X (ii) Skew of X	2	1	2	1,2/2
4.	In a control system, a random voltage X is known to have a mean value of -2 Volts and average power of 9Watts. If the voltage is amplified by an amplifier that gives an output Y=1.5X+2, find the mean and variance of Y.	2	2	2	1,2/2
5.	Let X be the information signal voltage and Y be the noise voltage at the same instant of time. The receiver receives a signal X+Y. What is the joint density function of X and Y?	2	1	3	1,2
6.	The joint pdf of two random variables X and Y is $f_{X,Y}(x,y) = \frac{1}{18}e^{-(\frac{x}{6}+\frac{y}{3})}, x \geq 0. y \geq 0$. Evaluate the marginal density functions of X and Y.	2	3	3	2
7.	Distinguish continuous random process and discrete random process with an example.	2	1	4	1,2/2
8.	For a stationary ergodic process with periodic components, the autocorrelation function is given by $R_{XX}(\tau) = 36 + \frac{4}{1+5\tau^2}$. Find the average power and AC power of the random process.	2	2	4	2,4/2
9.	Define white noise and sketch the PSD and autocorrelation of white noise.	2	3	5	1,12/2
10.	A discrete memory less source with source alphabets S_0, S_1, S_2, and S_3 have probabilities 0.25, 0.5, 0.125, and 0.125, respectively. Find the entropy of a discrete memory less source.	2	2	5	2/2

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	Part-B (5 × 8 = 40 Marks)				
11. a)	Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 orange marbles with replacement being made after each drawing. Find the probability that. (a) Both are white. (b) First is red and second is white. (c) Neither is orange. (d) Solve the problem with no replacement being done after each drawing.	4	2	1	2/2
b)	If a fair coin is tossed 10 times, find the probability of getting (i) Exactly 6 heads (ii) At least 6 heads (iii) At most 6 heads	4	2	1	2/2
12. a)	List the properties of distribution function and density function of a random variable X.	4	1	2	1/2
b)	A production line manufactures 1KΩ resistors that must satisfy 10% tolerance. (a) If a resistor is described by the Gaussian random variable X, for which mean is 1000Ω and standard deviation is 40Ω, what fraction of the resistors is expected to be rejected? (b) If a machine is not properly adjusted, the product resistances change to a new value where mean is 1050Ω. What fraction is now rejected?	4	3	2	2/2
13. a)	The joint pdf of (X,Y) is given by $f_{X,Y}(x,y) = \begin{cases} Ke^{-(x+y)}, & x>0, y>0 \\ 0, & otherwise \end{cases}$ Where K is a constant. Find K and determine the following. (i) P(X>1, Y<1) (ii) P(X<Y) (iii) P(X≤2)	4	2	3	2
b)	Find the expectation of (i) XY (ii) X^2Y (iii) XY^2 (iv) $(XY)^2$. If the joint pdf of (X,Y) is given by $f_{X,Y}(x,y) = \begin{cases} \frac{1}{100}, & 0<x<5, 0<y<20 \\ 0, & otherwise \end{cases}$	4	3	3	2
14. a)	Illustrate cross correlation function and auto correlation function with a real time application.	4	4	4	2,4,12/2
b)	If a random process X(t)= A coswt + B sinwt where A, B are uncorrelated, zero mean random variables having variance σ^2. Examine whether X(t) is a wide sense stationary random process or not?	4	3	4	2,4/2
15. a)	Two independent stationary random process X(t) and Y(t) have power spectrum densities $S_{XX}(w)=\frac{16}{w^2+16}$ and $S_{YY}(w)=\frac{w^2}{w^2+16}$, respectively. Also, X(t) and Y(t) are uncorrelated with zero mean value. Let another random process be Z(t)=X(t)+Y(t). Find (i) Power spectral density of Z(t) (ii) Cross power density spectrum of X(t) and Z(t)	4	2	5	2/2

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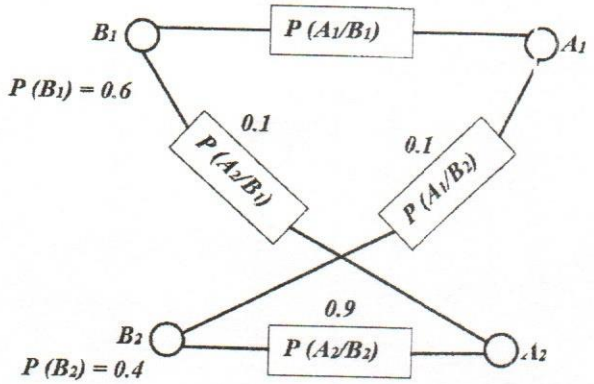
b)	A communication receiver is designed with following specifications to receive signals in 5MHz band: RF amplifier: Te=20^0K, Gain= 23dB ; LNA: Noise figure= 6dB, Gain : 20dB; Mixer IF amplifier: Noise figure: 12dB, gain =40dB. Estimate the following: (i) Effective noise temperature of the receiver (ii) Noise figure of the receiver (iii) Gain of the receiver	4	3	5	2,4/2
16. a)	A binary symmetric channel is shown below. Find the probability of (i) A_1 (ii) A_2 (iii) $P(B_1/A_1)$ (iv) $P(B_2/A_2)$ (v) $P(B_1/A_2)$ (vi) $P(B_2/A_1)$  	4	2	1	2/2
b)	At a major League Baseball park, five customers arrive at a concession stand on average in a ten – minute period. (i) What is the probability that in a ten – minute period exactly three people will arrive at the concession stand? (ii) Find the probability of exactly 3 customers arriving in 20 minutes? (iii) Find the probability of 3 or fewer customers arriving in 20 minutes? (iv) Find the probability of more than 3 customers arriving in 20 minutes?	4	3	2	2/2
17.	Answer any ***two*** of the following:				
a)	Two random variables X and Y have mean values 1, 2 respectively and variances 4 and 1 respectively. Their correlation coefficient is 0.4. New random variables W and V are defined by V= -X +2Y ; W= X+3Y. Find the correlation coefficient between V and W.	4	2	3	2
b)	Classify the random process and give example for each.	4	4	4	1,12/2
c)	Define the following terms: (i) Signal to noise ratio (ii) Noise figure (iii) Power spectral density (iv) Thermal noise	4	1	5	1,12/2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	40%

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