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Code No. : 14443

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) IV-Semester Main & Backlog Examinations, July-2022

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
1.	Define the following. Give an example. i) Entropy of a source ii) Independent events	2	1	1	1
2.	A man is known to speak the truth 2 out of 3 times. He throws a die and reports that it is a one. Find the probability it is actually one.	2	2	1	1,2
3.	Give a practical example where the following density functions are applicable. i) Uniform density function ii) Gaussian density function	2	1	2	1
4.	Find the expected value of the face value while rolling fair die?	2	2	2	1,2
5.	Let A represents the information signal and B represents the noise at some instant of time. Then the sum of two independent random voltages A and B available at the receiver is D=A+B. Express the density function of D in terms of A and B.	2	2	3	1,2
6.	Give the significance of all second central moments of two random variables X and Y.	2	1	3	1
7.	Illustrate a stationary random process X(t) with an example.	2	2	4	1,2
8.	Evaluate, the average power of the random process X(t) if auto correlation $R_{XX}(\tau) = 4 + \exp\left(\frac{- \tau }{10}\right)$	2	2	4	1,2
9.	List any two properties of cross power spectral density.	2	1	5	1
10.	Two noisy resistors 2KΩ at 30°C and 3KΩ at 40°C are connected in series. Determine the equivalent resistance.	2	2	5	1,2
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. Find the probability that (i) Both are white (ii) First is red and second is white (iii) Neither is orange. Perform the above experiment (I) With replacement (II) Without replacement	4	4	1	1,2
b)	In a bolt factory there are four machines A, B, C, D manufacturing 20%, 15%, 25%, 40% of the total output respectively of their outputs 5%, 4%, 3%, 2% in the same order are defective bolts. One bolt is chosen at random from the factory's production and is found to be defective. What is the probability that the bolt was manufactured by machine A or D?	4	3	1	1,2
12. a)	Evaluate mean and variance of a binomial distributed random variable X.	4	2	2	1,2
b)	Assume automobile arrivals at a gasoline station are Poisson and occur an average rate of 50 / hour. The station has only one gasoline pump. If all cars are assumed to require one minute to obtain fuel. What is the probability that a waiting line will occur at the pump?	4	3	2	1,2

Contd... 2

13. a)	For a bivariate random variables X and Y, $f_{X,Y}(x,y) = \begin{cases} b(x+y)^2, & -2 < x < 2, -3 < y < 3 \\ 0, & elsewhere \end{cases}$ (i) Find the constant b such that f is a valid joint density function (ii) Determine the marginal density functions of X and Y	4	3	3	1,2										
b)	Explain the significance of moment generating function and list its properties.	4	2	3	1										
14. a)	Illustrate the following concepts with a real time example and application. i) Auto correlation ii) Cross correlation	4	1	4	1,2										
b)	A random process X(t) is defined as X(t)=A Coswt+B Sinwt where A and B are uncorrelated zero mean random variables having variance σ^2 . Verify whether the random process is wide sense stationary or not.	4	2	4	1,2										
15. a)	Determine autocorrelation function and power spectral density of the random process. X(t)=A Cos(wt+ θ) where θ is the random variable over the ensemble and is uniformly distributed over (0 2 π).	4	2	5	1,2										
b)	A random process X(t) having PSD $S_{XX}(w) = \frac{3}{w^2+49}$ is applied to a network for which $h(t) = u(t)t^2e^{-7t}$. The network response is denoted by Y(t). Estimate the following i) Average Power of X(t) ii) Average Power of Y(t) iii) PSD of Y(t)	4	4	5	1,2										
16. a)	An urn contains 10 white and 3 black balls while another urn contains 3 white and 5 black balls. Two are drawn from the first urn and put into the second urn and then a ball is drawn from later. What is the probability that it is a white ball?	4	3	1	1,2										
b)	Let X be a discrete random variable with probabilities as shown in the table. Find the third central moment. <table border="1" style="margin: 10px auto;"> <tr> <td>X</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>P(X)</td> <td>$\frac{1}{3}$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{4}$</td> <td>$\frac{1}{4}$</td> </tr> </table>	X	0	1	2	3	P(X)	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{4}$	4	3	2	1,2
X	0	1	2	3											
P(X)	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{4}$											
17.	Answer any two of the following:														
a)	Show that two random variables X_1 and X_2 with joint pdf $f_{X_1,X_2}(x_1,x_2)$ is independent and orthogonal, where $f_{X_1,X_2}(x_1,x_2) = \begin{cases} \frac{1}{16}, & x_1 < 4, 2 < x_2 < 4 \\ 0, & elsewhere \end{cases}$	4	2	3	1,2										
b)	Briefly introduce the concept of random process and categorize its classifications with one example to each one.	4	3	4	1										
c)	Write short notes on white noise and its characteristics.	4	1	5	1										

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%
