Hall Ticket Number:

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VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

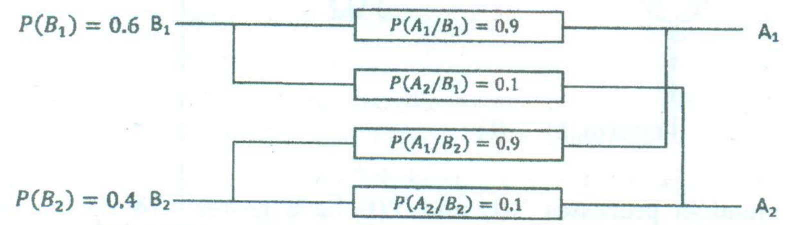
B.E. (E.C.E.) IV-Semester Advanced Supplementary Examinations, September-2022

Probability Theory and Stochastic Process

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

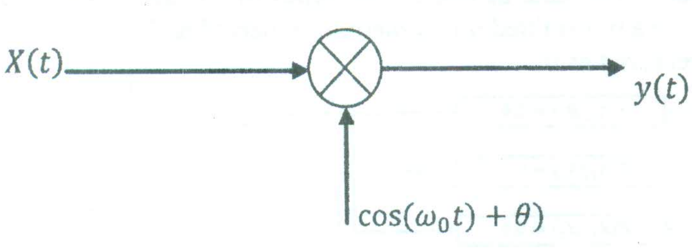
*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10× 2 = 20 Marks)

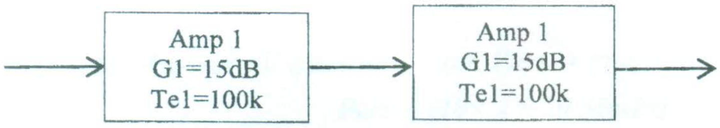
Q. No.	Stem of the question	M	L	CO	PO
1.	A bag contains 35 balls of three different colors viz. red, orange and pink. The ratio of red balls to orange balls is 3 : 2, respectively and probability of choosing a pink ball is 3/7. If two balls are picked from the bag, then what is the probability that one ball is orange and one ball is pink?	2	2	1	1,2
2.	Define entropy of a system and list its properties.	2	1	1	1,2
3.	An analog signal received at the detector (measured in μV) may be modelled as a gaussian random variable N(200,256) at a fixed point in time. What is the probability that the signal is larger than 240 μV?	2	2	2	1,2
4.	What is the significance of distribution function and density function of a random variable?	2	1	2	1,2
5.	Determine the constant b such that the given function is a valid density function. $$f_{X,Y}(x,y) = \begin{cases} b(x^2+4y^2), & 0 \le \lvert x \rvert < 1 \\ 0, & elsewhere \end{cases}$$	2	3	3	1,2
6.	State central limit theorem. Apply central limit theorem to any real time scenario.	2	1	3	1,2
7.	For a wide sense stationary random process X(t), at maximum correlation, evaluate auto covariance.	2	3	4	1,2
8.	Illustrate a discrete random sequence with an example.	2	2	4	1,2
9.	Mention Wiener–Khinchin relation.	2	1	5	1,2
10.	Sketch power spectral density of white noise and explain the terms.	2	2	5	1,2
	Part-B (5 × 8 = 40 Marks)				
11. a)	A binary communication channel carries data as one of two types of signals denoted by 0 and 1. Owing to noise a transmitted 0 is sometimes received as 1 and transmitted 1 is sometimes received as 0.  Determine the following based on the data given below. (i) Probability that 1 is received. (ii) Probability that 0 is received. (iii) Probability that a 1 was transmitted, given that a 1 was received. (iv) Probability that a 0 was transmitted, given that a 0 was received.	4	2	1	1,2

Contd... 2

	b)	A missile can be accidentally launched if two relays A and B both have failed. The probabilities of A and B failing are known to be 0.01 and 0.03 respectively. It is also known that B is more likely to fail (probability 0.06) if A failed. (i) What is the probability of an accidental missile launch? (ii) What is the probability that A will fail if B has failed? (iii) Are events "A fails" and "B fails" statistically independent?	4	3	1	1,2
12.	a)	The number of cars arriving at certain bank drive in-window during any 10-minutes period is a random variable X with b = 2. Estimate (i) The probability that more than 3 cars will arrive during any 10-minutes period. (ii) The probability that no cars will arrive.	4	3	2	1,2
	b)	Explain the following density functions with examples. (a) Uniform (b) Binomial	4	1	2	1,2
13.	a)	Write short notes on joint central moments and explain its significance.	4	2	3	1,2
	b)	The joint density function for X and Y is $f_{X,Y}(x,y) = \begin{cases} \frac{xy}{9}, 0 < x < 2, \; and \; 0 < y < 3 \\ 0, \quad elsewhere \end{cases}$ Which of the following is true? (i) X and Y are statistically independent (ii) X and Y are correlated	4	3	3	1,2
14.	a)	What are the features that can be extracted from autocorrelation function when applied to wireless communication?	4	3	4	1,2
	b)	Let X(t) be a WSS process with autocorrelation function $R_{XX}(\tau) = e^{-\alpha\|\tau\|}$ where $\alpha > 0$ is a constant. Assume X(t) amplitude modulates a carrier cos(W_0t + θ) as shown in figure, where W_0 is a constant and θ is a random variable uniformly distributed on $(-\pi, \pi)$. If X(t) and θ are statistically independent, determine the autocorrelation function X(t).	4	2	4	1,2



15.	a)	Two independent stationary random processes X(t) and Y(t) have power spectral density $S_{XY}(w) = \frac{w^2}{w^2+16}$ respectively with zero means. Let another random process U(t)=X(t)+Y(t). Then find (i) Power spectral density of U(t) (ii) Cross power spectral density $S_{XY}(w)$ (iii) Cross power spectral density $S_{XU}(w)$	4	2	5	1,2

	b)	Find the overall noise figure and equivalent input noise temperature of the system shown in the figure.  Room Temperature =27°c	4	3	5	1,2
16.	a)	Define the following and give one example for each. (i) Sample space (ii) Event (iii) Mutually exclusive events (iv) Independent events.	4	1	1	1,2
	b)	A pair of fair dice is thrown in a gambling problem. Person A wins if the sum of numbers showing up is six or less and one of the dice shows four. Person B wins if the sum is 5 or more and one of the dice shows a four. Find: (i) The probability that A wins. (ii) The probability that B wins.	4	2	2	1,2
17.		Answer any ***two*** of the following:				
	a)	Two random variables X and Y have means 1,2 and variances 4,1 respectively. Correlation coefficient of X and Y is 0.4. New random variables W and V are defined by V=-X+2Y and W=X+3Y. Find correlation between V and W.	4	2	3	1,2
	b)	Assume that an ergodic random process X(t) has an autocorrelation function $R_{XX}(\tau) = 18 + \frac{2}{6+\tau^2}(1 + 4\cos(2\tau))$. Find the estimated value of X and the average power of X(t).	4	3	4	1,2
	c)	Given a random process $X(t)=A\cos w_0 t$ where w_0 is a constant and A is uniformly distributed with mean 5 and variance 2. Estimate the average power of X(t).	4	3	5	1,2

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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