LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **STATISTICS**

FIRST SEMESTER – **APRIL 2025**

UST 1502 – PROBABILITY AND DISCRETE DISTRIBUTIONS

Date: 26-04-2025 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**Define the following**	
a)	Sample space.	
b)	Define conditional probability.	
c)	Probability mass function.	
d)	Expectation of a random variable.	
e)	Geometric distribution.	
2.	**Fill in the blanks**	
a)	The probability of an impossible event is________.	
b)	If two events A and B are independent, then $P(A \cap B) =$ ________.	
c)	The derivative of a cumulative distribution function gives the ________.	
d)	The expected value of a constant is ________.	
e)	The mean of a Bernoulli trial with probability $\boldsymbol{p}$ is ________.	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**Match the following**	
a)	Mutually exclusive events ------ Without replacement.	
b)	Bayes' theorem ------ Relationship between two variables.	
c)	Marginal distribution ------ Revised probability.	
d)	Covariance ------ Distribution of a subset of variables.	
e)	Hyper geometric ------ Events that cannot occur together.	
4.	**True or False**	
a)	The probability of any event is always greater than 1.	
b)	Bayes' theorem helps in updating probabilities based on new evidence.	
c)	The probability density function is always non-negative.	
d)	If two random variables are independent, their covariance is zero.	
e)	A Binomial distribution is a special case of a Poisson distribution.	
	SECTION B - K3 (CO2)	
	Answer any TWO of the following	**(2 x 10 = 20)**
5.	Two unbiased dice are thrown. Find the probability that a) Both the dice show the same number, b) The first shows 5, c) The total of the numbers on the dice is 7 and d) The total of the numbers on the dice is greater than 7.	
6.	State and prove the addition theorem for two events A and B. Also generalize the result to three events A, B, and C.	

7.	From a city population, the probability of selecting (i) a male or a smoker is 7/10, (ii) a male smoker is 2/5, and (iii) a male, if a smoker is already selected is 2/3. Find the probability of selecting a) a non- smoker, b) a male, and c) a smoker , if a male is first selected.
8.	A random variable x has the following probability function x: 0, 1, 2, 3, 4, 5, 6, 7 $p(x)$: 0, k, $2k$, $2k$, $3k$, k^2, $2k^2$, $7k^2+k$ a) Find k, b) Evaluate $P(X < 6), P(X \geq 6),$ and $P(0 < X < 5)$.

x	0	1	2	3	4	5	6	7
$p(x)$	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$

SECTION C – K4 (CO3)

Answer any TWO of the following (2 x 10 = 20)

9.	An urn contains 6 white, 4 red and 9 black balls. If 3 balls are drawn at random. Find the probability that a) Two of the balls are drawn white , b) one is of each colour, c) none is red, d) at least one is white
10.	A problem in Statistics is given to three students A, B and C whose chances of solving are 1/2, 3/4, and 1/4, respectively. What is the probability that the problem will be solved if all of them try independently?
11	State and prove the addition and multiplication theorems of expectation for two random variables. Then, extend these results to $\boldsymbol{n}$ random variables.
12	What are the properties of the Negative Binomial distribution? Explain in detail.

SECTION D – K5 (CO4)

Answer any ONE of the following (1 x 20 = 20)

13	a)State and Prove Bayes theorem. b) Suppose that a product is produced in three factories X, Y and Z. It is known that factory, X produces thrice as many items as factory Y, and that factories Y and Z produce the same number of items. Assume that it is known that 3 per cent of the items produced by each of the factories X and Z are defective while 5 per cent of those manufactured by factory Y are defective. All the items produced in the three factories are stocked, and an item of product is selected at random. (i) What is the probability that this item is defective? (ii) If an item selected at random is found to be defective, what is the probability that it was produced by factory X, Y and Z respectively?
14	Derive the m.g.f. of the Binomial distribution and use it to find its mean and variance.

SECTION E – K6 (CO5)

Answer any ONE of the following (1 x 20 = 20)

15	a) A coffee connoisseur claims that he is distinguish between a cup of instant coffee and a cup of percolator coffee 75% of the time. Its agreed that his claim will be accepted if he correctly identify at least 5 of the 6 cups. Find his chances of having the claim (i) accepted, (ii) rejected, when he does the ability he claims. b) State and prove Chebyshev's Inequality.
16	a) Show that the Poisson distribution is a limiting case of the Binomial distribution. b) Prove that the Geometric distribution satisfies the memory less property.

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