Name of the Student :	
Register No. :	R A

SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS
SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu
Academic Year: 2023-2024 (EVEN)

SLOT-C1
(SET-A)
MCQ

Test: FT-3 | **Date: 19/03/2024**
Course Code & Title: 21MAB203T-Probability and Stochastic Processes | **Duration: 1 hr 40 min**
Year & Sem: II & IV | **Max. Marks: 50**

Note:
- Part A should be answered in the Question paper itself within the first 5 minutes and the same should be handed over to the hall invigilator at the end of the 5th minute
- Only A/B/C/D have to be mentioned as an answer for MCQ in the space provided in the Question paper.
- Any striking (or) overwriting (or) using whitener in the answer (A/B/C/D) under Part-A will not be accepted. No marks will be awarded for that question.
- Part - B and Part - C should be answered in the answer booklet.

Course Articulation Matrix:

At the end of the course, student will be able to		Program Outcomes (PO)											
Course Outcomes (CO)		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Evaluate the characteristics of discrete and continuous random variables	3	3										
CO2	Explain the model and analyze systems using two-dimensional random variables Engineering	3	3										
CO3	Classify limit theorems and evaluate upper bounds using various inequalities	3	3										
CO4	Analyze the characteristics of random processes	3	3										
CO5	Examine problems in spectral density functions and linear time-invariant systems	3	3										

Part-A (4 × 1 = 4 Marks)
Answer ALL the questions

Q.No.	Question	Answer A/B/C/D	Marks	BL	CO	PO
1.	For two random variables X and Y, $E(X) = 5$, $E(Y) = 10$, $E(XY) = 75$, $E(X^2) = 4$ and $E(Y^2) = 149$, $COV(XY)$ is (A) 5 (B) 25 (C) 15 (D) 10		1	1	4	1,2
2.	The joint probability distribution of two continuous random variables X and Y is given by $f_{XY}(x,y) = e^{-(x+y)}$, $0 \leq x, y < \infty$ The marginal probability distribution of X is given by (A) e^{-y} (B) e^{-2y} (C) e^{-x} (D) e^{-2x}		1	2	4	1,2
3.	If X is a random variable with $E(X) = 3$ and $E(X^2) = 13$, then the lower bound for$P\{\|X-3\| < 5\}$ is (A) $\frac{20}{25}$ (B) $\frac{1}{25}$ (C) $\frac{14}{25}$ (D) $\frac{21}{25}$		1	1	4	1,2
4.	Jensen's inequality is applied to -------- function (A) convex (B) inverse (C) decreasing (D) increasing		1	2	4	1,2

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C1-Slot
SET-B
MCQ

Test: FT3
Course Code & Title: 21MAB203T-Probability and Stochastic Processes
Year / Sem: II/IV

Date: 19/03/2024
Duration: 1 hr 40 Minutes.
Max. Marks: 50

At the end of this course, learners will be able to:			Program Outcomes (PO)											
Course Outcomes (CO)		Learning Bloom's Level	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Evaluate the characteristics of discrete and continuous random variables	4	3	3										
CO2	Explain the model and analyze systems using two-dimensional random variables	4	3	3										
CO3	Classify limit theorems and evaluate upper bounds using various inequalities	4	3	3										
CO4	Analyze the characteristics of random processes	4	3	3										
CO5	Examine problems in spectral density functions and linear time-invariant systems	4	3	3										

Note:
- (i) Only A/B/C/D have to be mentioned as an answer for MCQ in the space provided in the Question paper.
- (ii) Any striking (or) overwriting (or) using whitener in the answer (A/B/C/D) under Part-A will not be accepted. No marks will be awarded for that question.
- (iii) Part - B and Part – C should be answered in the answer booklet.

Part-A (1 x 4 = 4 Marks)
Answer ALL the Questions

Q. No	Question	Answer	Marks	BL	CO	PO
1.	Let $X \in \{0,1\}$ and $Y \in \{0,1\}$ be two independent binary random variables. If $P(X=0)=p$ and $P(Y=0)=q$, then $P(X+Y)<1$ is equal to (A) pq (B) $pq+(1-p)(1-q)$ (C) $p(1-q)$ (D) $1-pq$		1	2	2	1,2
2.	If the joint pdf of the RV (X,Y) is given by $f(x,y)=kx$ in the region $0 \le x \le 2$ and $0 \le y \le 2$, then $k=$ (A) $k=1$ (B) $k=1/4$ (C) $k=1/2$ (D) $k=1/8$		1	2	2	1,2
3.	Consider $S=X_1+X_2+\cdots+X_n$ where $X_1,X_2,\dots,X_n$ be a sequence of independent and identically distributed RV's each having finite mean $E(X_i)=\mu$. Then for any $\epsilon>0$, weak law of large numbers states (A) $P\left(\left\|\frac{S}{n}-\mu\right\| \ge \epsilon\right) \to 0$ as $n\to\infty$ (B) $P\left(\left\|\frac{S}{n}-\mu\right\| < \epsilon\right) \to 0$ as $n\to\infty$ (C) $P\left(\left\|\frac{S}{n}-\mu\right\| \ge \epsilon\right) \to 0$ as $n\to 0$ (D) $P\left(\left\|\frac{S}{n}-\mu\right\| \ge \epsilon\right) \to \infty$ as $n\to\infty$		1	1	3	1,2
4.	Let X is a RV with $E(X)=\mu$ and $Var(X)=\sigma^2$, then for some $a>0$, which of the following equation denotes Tchebycheff inequality? (A) $P(\|X-\mu\| \ge a) \le \frac{\mu}{a}$ (B) $P(\|X-\mu\| \ge a) \le \frac{\sigma^2}{a}$ (C) $P(\|X-\mu\| \ge a) \le \frac{\sigma^2}{a^2}$ (D) $P(\|X-\mu\| \ge a) \le \frac{\mu^2}{a^2}$		1	1	3	1,2

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C1-Slot
SET-B
Part-B&C

Test: FT3
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Max. Marks: 50

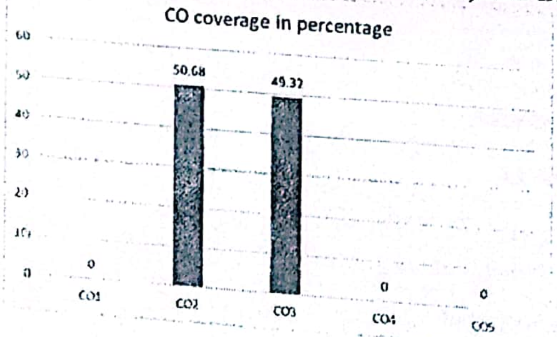
Part – B (8 x 2 = 16 Marks)
Answer any two questions

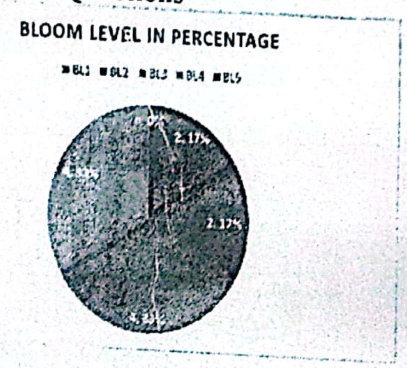
5.	The joint probability mass function of X and Y is given by $p(x,y) = k(3x + 2y)$, where $x = 1,2,3,4$; $y = 0,1,2,3$. Find the value of k, marginal distributions, P(X+Y>3).	8	4	2	1,2
6.	A discrete random variable X takes the values -1,0,1 with probability 1/8, ¾,1/8 respectively. Evaluate $P\{\lvert X-\mu\rvert \geq 2\sigma\}$ using Tchebycheff's inequality and compare it with the actual probability.	8	4	3	1,2
7(i).	Two random variables X and Y are distributed according to $f_{X,Y}(x,y) = \begin{cases} \frac{1}{4}xy & 0 \leq x \leq 2 \quad 0 \leq y \leq 2 \\ 0 & otherwise \end{cases}$ Find the marginal distributions.	4	3	2	1,2
7(ii).	Suppose that the average grade on the Mathematics exam is 75%, find an upper bound on the proportion of students who score at least 85%.	4	3	3	1,2

Part – C (15 x 2 = 30 Marks)
Answer any two question

8.	The joint pdf of (X,Y) is given by $f(x,y) = 24xy; x > 0, y > 0, x + y \leq 1$ and $f(x,y) = 0$, elsewhere. Find the covariance of X and Y.	15	4	2	1,2
9.	If $X_1, X_2, \ldots, X_n$ are Poisson variates with parameters $\lambda = 2$, use the central limit theorem to estimate $P(120 \leq S_n \leq 160)$ and $P(130 \leq S_n \leq 150)$ where $S_n = X_1, X_2, \ldots, X_n$ and $n = 75$.	15	4	3	1,2
10(i).	If the joint pdf of (X,Y) is given by $f_{XY}(x,y) = x^2 + 2y^2$; where $0 \leq x \leq 1$ and $0 \leq y \leq 1$, find the pdf of $U = XY$.	8	3	2	1,2
10(ii).	Let X be a positive random variable with $E(X) = 5$. Prove that $f(x) = e^{\frac{1}{x+1}}$ is a convex function in $(0, \infty)$. And then estimate the value of $E\left(e^{\frac{1}{x+1}}\right)$.	7	3	3	1,2

Course Outcome (CO) and Bloom's level (BL) Coverage in Questions





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Part-B ($2 \times 8 = 16$ Marks) **Answer any TWO questions**					
Q.No.	**Question**	**Marks**	**BL**	**CO**	**PO**
5.	The joint probability mass function of X and Y is given by $p(x,y) = k(x+3y)$, where $x = 1,2,3,4; y = 1,2,3,4$. Find the value of k, marginal distributions, $P(X+Y>3)$.	8	3	2	1,2
6.	A random variable is exponentially distributed with parameter 1. Use Tchebycheff's inequality to find the lower bound for $P(-1 \leq X \leq 3)$. Also find the actual probability.	8	3	3	1,2
7 a.	Two random variables X and Y have joint distribution $f_{XY}(x,y) = 9x^2y^2, 0 < x,y < 1$. Find the marginal distributions.	4	2	2	1,2
7 b.	Let X and Y are two random variables with mean and variance of X as 6 and 2, respectively and mean and variance of Y as 4 and 1 respectively, Find the maximum possible value of $E[XY]$.	4	2	3	1,2
Part-C ($2 \times 15 = 30$ Marks)					
Answer any TWO questions					
Q.No.	**Question**	**Marks**	**BL**	**CO**	**PO**
8.	Given the joint pdf of (X,Y) as $f(x,y) = k(2-x-y), 0 < x,y < 1$. Find k and covariance.	15	4	4	1,2
9.	The life time of a certain brand of tube light may be considered as a random variable with mean 1200 hours and S.D. 250 hours. Using CLT, find the probability that the average life time of 60 lights (i) exceeds 1250 hours (ii) between 1100 and 1250 hours (iii) less than 1100 hours	15	4	4	1,2
10 a.	If X and Y each follow an exponential distribution with parameter 1 and are independent, find the joint pdf $g_{UV}(u,v)$ where $U = X - Y$.	8	4	4	1,2
10 b.	Let Z be standard normal variate with MGF $M_Z(t) = e^{t^2/2}$. Using Chernoff bounds, find an upper bound for $P[Z \geq a]$.	7	4	4	1,2