BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2025)

CLASS: B.Tech. **SEMESTER : III**
BRANCH: ECE **SESSION : MO/2025**

SUBJECT: EC24209 PROBABILITY AND RANDOM PROCESSES

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	If the events A and B are independent, then prove that the events $\bar{A}$ and $\bar{B}$ are also independent.	[2]	I	II
Q.1(b)	If A and B are independent events of a random experiment such that $P(A \cap B) = \frac{1}{5}$ and $P(\bar{A} \cap \bar{B}) = \frac{1}{4}$ then find $P(A)$	[3]	I	III
Q.2(a)	Consider the set identity, $A(B \cup C) = AB \cup AC$, and prove that if in this set identity, all sets are replaced by their complements, all unions by intersections, and all intersections by unions, the identity is preserved.	[2]	I	II
Q.2(b)	Three cards are drawn successively without replacement from a pack of 52 well-shuffled cards. Determine the probability that first two cards are kings and the third draw is an ace.	[3]	I	V
Q.3(a)	The probability density function (pdf) of a random variable, X, is given by $f_X(x) = \begin{cases} 1-\lvert 1-x \rvert & for\ 0 < x < 2 \\ 0 & otherwise \end{cases}$. Verify whether the given pdf is the valid pdf or not.	[2]	IV	IV
Q.3(b)	Consider the experiment of tossing four fair coins. The random variable X is associated with the number of tails showing. Compute and sketch the cumulative distribution function (CDF) and probability density function (PDF) of X.	[3]	III	V
Q.4(a)	State and prove the Moment Theorem.	[2]	II	II
Q.4(b)	Define the Poisson distribution function and obtain its mean and variance.	[3]	III	II
Q.5(a)	Obtain the moment-generating function of the random variable X having the pdf, $f_X(x) = \begin{cases} \frac{1}{3} & for\ -1 < x < 2 \\ 0 & otherwise \end{cases}$. Further, verify the answer.	[2]	V	IV
Q.5(b)	If X is exponential distribution function with the mean of $\frac{1}{2}$, then obtain the probability density function, $f_Y(y)$ of the random variable $Y = X^2$.	[3]	V	V

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