BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2024)

CLASS: BTECH — **SEMESTER : III/ADD**
BRANCH: ECE — **SESSION : MO/2024**

SUBJECT: EC213 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)	Determine the probability of the card being either a red or a king when one card is drawn from a regular deck of 52 cards.	[2]	I	II
Q.1(b)	A certain test for a particular cancer is known to be 95% accurate. A person submits to the test and the results are positive. Suppose that the person comes from a population of 100,000, where 2000 people suffer from that disease. What can be concluded about the probability that the person under test has that particular cancer.	[3]	I	V
Q.2(a)	A fair dice is rolled. Consider the events $A = \{1,3,5\}$, B= $\{1,2\}$ and C= $\{1,3,4,5\}$. Find $P[(A \cup B)/C]$.	[2]	I	II
Q.2(b)	A box contains white and black balls. When two balls are drawn without replacement, suppose the probability that both are white is 1/3. (a) Find the smallest number of balls in the box. (b) How small can the total number of balls be if black balls are even in number?	[3]	I	V
Q.3(a)	If X is exponentially distributed with parameter λ, find the value of k such that $\frac{P(X > k)}{P(X \leq k)} = a$.	[2]	II	I
Q.3(b)	Determine the characteristic function, $\phi_X(\omega)$ of a random variable $X \sim N(\eta, \sigma^2)$, From the $\phi_X(\omega)$, find the first and second order moments.	[3]	II	V
Q.4(a)	The density function $f_X(x)$ of random variable X is defined as $f_X(x) = \begin{cases} \frac{k}{2} & for\ 0 < x \leq 2 \\ \frac{1}{4} & for\ 2 < x \leq 3 \end{cases}$ where k is an unknown constant. Find and plot the distribution function, $F_X(x)$	[2]	II	II
Q.4(b)	Define the Rayleigh distribution function and obtain its mean and variance.	[3]	II	I
Q.5(a)	If joint density function of the random variables X and Y is given by $f_{XY}(x,y)$, then prove that the marginal densities of X and Y will be $f_X(x) = \int_{-\infty}^{\infty} f_{XY}(x,y)dy$ and $f_Y(y) = \int_{-\infty}^{\infty} f_{XY}(x,y)dx$, respectively.	[2]	III	II
Q.5(b)	The joint density function of the random variables X and Y is given by $f_{XY}(x,y) = \begin{cases} ke^{-(ax+by)} & for\ x > 0, y > 0 \\ 0 & otherwise \end{cases}$, where k is an unknown constant. Determine $P(X > Y)$. Are X and Y independent?	[3]	III	V

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