BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSc | **SEMESTER: I**
BRANCH: CQEDS | **SESSION: MO/2025**

SUBJECT: ED25107 PROBABILITY- I

TIME: 3 Hours | **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Suppose a box contains four black and eight white balls. We draw two balls from the box without replacement. Assume that each ball in the box is equally likely to be drawn, what is the probability that both drawn balls are black?	[5]	1	1,3
Q.1(b)	Write the definition of conditional probability. Also, write Bayes' formula.	[2+3]	2	1,3
Q.2(a)	Let X be a random variable with pdf $f(x) = \begin{cases} c(1-x^2), -1 < x < 1 \\ 0 \quad \text{otherwise} \end{cases}$. What is the value of c? What is the CDF of X?	[2+3]	5	3
Q.2(b)	Write the definition of variance of a random variable X. Suppose X has the following probability mass function: $p(0) = 0.2, p(1) = 0.5, p(2) = 0.3.$ Find $E[X]$ *and* Var(X).	[2+3]	3	3
Q.3(a)	Write the definition of exponential random variable X with parameter λ. Show that the moment generating function $\phi_X(t)$ of X is $\frac{\lambda}{\lambda - t}$ for $\lambda > t$. Further deduce expectation of X.	[1+3+1]	4	2
Q.3(b)	The joint density function of X and Y is $f(x,y) = \begin{cases} cxy, & 0 < x < 1,\ 0 < y < 1 \\ 0 & \text{otherwise} \end{cases}$. Find c. Evaluate $P\{X > 0.5,\ Y < 1\}$. Also, compute the marginal density of X.	[1+2+2]	5	3
Q.4(a)	Write the definition of conditional probability mass function of X, given that $Y = y$. The joint probability mass function of X and Y, $p(x,y)$ is given by $p(1,2) = 0.1, p(1,4) = 0.2, p(2,2) = 0.3, p(2,4) = 0.4.$ Compute conditional probability mass function of X, given that $Y = 2$.	[2+3]	5	1,3
Q.4(b)	Write the definition of independent random variables. Check whether the above random variables X and Y are independent. Also, compute $E[X \mid Y = 2]$.	[1+2+2]	3	3
Q.5(a)	What is binomial random variable? Let X and Y be independent binomial random variables with respective parameters (n, p) and (m, p). Calculate the distribution of $X + Y$.	[1+4]	4, 5	2
Q.5(b)	What the definition of covariance of X and Y? Let X and Y be two random variables, given in Q.3(b). Then compute Cov(X,Y).	[2+3]	3,5	1, 3

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