Graphic Era HILL UNIVERSITY

Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

A*

End Term (Odd) Semester Examination November 2025

Roll no

Name of the Course: **B.Tech. (CSE)**
Semester: **III**
Name of the Paper: **Probability and Random Processes**
Paper Code: **TCS-344**
Time: 3 Hour

Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks) (CO1)

a. Define conditional probability and Baye's theorem. Further, 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 non-smoker,
- a male,
- a smoker if a male is first selected.

b. Define the following events with suitable examples:
(i) Equally likely events
(ii) Mutually exclusive events
(iii) Independent events
(iv) Dependent events
(v) Exhaustive events.

c. (i) A room has three electric lamps. From a collection of 10 electric bulbs, of which 6 are good, 3 are selected at random and put in the lamp. Find the probability that the room is lighted.
(ii) A sample space contains three sample points with associated probabilities given by $2p$, p^2 and $4p-1$. Find the value of p.

Q2. (2X10=20 Marks) (CO2)

a. Define random variable and its types with suitable examples. Let X be a continuous random variable with probability density function:

$$f(x) = \begin{cases} ax, & 0 \le x \le 1 \\ a, & 1 \le x \le 2 \\ -ax + 3a, & 2 \le x \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

(i) Determine the constant a and (ii) compute $P(X \le 1.5)$.

b. A random variable X has the following probability function:

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

(i) Find k (ii) Find $P(X < 6)$, $P(X \ge 6)$ and $P(0 < X < 5)$ (iii) If $P(X \le a) > 0.5$, find the minimum value of a, and (iv) Determine the distribution function of X.

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c. Define binomial distribution and also, prove that mean of binomial distribution is np and variance of binomial distribution is npq

Q3. (2X10=20 Marks) (CO3)

a. Define correlation and its types. Also, check that the two variables x and y are correlated or not in the following table:

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

b. Write some applications for regression analysis and obtain regression coefficients from the following data:

x	1	2	3	4	5	6	7	8
y	3	7	10	12	14	17	20	24

Hence, find regression lines.

c. Describe exponential distribution with real life application. Also, derive mean and variance of exponential distribution.

Q4. (2X10=20 Marks) (CO4)

a. Explain random process with examples and its classification. Also, compare between random variable and random process.

b. Prove that random process $X(t) = A\, Sin\, (\omega t + \theta)$, where A and ω are constants; θ is random variable uniformly distributed in interval $(0, 2\pi)$ is stationary random process.

c. Define wide-sense stationary random process. Also, show that stationary first order-random process has constant a mean and a constant variance.

Q5. (2X10=20 Marks) (CO5)

a. Define autocorrelation function and cross correlation function with properties. Also, show that random process $X(t) = A\, cos\, (\omega t + \emptyset)$, where A and ω are constants; $\emptyset$ is a random variable uniformly distributed in interval $[0, 2\pi]$ is wide-sense stationary process.

b. Describe power density spectrum and its properties. Prove that average power of the random process $X(t) = A_0\, cos\, (\omega_0 t + \theta)$ is $A_0^2/2$, where A_0 and ω_0 are real constants, and θ is a random variable uniformly distributed on the interval $(0, \pi/2)$.

c. Define the following:
- (i) Linear system with example
- (ii) Stable linear system
- (iii) Linear time-invariant system
- (iv) Autocorrelation function of response
- (v) Cross-correlation function of input and output.

Also, prove that mean value of system response $Y(t)$ is equal to the mean value of $X(t)$ times the area under network's impulse response.