

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2024

B.Tech. -III Semester (ECE)

COURSE CODE(CREDITS): 18B11MA314(4)

MAX. MARKS: 15

COURSE NAME: Probability Theory and Random Processes

COURSE INSTRUCTORS: BKP\*

MAX. TIME: 1 Hour

**Note:** (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.

(d) Use of scientific calculator is allowed.

- In a digital circuit, three independent flip-flops are used, each of which can be in a stable state of either 0 or 1. What is the probability that at least 2 flip-flops are in the '1' state when they are simultaneously toggled? (CO1)[2]
- In an electronics manufacturing plant, there are two production lines: Line A and Line B. Line A produces 70% of the components, while Line B produces 30%. The defect rate for Line A is 1%, and for Line B, it is 4%. If a randomly selected component is found to be defective, what is the probability that it was produced by Line B? (CO1)[4]
- Let  $X$  and  $Y$  be the number of hardware failures in two computer labs in a given month. The joint distribution of  $X$  and  $Y$  is given in the table below:

$P_{XY}(x, y)$		x		
		0	1	2
y	0	0.52	0.20	0.04
	1	0.14	0.02	0.01
	2	0.06	0.01	0

- Compute the probability of at least one hardware failure.
- From the given distribution, are  $X$  and  $Y$  independent? Why or why not?
- Compute  $P[X = 0|Y = 1]$ . (CO2)[3]

- In a signal processing system, three signals  $X$ ,  $Y$ , and  $Z$  are measured with the following variances and covariances:

$$\text{Var}(X) = 4, \quad \text{Var}(Y) = 9, \quad \text{Var}(Z) = 16$$

$$\text{Cov}(X, Y) = 2, \quad \text{Cov}(X, Z) = 3, \quad \text{Cov}(Y, Z) = 1$$

Two output signals  $U$  and  $V$  are generated as linear combinations of these input signals:

$$U = 3X + Y + 2Z$$

$$V = 2X + 2Y + Z$$

Calculate the covariance  $\text{Cov}(U, V)$  between the output signals  $U$  and  $V$ . Also find the correlation coefficient between the two output signals  $U$  and  $V$ . (CO2)[6]