

Time: 3 hours

Max. Marks: 80

N.B. :1) Question no. 1 is compulsory

2) Answer any 3 questions from remaining five questions

Q1 Answer **any four** questions

- a. What are the three axioms of probability? **05**
- b. Define central limit theorem. What is the significance of central limit theorem? **05**
- c. A continuous random variable x that can assume any value between $x = 2$ and $x = 5$ has a density function given by $f(x) = k(1+x)$. Find $P(X < 4)$ **05**
- d. Define SSS process. How it is different from WSS? **05**
- e. Define autocorrelation function and state its properties **05**

- Q2 a. In a binary Symmetric channel, the probability that a transmitted '0' is received as '0' is 0.9 and the probability that a transmitted '1' is received as '1' is 0.95. If the probability that a '0' is transmitted is 0.55, find **10**
- i) The probability that a '1' was transmitted given that a '1' was received.
 - ii) The probability that a '0' was transmitted given that a '0' was received.
 - iii) Error probability

- b. i. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y) **05**
- ii. State and Prove Bayes Theorem **05**

- Q3 a. The joint pdf of two dimensional RV (X, Y) is given by **10**

$$f(x, y) = x^2 + \frac{xy}{3}; 0 \leq x \leq 1, 0 \leq y \leq 2. \text{ Find}$$

- i. $P(Y < 0.5/X < 0.5)$
- ii. Are x and y independent random variables? **10**
- b. State and prove Chebyshev inequality. **10**

- Q4 a. Derive the moment generating function for Poisson distribution. By using the moment generating function, derive the mean and variance of Poisson distribution **10**

- b. If the joint pdf of (X, Y) is given by $f(x, y) = x + y; 0 \leq x, y \leq 1$, find the pdf of $U = XY$ **10**

- Q5 a. If the joint pdf of (X, Y) is given by $f(x, y) = 24y(1-x), 0 \leq y \leq x \leq 1$, Find $E(XY)$ **10**

- b. Given a random process $x(t) = A \cos(\omega t + \Theta)$ where A and ω are constants and Θ is a random variable with uniform distribution over $(-\pi, \pi)$, Verify whether $x(t)$ is a WSS process or not. **10**

- Q6 a. Discuss the properties of linear time invariant system if input is a WSS process. **10**

- b. Find linear regression equation for the following two sets of data. Predict the output when input $x=7$. State any two applications of linear regression. **10**

x	2	4	6	8
y	3	7	5	10