

**Subject: Probability Theory and Stochastic Process**

**Time: 3 Hours**

**Max. Marks: 70**

- Note:** (i) First question is compulsory and answer any four questions from the remaining six questions. Each question carries 14 Marks.  
(ii) Answer to each question must be written at one place only and in the same order as they occur in the question paper.  
(iii) Missing data, if any, may be suitably assumed.

1. a) Define
- (i) Classical definition of probability
  - (ii) Define Baye's theorem.
- b) State the properties of conditional distribution function
- c) Define Joint characteristic function.
- d) State the central limit theorem.
- e) Define Covariance function and its properties.
- f) What is meant by a strict sense stationary random process?
- g) How do you find the autocorrelation function of response of a LTI System?
2. a) Explain Joint and conditional probabilities
- b) A box contains 6 white and 4 black balls. Remove two balls at random without replacement. What is the probability that the first one is white and the second one is black?
3. a) Explain about the following.
- (i) Moments about the origin.
  - (ii) Central moments.
- b) Let X be a Continuous random Variable with density function
- $f_X(x) = (x/9) + K \quad \text{for } 0 \leq x \leq 6$
- (i) Find K
  - (ii) Find  $P\{2 \leq x \leq 5\}$
4. a) Define joint distribution and joint probability density function for the two random variables X and Y.
- b) Two random variables X and y have the joint characteristic function
- $$\phi_{XY}(\omega_1, \omega_2) = \exp(-2\omega_1^2 - 8\omega_2^2)$$
- (i) Show that X and Y are zero mean random variables.
  - (ii) Are X and Y correlated?



5. a) State and prove the properties of Autocorrelation function.  
b) A random process is defined by  $X(t)=A$ , where  $A$  is a Continuous random variable uniformly distributed on  $(0,1)$ .  
(i) Find whether it is first order stationary or not.  
(ii) Determine whether it is wide sense stationary or not.
6. a) Find out the power density spectrum of the response of a LTI System.  
b) Consider a WSS random process  $X(t)$  with power spectral density  $S_{xx}(\omega)$ . Another random process is given by  $Y(t)=X(t+T)+X(t-T)$ , where  $T$  is a constant. Find the power spectrum of  $Y(t)$ .
7. a) Derive the relationship between Cross correlation function and the power density spectrum.  
b) Write a Short notes on  
(i) Mutual Information (ii) Channel Capacity

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