

QP Code : MV-18413

(3 Hours)

[ Total Marks : 100

- N. B. : (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions out of remaining six questions.

1. (a) Explain any two properties of cross correlation function. 5  
 (b) State and prove any two properties of Probability Distribution Function. 5  
 (c) Define Strict Sense Stationary and Wide Sense Stationary Process. 5  
 (d) State and explain joint and conditional Probabilities of events. 5
  
2. (a) Box 1 contains 5 white balls and 6 black balls. Box 2 contains 6 white balls and 4 black balls. A box is selected at random and then a ball is chosen at random from the selected box. 8  
 (i) What is the probability that the ball chosen will be a white ball?  
 (ii) Given that the ball chosen is white, what is the probability that it came from Box 1?  
 (b) The joint Probability density function of  $(x, y)$  is given by 12  

$$f_{xy}(x, y) = Ke^{-(x+y)}; \quad 0 < x < y < \infty$$
 Find : K  
 (i) Marginal densities of  $x$  and  $y$   
 (ii) Are  $x$  and  $y$  independent?
  
3. (a) If  $X$  and  $Y$  are two independent random variables and if  $Z = X + Y$ , then prove that the probability density function of  $Z$  is given by convolution of their individual densities. 10  
 (b) Find the characteristic function of Binomial Distribution and Poisson Distribution. 10
  
4. (a) Define Central Limit Theorem and give its significance. 5  
 (b) Describe sequence of random variables. 5  
 (c) State and prove Chapman – Kolmogorov Equation. 10
  
5. (a) Find the autocorrelation function and power spectral density of the random process  $x(t) = a \cos (bt + Y)$  where  $a, b$  and constants and  $Y$  is random variable uniformly distributed over  $(-\pi, \pi)$ . 10  
 (b) Show that the random process given by 10  

$$x(t) = A \cos (w_0 t + \theta)$$
 Where  $A$  and  $w_0$  are constant and  $\theta$  is uniformly distributed over  $(0, 2\pi)$  is wide sense stationary.

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6. (a) Explain power spectral density function. State its important properties and prove any one of the property. 10  
 (b) Prove that if input to LTI system is WSS, then the output is also WSS. 10
7. (a) Prove that the Poisson process is Markov Process. 5  
 (b) The transition matrix of Markov chain with three states 0, 1, 2, is 10

$$\text{given by } P = \begin{matrix} & \begin{matrix} 0 & 1 & 2 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} 0.75 & 0.25 & 0 \\ 0.25 & 0.5 & 0.25 \\ 0 & 0.75 & 0.25 \end{bmatrix} \end{matrix}$$

and the initial state distribution is

$$P(x_0 = i) = 1/3, \quad i = 0, 1, 2.$$

Find : (i)  $P [x_2 = 2]$  (ii)  $P [x_3 = 1, x_2 = 2, x_1 = 1, x_0 = 2]$

- (c) Define Markov Chain with an example and application. 5

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