

T.E. sem V (CBGS) (EXTC),  
RSA

18/11/14.

QP Code : 14830

(3 Hours)

[ Total Marks : 80

- N.B :** (1) Question No.1 is compulsory.  
(2) Solve any **three** out of remaining **five** questions.  
(3) **Assume** suitable **data** if needed.

1. (a) State and explain : 20  
(i) Independent Events  
(ii) Joint and conditional probabilities of events  
(b) Explain what is moment generating function and why is it called so?  
(c) State central limit theorem with its importance.  
(d) Define Markov chain giving an example.  
(e) Explain Bayes theorem and total probability theorem.
2. (a) Two dice with faces 1, 2, 3, 4, 5, 6 are thrown and the sum of the faces is counted. 10  
Plot the probability mass function for the sum of the faces. What is the probability that the product of the faces is 12?  
(b) X and Y are two random variables for which joint pdf is given by  $P(x = i, Y = j) = c(i + j)$   $i = 1, 2, 3, 4; j = 1, 2, 3$  find c and conditional mean and variance of X given  $Y = 1$ . 10
3. (a) For a certain communication channel the probability that '0' is received as '0' is 0.8 while the probability that '1' is received as '1' is 0.95. If probability of transmitting 0 is 0.45. find 10  
(i) a '1' is received  
(ii) '1' was transmitted given that '1' was received  
(iii) Probability that error has occurred.  
(b) If X and Y are exponential distributions with unity parameter, find the probability distribution function of 10  
 $U = X + Y$   $V = X/(X + Y)$
4. (a) Let  $X_1, X_2, X_3, \dots$  be sequence of Random variables. 10  
Define :  
(i) Convergence almost everywhere  
(ii) Convergence in probability  
(iii) Convergence in mean square sense  
(iv) Convergence in distribution.  
For the above sequence of the Random variable X.
- (b) What is Power spectral Density? Explain its significance. Find the power spectral density of random process given by  $X(t) = a \cos(bt + Y)$  where Y is a random variable uniformly distributed over  $(0, 2\pi)$ . 10

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5. (a) Define autocorrelation function of a WSS random variable. List the properties of Autocorrelation Function of Random Process and prove any two properties. Also give one practical application of Autocorrelation function. 10
- (b) State Chapman-Kolmogorov equation. Transition probability matrix of Markov Chain is 10

$$\begin{array}{c} 1 \\ 2 \\ 3 \end{array} \begin{array}{ccc} 1 & 2 & 3 \\ \left[ \begin{array}{ccc} 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{array} \right] \end{array}$$

Find the limiting probabilities.

6. (a) Prove that if input LTI system is WSS the output is also WSS. What is Ergodic process? 10
- (b) A random process is defined by  $X(t) = 10 \cos(100t + \theta)$  where  $\theta$  is uniformly distributed in  $(0, 2\pi)$ . Verify whether  $X(t)$  WSS random Process and correlation ergodic. 10