Paper / Subject Code: 32224 / Random Signal Analysis

June 11, 2024 02:30 pm - 05:30 pm 1T01035 - T.E.(Electronics and Telecommunication)(SEM-V) (Choice Base Credit Grading System) (R- 19) (C Scheme) / 32224 - Random Signal Analysis QP CODE: 10055767

Time: 3 hours Max. Marks: 80

- N.B.: 1) Question no. 1 is compulsory.
 - 2) Answer any 3 questions from remaining five questions.

1 Answer any four questions

- (a) Define Discrete and Continuous random variables by giving examples.
- (b) Explain any two properties of Auto correlation Function. 5
- (c) Define SSS process. How it is different from WSS?
- (d) Define mathematical, statistical, and axiomatic definitions of probability. 5
- (e) Explain the central limit theorem.
- 2. (a) For the following probability density function

$$f_x(x) = \begin{cases} kx, & 0 \le x < 2\\ k(4-x), & 2 \le x \le 4\\ 0, & otherwise \end{cases}$$

- (i) Find the value of k for which $f_x(x)$ is a valid pdf.
- (ii) Find the mean and variance of X.
- (iii) Find the CDF.
- (b) Suppose X and Y are two random variables. Define Covariance and correlation of 10 X and Y. When do you say that X and Y are
 - i) Orthogonal
 - ii) Independent
 - iii) Uncorrelated

Are uncorrelated variables independent?

- 3. (a) Prove that for a linear time invariant system, if input is a WSS process, the output is also a WSS process.
 - (b) The joint pdf of X and Y is given by,

$$f_{x,y}(x,y) = e^{-(x+y)}; \ x > 0; y > 0$$

10

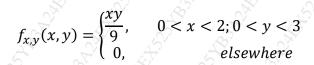
Find the pdf of $Z = \frac{x + y}{2}$

- 4. (a) A binary computer communication channel has the following error probabilities: 10 P(R1 | S0) = 0.2, P(R0 | S1) = 0.06 where S0 = {'0' sent} S1 = {'1' sent} R0 = {'0' received} R1 = {'1' received} Suppose that 0 is sent with a probability of 0.8, find
 - (a) The probability that '1' is received
 - (b) The probability that '1' was sent given that 1 is received
 - (c) The probability that '0' was sent given that '0' is received.
 - (b) Consider a random process $Y(t) = X(t)(cos\omega_0 t + \theta)$, where X(t) is a wide-sense stationary random process, θ is a random variable independent of X(t) and is distributed uniformly in $(-\pi, \pi)$ and ω_0 is a constant. Prove that Y(t) is wide-sense stationary.

5. (a) Let X be a random variable with PDF. Find Moment Generating Function of X 10 and Var(X).

f(x) =
$$\frac{1}{2} (e^{-x/2})$$
; x >0
= 0; else

(b) The density function of two random variables X and Y is;



- (a) Show that X and Y are statistically independent.
- (b) Show that X and Y are uncorrelated.
- 6. (a) Find the equation of the regression line from the following data.

X	1 4	2	3	4	5	6	7
Y	9	8	10	12	11	13	14

(b) State and prove Chebyshev inequality.