Code: 15A04304

R15

B.Tech II Year I Semester (R15) Regular & Supplementary Examinations November/December 2017

PROBABILITY THEORY & STOCHASTIC PROCESSES

(Electronics & Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) A man is known to speak the truth 2 out of 3 times. He throws a die and reports that it is a one. Find the probability it is actually one.

(b) A Continuous random variable X as a probability density function $f(x) = 3x^2$ for $0 \le x \le 1$. Find a and b such that: (i) $P\{X \le a\} = P\{X > a\}$ (ii) $P\{X > b\} = 0.05$

(c) The joint density function $g(x, y) = bx^{-x}\cos y$ for $0 < x < 2$ and $0 < y < \pi/2$. If $g(x, y)$ is a valid density function then find 'b' Value.

(d) Show that the mean value of a weighted sum of random variables equals the weighted sum of mean values.

(e) A random process X(t) = At, Where A is uniformly distributed random variable over the interval (0,2). Find the mean value of the process.

(f) Define wide sense stationary process?

(g) The auto correlation function of a random process $R_{XX}(\tau) = A0^2 \cos\tau$. Find the power spectral density.

(h) Define cross power spectral density

(i) Bring out the differences between narrowband and broadband noises.

(j) X(t) is a stationary random process with zero and auto correlation $R_{XX}(\tau) = e^{-2|\tau|}$ is applied to a system of function $H(w) = \dfrac{1}{jw+2}$. Find mean PSD of its output.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) State and prove the Baye's theorem.

(b) Assume automobile arrivals at a gasoline station are Poisson and occur an average rate of 50 / hour. The station has only one gasoline pump. If all cars are assumed to require one minute to obtain fuel. What is the probability that a waiting line will occur at the pump?

OR

3 (a) Define Gaussian density functions and derive the Gaussian distribution function.

(b) A pair of fair dice is thrown in a gambling problem. Person A wins if the sum of numbers showing up is six or less and one of the dice shows four. Person B wins if the sum is 5 or more and one of the dice shows a four. Find: (i) The probability that A wins. (ii) The probability of B winning. (iii) The probability that both A and B wins.

UNIT – II

4 (a) Two random variables X and Y have a joint probability density function:

$$f_{X,Y}(x,y) = \begin{cases} \frac{5}{16}x^2y & 0 < y < x < 2 \\ 0 & \text{elsewhere} \end{cases}$$

(i) Find the marginal density functions of X and Y. (ii) Are X and Y statistically independent?

(b) Two random variables Y_1, Y_2 are defined as

$Y_1 = X\cos\theta + Y\sin\theta$

$Y_2 = -X\sin\theta + Y\cos\theta$

Find the co-variance between Y_1 and Y_2.

OR

5 (a) State all the properties of joint probability density function.

(b) If the joint probability density function of X, Y is given by $f_{X,Y}(x, y) = x+y$ for $0<x, y<1$. Find the probability density function of U = XY.

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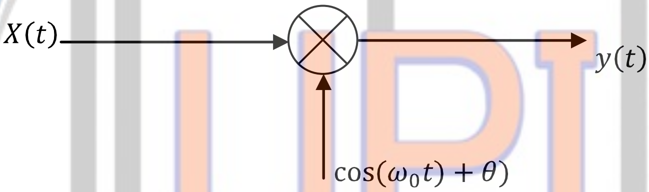
UNIT – III

6 (a) Discuss in detail about: (i) First order stationary random process. (ii) Ergodic process.

(b) $X(t)$ be a wide sense stationarity random process with autocorrelation function $R_{xx}(\tau) = e^{-a|\tau|}, a > 0$. $X(t)$ is a "Amplitude modulates" a "carrier" $\cos(\omega_0 t + \theta)$ as shown in below figure. Here θ is a random variable uniform on $(-\pi, \pi)$. Show that the process $y(t)$is a wide sense stationarity process.



OR

7 (a) State and prove the all properties of cross correlation function.

(b) The auto correlation function for a stationary process X(t) is given by $R_{XX}(\tau) = 9 + 2e^{-|\tau|}$. Find the mean and variance of $Y = \int_0^2 x(t)dt$.

UNIT – IV

8 (a) "The power spectral density of any random waveform and its autocorrelation function are related by means of Fourier transform". Prove and illustrate the above statement.

(b) A random process $X(t) = A\cos(\omega_0 t + \theta)$, where A_0, ω_0 constants and θ is a variable uniformly distributed on the interval $(0, \pi/2)$. Find the average power?

OR

9 (a) Derive the expression for cross power spectral density?

(b) The cross correlation function of any two random processes X(t) and Y(t) is:

$$R_{XY}(t, t+) = AB/2\ \sin w_0 + \cos\ w_0(2t + w_0)\ for\ -T < t < T.$$

Find the cross power spectral density.

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UNIT – V

10 (a) Show that a narrow band noise process can be expressed as in-phase and quadrature components of it.

(b) The input voltage to an RLC series Circuit is a stationary random process X(t) with E[x(t)] = 2 and $R_{XX}(\tau) = 4 + e^{-2|\tau|}$. Let Y(t) be the voltage across capacitor. Find E[Y(t)].

OR

11 (a) Define and explain the following random process: (i) Band pass. (ii) Band limited. (iii) Narrowband.

(b) A mixer stage has a noise figure of 20dB and this is preceded by a amplifier that has a noise figure of 9dB and an available power gain 15dB. Calculate the overall noise figure referred to the input.

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