Register Number: ………….

B.E DEGREE EXAMINATIONS: APRIL/ MAY 2016

(Regulation 2013)

Sixth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

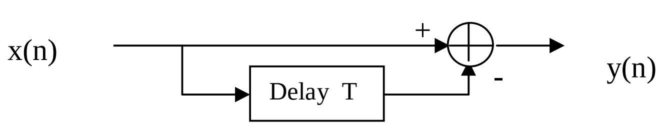
U13ECT604**:** Statistical Theory of Communication

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. If , then the events A and B are
   a) Independent b) Mutually exclusive
   c) Dependent events d) Correlated events
2. The relationship between probability density function and cumulative distribution function is ------------------
3. The number of telephone calls made during a period of time is a
   a) Gaussian process b) Binomial process
   c) Poisson process d) Exponential process
4. and
5. Which one of the following is a discrete random sequence?
   a) Output of a sine wave generator b) Output of Modulator
   c) Output of a microphone d) Output of Huffman Encoder
6. Cross correlation function of the input and output of a LTI system with impulse response is ___________
7. The transfer function of the system given in the following figure is



   a) b)
   c) d)
8. The capacity of binary symmetric channel is _____________
9. Entropy is a measure of the
   a) Probability of message b) Uncertainty
   c) Amount of information d) Rate of information
10. The capacity of binary symmetric channel is _____________

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. Using Venn diagram for three sets A,B,C, shade the areas corresponding to the sets:

    i) $(A \cup B) - C$ ii) $\bar{B} \cap A$

12. Define the terms Variance and Skew.

13. Give any two examples for discrete random variable.

14. Random variable X and Y have the joint density function

$$f_{X,Y}(x,y) = \begin{cases} \frac{1}{24}, & 0 < x < 6 \ \ and\ 0 < y < 4 \\ 0\ , & elsewhere \end{cases}$$

    What is the expected value of the function $g(X,Y) = XY$.

15. If $X(t)$ is a stationary process, find the power spectrum of $Y(t) = A_o + B_o X(t)$ in terms of the power spectrum of $X(t)$ if A_o and B_o are constants.

16. State central limit theorem.

17. Find whether the given system is LTI : $y(t) = 5.x(t) + 3$

18. Why is the matched filter an optimum filter?

19. What is the significance of source coding theorem?

20. The channel data rate for GSM cellular system is specified as 270.833 kbps. The channel bandwidth is 200 KHz. If the signal to noise ratio (SNR) of a wireless communication channel is 10 dB, show that the maximum achievable channel data rate is adequate for GSM specification.

PART C (5 x 14 = 70 Marks)

(Answer not more than 400 words)

Q.No. 21 is Compulsory

21. (i) State and prove Wiener-Khinchine relation. (10)

    (ii) An intercom system master station provides music to six hospital rooms. The probability that any one room will be switched on and draw power at any time is 0.4. When ON, a room draws 0.5 W. (4)

    a) Find and plot the density and distribution function for the random variable "power delivered by the mater station".

    b) If the master station amplifier is overloaded when more than 2W is demanded, what is its probability of overload?

22. (a) (i) Describe the Gaussian distribution with example. (7)

    (ii) A random process is defined by $X(t) = At$, where A is a continuous random variable uniformly distributed on (0, 1). (7)

    a) Determine the form of the sample functions.

    b) Classify the process.

    c) Is it deterministic?

(OR)

(b) (i) A joint sample space for two random variables X and Y has four elements (1,1), (2,2), (3,3) and (4,4). Probabilities of these elements are 0.1, 0.35, 0.05 and 0.5 respectively. (7)

a) Determine through logic and sketch the distribution function $F_{X,Y}(x,y)$.

b) Find the probability of the event $\{X \leq 2.5, Y \leq 6\}$.

c) Find the probability of the event $\{X \leq 3\}$.

(ii) Describe Binomial distribution with example. (7)

23. (a) (i) A two level semi-random binary process is defined by (7)

$$X(t) = A \; or - A \;, \quad (n-1)T < t < nT$$

where the levels A and $-A$ occurs with equal probabilitry, T is a positive constant, and $n = 0, \pm 1, \pm 2, ...$

Find the following :

a) The mean value $E[X(t)]$

b) $R_{XX}(t_1 = 0.5\,T, t_2 = 0.7\,T)$

c) $R_{XX}(t_1 = 0.2T, t_2 = 1.2T)$

(ii) List the properties of autocorrelation and cross correlation. (7)

(OR)

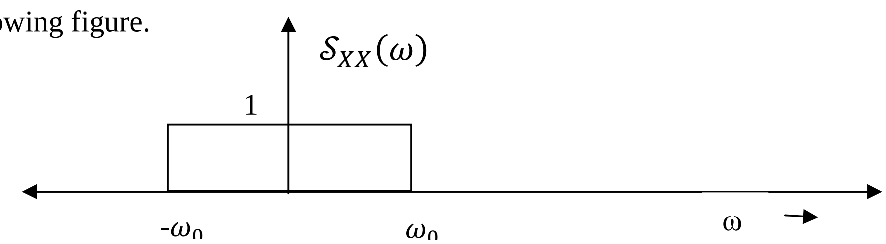
(b) (i) Two random processes are defined by (7)

$$Y_1(t) = X(t)\cos(\omega_0 t)$$

$$Y_2(t) = Y(t)\cos(\omega_0 t + \Theta)$$

where $X(t)$ and $Y(t)$ are jointly wide-sense stationary process. If Θ is a constant, is there any value of Θ that will make $Y_1(t)$ and $Y_2(t)$ orthogonal?

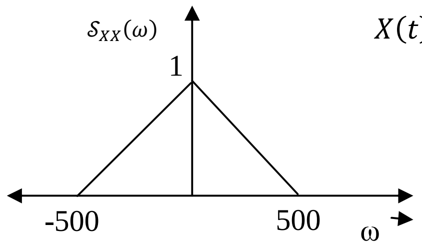
(ii) The power density spectrum $\mathcal{S}_{XX}(\omega)$ of a random process $X(t)$ is plotted in the following figure. (7)

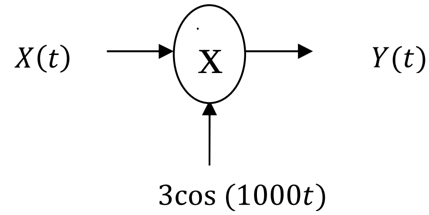


Find the autocorrelation function $R_{XX}(\tau)$ of the random process $X(t)$.

24. (a) (i) Derive the output power spectrum of LTI system for random input. (10)

(ii) Consider the following system with the random input $X(t)$. (4)



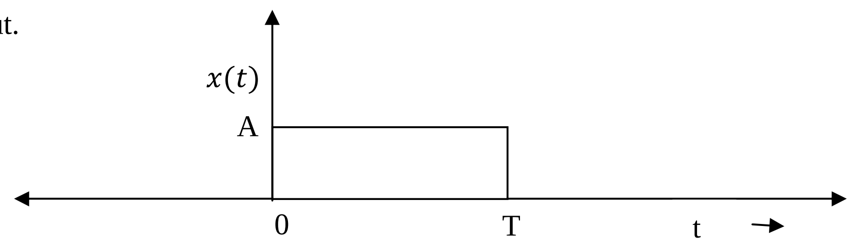


where $S_{XX}(\omega)$ is the power density spectrum of the input. Sketch the power density spectrum of $Y(t)$.

(OR)

(b) (i) Derive the impulse response and transfer function of the matched filter. (10)

(ii) Consider the following time domain signal $x(t)$. Determine the matched filter output. (4)



25. (a) (i) A memoryless source emits six messages with probabilities 0.3, 0.25, 0.15, 0.12, 0.1 and 0.08. Design the Huffman code for the source. Determine its efficiency. (10)

(ii) Describe the Discrete Memoryless Channel. (4)

(OR)

(b) State and derive channel capacity theorem.

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