2054

B.E. (Electronics and Communication Engineering)
Fourth Semester
EC-407: Probability and Random Processes

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt _five_ questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

1 a) When are two events said to be mutually exclusive? Explain with an example. (5×2)

b) Differentiate between ergodic and stationary processes.

c) Axiomatic approach of probability theory overcomes the limitations of classical approach. Discuss with suitable examples.

d) Find the capacity of the Binary Symmetric Channel when probability p is given as 0.6.

e) Why flicker noise is called low frequency noise?

Section - A

2 a) Enlist the properties of distribution function for continuous random variable. Let (4) X be a continuous random variable with pdf

$$f(x) = \begin{matrix} ax & ; 0 \leq x \leq 1 \\ a & ; 1 \leq x \leq 2 \\ -ax + 3a & ; 2 \leq x \leq 3 \\ 0 & ; otherwise \end{matrix}$$

(i) Determine the constant a;

(ii) P(X≤ 1.5)

b) Bayes theorem is a combination of addition and multiplication theorem. Justify (3) with the suitable mathematics.

c) Define the following: layer, Hilbert transform, Bandwidth of LPF. (3)

3 a) Write short note on Rayleigh distribution. (4)

b) The joint probability distribution of X and Y is given by, (6)

$$f(x,y) = \frac{1}{27}(2x + y); x: 0,1,2 \text{ and } y: 0,1,2$$

(i) Find the marginal distributions of X and Y.

(ii) Are X and Y independent random variables.

4 a) X(t) and Y(t) are the input and output of LTI system respectively. If X(t) is wide (4) sense stationary process, comment on the stationarity of the autocorrelation of Y(t).

b) Write down the properties of power spectral density. (3)

c) If X is a continuous random variable with pdf (3)

$$f(x) = \frac{2}{x^3} \; ; \; x \geq 1$$
$$0 \; ; \; x < 1$$

Find the Expectation of x.

Section - B

5 a) Apply the Huffman Coding to find the efficiency of the following message (5) ensemble:

[X] = [x1, x2, x3, x4, x5, x6, x7]

[P] = [0.4, 0.12, 0.12, 0.08, 0.08, 0.04 0.16]

b) Verify that: H(XY)= H(Y/X) + H(X) where H represent the entropy and X, Y are (5) transmitter and receiver respectively.

6 a) Explain the tradeoff between bandwidth and SNR. Define Shannon's limit. (5)

b) A signal is bandlimited to 8kHz. The signal is quantized in 6 levels of a system (5) with respective probabilities as 0.2, 0.1, 0.1, 0.05, 0.05 and 0.05. Calculate the entropy and the rate of information.

7 a) What is entropy? Prove that the entropy is maximized when probability of all (6) messages is equal.

b) In a cascade amplifier, show that the contribution to overall noise-figure is (4) primarily by the first stage and contribution by succeeding stages becomes smaller and smaller.

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