2055

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

Time allowed: 3 Hours   Max. Marks: 50

NOTE: Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

Q.1a) Define central limit theorem.   (5×2)

b) When is a stochastic process said to be ergodic.

c) Suppose a coin is flipped 3 times. What is the probability of getting two tails and one head?

d) Write down the properties of power spectral density.

e) Why flicker noise is called low frequency noise?

Section - A

Q.2a) Let X be a continuous random variable with pdf   (3)

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

(i) Determine the constant a; (ii)$P(X \leq 2.5)$

b) Bayes theorem is a combination of addition and multiplication theorem. Justify with (4)
the suitable mathematics.

c) Discuss briefly: Properties of Hilbert transform, Bandwidth of HPF.   (3)

Q.3a) If Z=aX+bY, where a and b are constants. Prove: EZ = aEX+bEY (E represents (5)
Expected value).

b) The joint probability distribution of X and Y is given by,   (5)

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

(i) Find the marginal distributions of X and Y.(ii) Are X and Y independent
random variables.

Q.4a) X(t) and Y(t) are the input and output of LTI system respectively. If X(t) is wide (5)
sense stationary process, comment on the stationarity of the autocorrelation of Y(t).

b) The number of calls received in a telephone exchange follows a Poisson distribution (5)
with an average of 10 calls per minute. What is the probability that in one-minute
duration,
(i) no call is received (ii) exactly 5 calls are received.

Section - B

Q.5a) Apply the Shannon Fano coding to find the efficiency of the following message (6)
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) What are discrete memoryless channels? Find the capacity of the Binary Symmetric (4)
Channel when probability p is given as 0.6.

P.T.O.

Q.6a) "For a fixed signal power, and in the presence of white Gaussian Noise, the channel (5) capacity approaches an upper limit with Bandwidth increased to infinity." Explain the related Trade-off.

b) A signal is band limited 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.

Q.7a) What is entropy? Verify that: $H(XY) = H(Y/X) + H(X)$ where H represent the (5) entropy and X, Y are transmitter and receiver respectively.

b) In a cascade amplifier, show that the contribution to overall noise-figure is (5) primarily by the first stage and contribution by succeeding stages becomes smaller and smaller.

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