1371

B. Tech 3rd Semester Examination

Communication Theory (O.S.)

EC-3002

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of question paper and all the subparts of the questions in Section E. Use of scientific calculator is permitted.

SECTION - A

1. (a)   State and prove Sampling Theorem used to reconstruct the original signal.   **(10)**

   (b)   Prove that total energy in a given non periodic time function is area of $|F(t)|^2$ curve and $|F(t)|^2$ is called energy spectral density.   **(10)**

2. (a)   State and prove the convolution theorem in time domain and frequency domain.   **(10)**

   (b)   Determine the frequency spectra of an impulse train.
                                                                   (10)

SECTION - B

3. (a)   Explain the difference between continuous and discrete random variable with example.   **(10)**

   (b)   The pdf of a continuous variate is $p(x) = ke^{-|x|}$, where k is unknown constant. Find k and corresponding probability function F(x).   **(10)**

4. (a) State and prove any three properties of autocorrelation function. **(10)**

   (b) Three balls are drawn at random from a box containing 500 white balls, 300 red balls and 200 black balls. Assuming that each ball is replaced before the next is drawn, find the probabilities of the following outcomes:

   (a) each ball is of different colour (b) two or more balls are of the same colour (c) no white balls (d) two or more black balls given that one ball is black **(10)**

SECTION - C

5. (a) Explain the role of thermal and partition noise in communication system. **(8)**

   (b White noise having spectral density of 2 volts^2 per cycle is applied to the RL high pass network with x(t) input and y(t) output. Determine the autocorrelation function and spectral density of the output y (t). **(12)**

6. Discuss the followings:

   (a) shot noise in space charge limited diodes (b) The maximum mean square error criterion (c) equivalent noise bandwidth (d) experimental determination of noise figure. **(20)**

SECTION - D

7. An analog signal having 4kHz bandwidth is sampled at 1.25 times the Nyquist rate and each sample is quantized into one of equally likely levels. Assume that successive samples are statistically independent.

   (a) What is the information rate of this source? (b) Can the output of this source without error over an AWGN channel with a bandwidth of 10kHz and an S/N ratio of 20 dB? (c) Find the S/N ratio required for error free transmission for part (i) (d) Find the bandwidth required for an AWGN channel for error free transmission of output of this source if S/N ratio is 20 dB. **(20)**

8. Discuss the followings:

   (a) Redundancy (b) Calculation of channel capacity of Discrete noisy channel (c) Entropy **(20)**

SECTION - E

9. (i) What is difference between discrete and continuous signal?

   (ii) What is a criterion for occurrence of Fourier Transform?

   (iii) State duality property and modulation property of Fourier Transform

   (iv) What is ergodic process?

   (v) What do you understand by moment and variance of continuous random variables?

   (vi) What is relation between autocorrelation and power spectral density?

   (vii) Explain the role of shot noise in triodes.

   (viii) What do you understand by non linear systems? Give one example.

   (ix) What are the units of information?

   (x) What is relationship between channel capacity and information rate? **(10×2=20)**