Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 710203 **Date: 13-06-2013**

Subject Name: Information Theory and Coding

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Derive the relationship between probability and PDF. **05**

(b) Apply Huffman coding method for the following message ensemble: **07**

[X] = [x_1 x_2 x_3 x_4 x_5 x_6 x_7]

[P] = [0.4 0.2 0.12 0.08 0.08 0.08 0.04]

Take M = 2

Calculate: (i) Entropy

(ii) Average Length

(iii) Efficiency

(c) Define Entropy and its unit. **02**

Q.2 **(a)** In a random experiment a trial consists of four successive tosses of a coin. If we define an random variable X as the number of heads appearing in a trial, determine $P_x(x)$ and CDF $F_x(x)$. **07**

(b) Explain Gaussian distribution for continuous random variables. **07**

OR

(b) (i) Explain how moments about origin can be found out from the characteristics function. **04**

(ii) Define random variable and differentiate between discrete and continuous random variable. **03**

Q.3 **(a)** A box contains 6 white, 5 red and 4 black balls. Three balls are drawn in succession. Find the probability that the balls will be of different colours. **04**

(b) Define random process and explain ensemble and time averages. **03**

(c) Apply Shanon Fano coding algorithm to given message ensemble: **07**

[X] = [x_1 x_2 x_3 x_4 x_5 x_6]

P[X] = [0.3 0.25 0.2 0.12 0.08 0.05]

Take M=2

Find out: (i) Entropy

(ii) Code words

(iii) average length

(iv) efficiency

OR

Q.3 **(a)** A continuous signal is bandlimited to 5 KHz. The signal is quantized in 8 levels of a PCM system with the **04**

probabilities 0.25, 0.2, 0.2, 0.1, 0.1, 0.05, 0.05 and 0.05. Calculate the entropy and the rate of information.

(b) Compare auto-correlation and cross correlation in detail. **03**

(c) Find the equation of channel capacity of a Gaussian channel. **07**

Q.4 **(a)** A discrete source transmits message x_1, x_2 and x_3 with the probabilities 0.3, 0.4 and 0.3. The source is connected to the channel given in fig. Calculate all the entropies. **07**

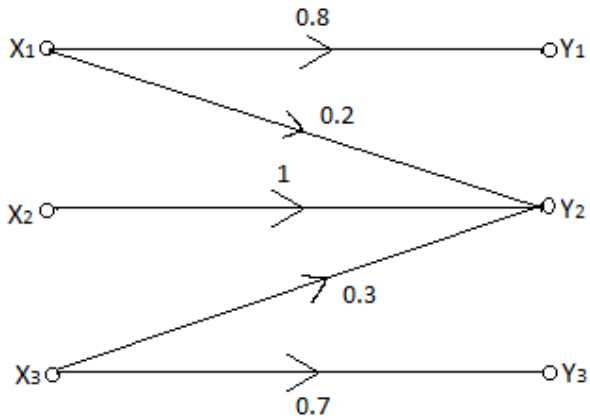

Fig.Q.4 (a)

(b) A communication system has S/N = 31 and BW = 3 kHz. Find the allowable percentage reduction in signal power if BW is increased to 4 KHz. **05**

(c) Write positive statement of Shanonôs theorem. **02**

OR

Q.4 **(a)** Write a short note on convolution coding. **07**

(b) The generator polynomial of a (7, 4) cyclic code is $g(x) = 1+x+x^3$. Find the code words for the following data (i) 1101 (ii) 0101 (iii) 1001 **05**

(c) What is kraftôs inequality ? **02**

Q.5 **(a)** For a (7,4) block code generated by [G] below, explain how the error syndrome helps in correcting a single error. **07**

$$G = \begin{bmatrix} 1000110 \\ 0100011 \\ 0010101 \\ 0001111 \end{bmatrix}$$

(b) Write a short note on Cryptography. **07**

OR

Q.5 **(a)** Explain lossy JPEG image compression standard. **07**

(b) Explain in short **07**

(i) Hamming Distance
(ii) Uniquely decodable codes
(iii) Central limit theorem

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