Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 712703N **Date: 12-01-2013**

Subject Name: Info Theory & Coding

Time: 02.30 pm – 05.00 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)** What is an instantaneous code? Describe the procedure to construct a binary instantaneous code with examples. **07**

(b) State and prove the Kraft's inequality theorem with an example. **07**

Q.2 **(a)** A binary symmetric channel has the following noise matrix with source probabilities of P(x1) = 2/3 and P(x2) =1/3. **07**

$$P(Y/X) = \begin{array}{c|cc|} & y1 & y2 \\ x1 & 3/4 & 1/4 \\ x2 & 1/4 & 3/4 \end{array}$$

Determine H(X),H(Y), H(Y/X), H(X/Y) and I(X,Y)

(b) A message source produces two independent symbols A and B with probabilities P(A)= 0.4 and P(B)=0.6. Calculate the efficiency of the source and hence its redundancy. If the symbols are received in average with 4 in every 100 symbols in error, calculate the transmission rate of the system. **07**

OR

(b) Show that H(X,Y)=H(X/Y)+H(Y) **07**

Q.3 **(a)** Consider a source S = {s1, s2} with probabilities ¾ and ¼ respectively. Obtain Shannon-Fano code for source S, its 2nd and 3rd extensions. Calculate efficiencies for each case. **07**

(b) (a) Apply Huffman encoding procedure for the following set of messages and determine the efficiency of the binary code so formed. **07**

x1	x2	x3
0.7	0.15	0.15

(b) If the same technique is applied to the 2nd order extension for the above messages, how much efficiency will be improved?

OR

Q.3 **(a)** The source emits the messages consisting of two symbols each. These messages and their probabilities are given below. Design the source encoder using Shannon's encoding algorithm and also find encoder efficiency. **07**

Message M_i	Probability P_i
AA	9/32
AC	3/32
CC	1/16
CB	3/32
CA	3/32
BC	3/32
BB	9/32

(b) Consider a source with 8 alphabets A to H with respective probabilities of 0.22, 0.20, **07**

0.18, 0.15, 0.10, 0.08, 0.05, 0.02. Construct binary, ternary and quaternary compact (Huffman) code and determine the efficiency in each case.

Q.4 **(a)** For a systematic (7,4) linear block code, the parity matrix P is given by **07**

$$[P]=\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{vmatrix}$$

Find all possible valid code-vectors and draw the corresponding encoding circuit.

(b) Design a single error correcting code with a message block size of 11 and show that by an example that it can correct single error. **07**

OR

Q.4 **(a)** What are different properties of Cyclic codes? Also compare cyclic codes with linear codes. **07**

Q.4 **(b)** The generator polynomial of a (15,7) cyclic code is $g(x)= 1+x^4+ x^6+ x^7+ x^8$. Find the code word in systematic form for the message (0 1 0 1 0 1 0). Also draw the block diagram for the encoder. **07**

Q.5 **(a)** Explain BCH code in detail. **07**

(b) Write a short note on Lossless Image Compression. **07**

OR

Q.5 **(a)** Write a short note on Cryptography. **07**

(b) What is Viterbi algorithm? Explain with an example. **07**

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