Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 710402N **Date: 09-01-2013**

Subject Name: Information Theory and 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)** Differentiate between the *source coding* and *channel coding*. Mention the obvious advantages of both of them. **07**

(b) What is the difference between the *block code* and the *instantaneous code*? Explain with examples. **07**

Q.2 **(a)** State and prove the *Kraft's inequality theorem* with suitable example. **07**

(b) Variable length coding is preferred over fixed length codes for better coding efficiency. Justify the statement with a suitable example. **07**

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

Q.3 **(a)** Construct a binary instantaneous code for the following source alphabets with the prescribed lengths of code words: **07**

Symbol	A	B	C	D	E	F	G
Length	2	4	7	7	3	4	7

(b) Find the ternary and quaternary (three and four code symbols) Huffman codes for the source shown in figure below: **07**

Symbol	A	B	C	D	E	F	G	H
Prob.	0.1	0.2	0.1	0.3	0.05	0.1	0.05	0.1

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Q.3 **(a)** i. Define *entropy* of an information source. Enlist and explain, briefly, some important properties of entropy. **04**

ii. Prove that for every binary instantaneous code the *average length (L)* ≥ *entropy (H(S))*. **03**

(b) For a binary symmetric channel (BSC), find H(X), H(Y), H(X|Y), H(Y|X) and I(X|Y). Let P(y1|x1) = 2/3, P(y2|x1) = 1/3, P(y1|x2) = 1/10, P(y2|x2) = 9/10, P(x1) = 1/3 and P(x2) = 2/3. **07**

Q.4 **(a)** Consider a (7,4) code whose generator matrix is given as: **07**

G = [1111000; 1010100; 0110010; 1100001]

i. Determine the codewords for message bits 0010, 1010 and 1101. Compute the syndrome of the received vector 1101101.

ii. Determine error detecting and correcting capabilities of the code.

(b) Write notes on *standard array* and error *detection* and *correction* of the linear block codes. **07**

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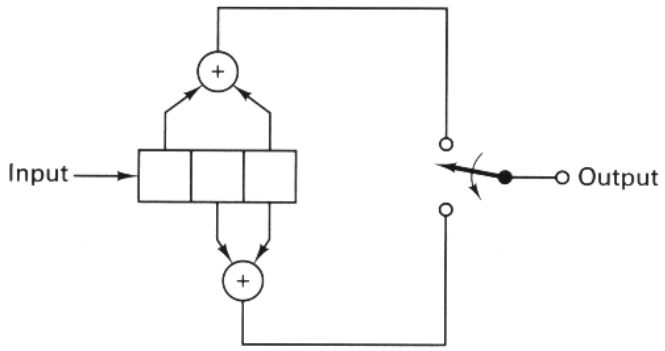
Q.4 (a) Explain the *perfect* code for single error correction. Draw and briefly describe the encoder for Hamming code of length 7. **07**

Q.4 (b) Design a feedback shift register encoder for an (8,5) cyclic code with a generator $g(X) = 1 + X + x^2 + x^4$. Use encoder to find the codeword for the message 10101 in a systematic form. **07**

Q.5 (a) For the Convolutional encoder shown in figure below (i) determine the connection vectors and polynomials and (ii) draw the state diagram, tree diagram and trellis diagram. **07**



(b) Explain the Reed-Solomon (RS) encoding and decoding procedure. **07**

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Q.5 (a) Compare the Viterbi and Sequential decoding algorithms for a Convolutional code stating their advantages and limitations. **07**

(b) Describe the data encryption standard *(DES) encryption* procedure. **07**

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