

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**

----- **OR** -----

- (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

----- **OR** -----

- 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) $\geq$ *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 $P(y_1|x_1) = 2/3$, $P(y_2|x_1) = 1/3$, $P(y_1|x_2) = 1/10$, $P(y_2|x_2) = 9/10$, $P(x_1) = 1/3$ and $P(x_2) = 2/3$. **07**

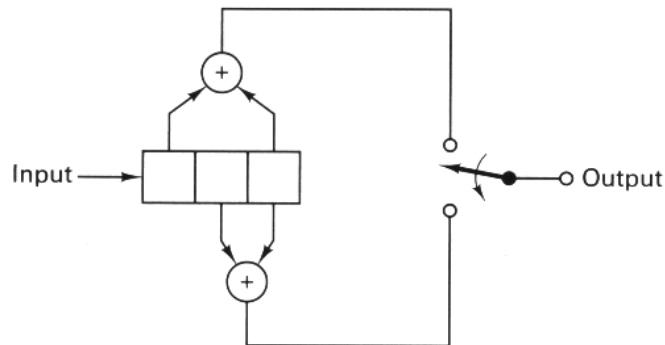
- Q.4 (a)** Consider a (7,4) code whose generator matrix is given as: **07**

$$G = [1111000; 1010100; 0110010; 1100001]$$

- 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

----- OR -----

- 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

----- OR -----

- 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
