Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER - I EXAMINATION – SUMMER 2017

Subject code: 2710502 **Date : 11/05/2017**

Subject Name: Information Theory and Coding

Time: 02:30 pm to 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*. Describe the necessities and methods of both types of coding. **07**

(b) With the help of suitable examples explain the difference between the *block code* and the *instantaneous code*. **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) Define *entropy* and discuss the conditions for maximum and minimum entropy. Enlist and explain, briefly, some important properties of entropy. **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 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)** Encode the sequence "BADF" using Arithmetic coding for the symbols with following probability distribution: **04**

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

03

(b) A source emits three equiprobable messages randomly and independently. **07**

i. Find the source entropy.

ii. Find the compact ternary code, the average length of the codeword, the code efficiency and the redundancy.

Q.4 **(a)** Consider a (7,4) block 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 vectors 1110010 and 1011010.

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

(b) What is *channel capacity?* State and prove the Shannon's fundamental theorem. **07**

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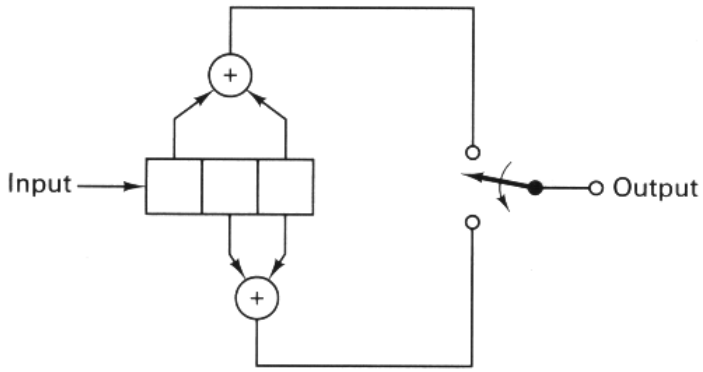
Q.4 **(a)** Explain the single error correction *perfect* code (Hamming code). **07**

Q.4 **(b)** Find a generator polynomial g(x) for a (7, 4) cyclic code and find code vectors for the following data vectors: 1010, 1111, 0001 and 1000. **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)** Explain the Sequential decoding algorithm for a Convolutional code stating its advantages and limitations. **07**

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

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