Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject code: 710402 N

Subject Name: Information Theory and Coding

Date: 01 /02 /2011 **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)** Explain the requirements of coding an information source. Describe the *2-out-of-5* code. Encode the sequence *"2709"* using this code. Is this encoding uniquely decodable? Justify. **07**

(b) What is an Instantaneous code? Describe the procedure to construct a binary instantaneous code. Give a few examples of an instantaneous code. **07**

Q.2 **(a)** Five symbols s1, s2, s3, s4 and s5 are given. Assign two different binary instantaneous codes to them. Draw the decoding trees for the same. Which one is a better assignment? Justify your answer. **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) Construct a ternary (three code symbols) instantaneous code for the following source alphabet with the prescribed lengths of code words: **07**

Symbol	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Length	1	3	3	4	4	2	2	2	2	2

Q.3 **(a)** State and prove the Kraft's inequality theorem with an example. **07**

(b) Encode the sequence *"BADF"* using Arithmetic coding for the symbols with following probability distribution: **07**

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

OR

Q.3 **(a)** i. The average code length (L_{min}) of a code will always be greater or equal to the source entropy *H(s)*. Justify the statement with a suitable example. **04**

ii. State and prove the relation between information rate, reliability and channel capacity for a noisy binary symmetric channel (BSC). **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 the linear block code with the codeword defined by: **07**
U = m1 + m2 + m4 + m5, m1 + m3 + m4 + m5, m1 + m2 + m3 + m5, m1 + m2 + m3 + m4, m1, m2, m3, m4, m5.

i. Find the Generator and parity check matrices.

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)** A (15,5) cyclic code has a generator polynomial of the following form: **07**

$g(X) = 1 + X + X^2 + X^5 + X^8 + X^{10}$

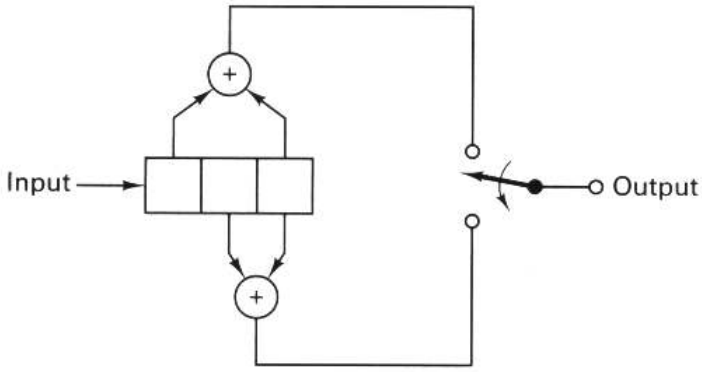
i. Draw the block diagram of the encoder for this code.

ii. Find the code polynomial (in systematic form) for the message $m(X) = 1 + X^2 + X^4$.

iii. Is $V(X) = 1 + X^4 + X^6 + X^8 + X^{14}$ a valid code polynomial?

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

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