

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014**

**Subject code: 710402N****Date: 02-12-2014****Subject Name: Information Theory and Coding****Time: 10:30 am - 01:00 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) State and prove Kraft inequality theorem. Encode the sequence “2709” using 2-out-of-5 code. Is this encoding uniquely decodable? Justify. **07**
- (b) Variable length coding is preferred over fixed length codes for better coding efficiency. Justify the statement with example. **07**

- Q.2** (a) A zero memory source emits six messages with probabilities 0.3, 0.25, 0.15, 0.12, 0.1 and 0.08. Find the 4-ary (quaternary) Huffman code. Determine its average word length, the efficiency and the redundancy. **07**
- (b) Can we have a channel with infinite channel capacity? Justify your answer with mathematical equations. **07**

**OR**

- (b) Explain Shannon-Fano code with an appropriate example. **07**
- Q.3** (a) A binary channel matrix is given by, It is also given  $P_X(x_1) = 1/3$ ,  $P_X(x_2) = 2/3$ . **07**

$$\begin{array}{cc} & \text{Output} \\ & y_1 \quad y_2 \\ \text{Input } \begin{array}{c} x_1 \\ x_2 \end{array} & \left[ \begin{array}{cc} \frac{2}{3} & \frac{1}{3} \\ \frac{1}{10} & \frac{9}{10} \end{array} \right] \end{array}$$

Determine  $H(x)$ ,  $H(x/y)$ ,  $H(y)$ ,  $H(y/x)$  and  $I(x,y)$ .

- (b) Compare the Viterbi and Sequential decoding algorithms for a Convolution code stating their advantages and limitations. **07**

**OR**

- Q.3** (a) A rate  $\frac{1}{2}$  convolution encoder with constraint length 3 is described by  $g_1(x) = 1+x+x^2$  and  $g_2(x) = 1+x^2$ . Draw the trellis diagram for this encoder and encode the message 10111. **07**
- (b) Explain the Reed-Solomon (RS) encoding and decoding procedure. **07**

- Q.4** (a) For a (6, 3) systematic linear block code, the three parity check digits are  $c_4 = d_1+d_2+d_3$ ,  $c_5 = d_1+d_2$ ,  $c_6 = d_1+d_3$  **07**
- i) Construct the appropriate generator matrix for this code and code table.
  - ii) Determine the error correcting capability.
  - iii) Decode the received words 101100, 000110, 101010.
- (b) Briefly explain Burst error detecting and correcting codes. **07**

**OR**

- Q.4** (a) Find a generator polynomial  $g(x)$  for a (7,4) cyclic code and find code vectors for the following data vectors: 1010, 1111, 0001, 1000. **07**

- (b) Consider a telegraph source having two symbols dot and dash. The dot duration is 0.2 sec and the dash duration is 3 times of the dot duration. The probability of the dot's occurring is twice that of dash and time between symbols is 0.2 seconds. Calculate information rate of telegraph source. **07**
- Q.5** (a) Give differences between public key and private key encryption. Discuss the Knapsack problem. **07**
- (b) An often –heard saying is that “A picture is worth a thousand words” Is a picture really worth a thousand words? Explain in the context of image compression. **07**
- OR**
- Q.5** (a) What is the output of the first iteration of the DES algorithm when the plaintext and the key are each made up of zero sequences? **07**
- (b) Explain JPEG standard for image compression. **07**

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