MEDC–301

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M. E. (Third Semester)
EXAMINATION, Feb./March, 2009
INFORMATION THEORY AND CODING

(Elective – IV)

(MEDC – 301)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 40

Note : Attempt any *five* questions. All questions carry equal marks.

1. (a) A transmitter has an alphabet of four letters $[x_1, x_2, x_3, x_4]$ and the receiver has an alphabet of three letters $[y_1, y_2, y_3]$. The joint probability matrix is :   15

$$P(xy) = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \end{array} \begin{array}{ccc} y_1 & y_2 & y_3 \\ \left[\begin{array}{ccc} 0\cdot3 & 0\cdot05 & 0 \\ 0 & 0\cdot25 & 0 \\ 0 & 0\cdot15 & 0\cdot05 \\ 0 & 0\cdot05 & 0\cdot15 \end{array}\right] \end{array}$$

Calculate all the entropies and mutual information.

(b) Explain channel capacity.   5

2. (a) Explain source coding theorem for discrete memoryless sources.   8

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(b) A discrete memoryless source has an alphabet of eight letters $x_i, i = 1, 2, ..., 8$ with probabilities [0·25, 0·20, 0·15, 0·12, 0·10, 0·08, 0·05, 0·05].   12

Use the Huffman encoding procedure to determine a binary code for the source output and find the efficiency. Suggest how the efficiency of Huffman code can be improved ?

3. (a) For the binary symmetric channel with transition probabilities :   12

$$P(0/1) = P(1/0) = P$$

find the channel capacity. Also plot the variation of channel capacity as a function of P.

(b) Find the channel capacity for the channel shown :   8
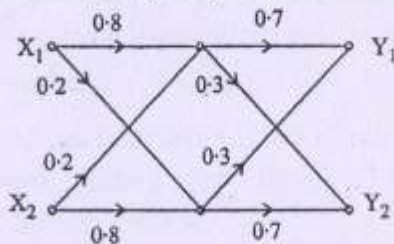
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4. The generator matrix for a linear binary code is :   20

$$G = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

(i) Express G in systematic form.

(ii) Determine the parity check matrix for the code.

(iii) Construct the table of syndromes for the code.

(iv) Determine the minimum distance of the code.

(v) Demonstrate that the code word corresponding to the information sequence (101) is orthogonal to parity check matrix.

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5. Find the generator polynomials for a cyclic code with block length $n = 7$. Also find the generator matrix from one the polynomial obtained. Draw the block diagram encoder.   rgpvonline.com

6. (a) Explain the structure and parameter of BCH code.

(b) Explain soft decision decoding and hard decision decoding of linear block codes and compare performance.

7. (a) A convolutional code is described by :

$$g_1 = [101], \; g_2 = [111], \; g_3 = [111]$$

draw the encoder corresponding to this code.

(b) Explain the decoding processes of convolutional code including Viterbi algorithm.

8. Write short notes on the following :   5 ea

(i) Lempel-Ziv coding

(ii) Hamming code

(iii) Fading channel

(iv) Shannon-Hartley theorem