Integral University, Lucknow

I Mid Semester Examination 2012-2013

INFORMATION THEORY AND CODING (EC-031)

Year : Final Year Electronics & Communication Engineering

Maximum Marks: 30

Time : 90 Minutes

Note: Attempt any three questions. Make figures, data sheets & graphs where it needed.

1. A discrete memoryless source has a alphabet of seven symbol whose probabilities of occurrence are as described here :

Symbol	s_0	s_1	s_2	s_3	s_4	s_5	s_6
Probability	0.25	0.25	0.125	0.125	0.125	0.0625	0.0625

   Compute the Huffman code for this source for the above.

2. Consider a Binary Symmetric Channel shown in the Fig 1.1 is emitting two symbols x_1 & x_2 and it's symbol emitting probability respectively is given as p & (1-p).

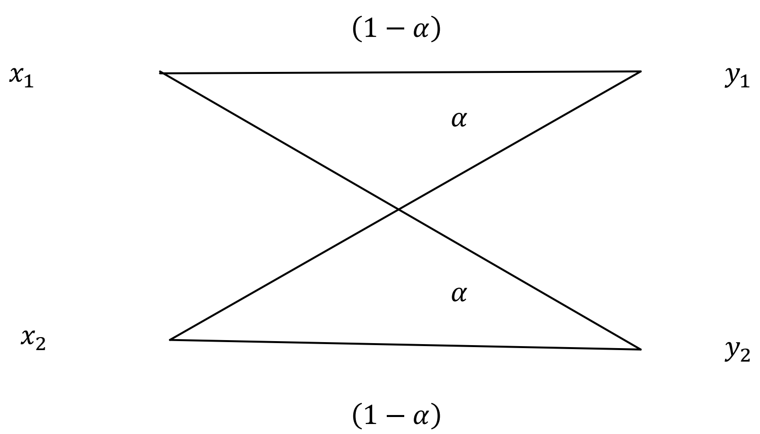

Fig 1.1 : Binary Symmetric Channel

Calculate the following parameters

(a). H(X)   (b). H(Y)   (c). H(X/Y)   (d). H(Y/X)   (e). I(X;Y)

3. Write short notes on the ISBN codes & bar codes.
4. Explain Shannon theorem with it's mathematical expressions in detail.
5. One of five possible messages Q_1 to Q_5 having their probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{16}$, respectively, is transmitted. Calculate the average entropy & design a codebook by using Shannon Fanon coding.

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1. Let a systematic block code whose parity check equations are given as

$$p_1 = m_1 \oplus m_2 \oplus m_4$$
$$p_2 = m_1 \oplus m_3 \oplus m_4$$
$$p_3 = m_1 \oplus m_2 \oplus m_3$$
$$p_4 = m_2 \oplus m_3 \oplus m_4$$

where m_i are the message digits & p_i are the check digits. Calculate the following

(I). Generator matrix & Parity check matrix of the above code.

(II). Calculate all code vectors

(III). Are the vector 10101010 & 01011100 the code vector.

2. Consider the convolutional encoder shown in the Fig 1 as below mention.

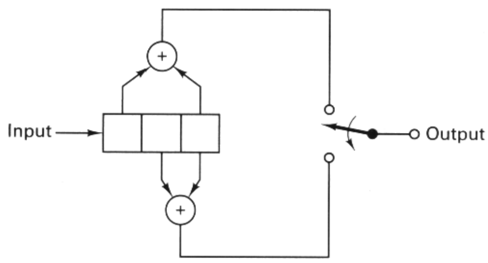

Fig 1

(I). Write the connection vectors and polynomial for this encoder.

(II). Draw the state diagram, tree diagram & trellis diagram.

3. Consider a block code (7,4) whose generator matrix is given as

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

(I). Find all code words of the code.

(II).Find H, the parity check matrix of the code.

(III).What is the error correcting & error detecting capability of the above code.

(IV). Compute the syndrome for the received vector 1101101. Is this a valid code vector.

4. Write down compression between Amplitude Modulation system or Frequency Modulation system with optimum system with appropriate plots & figures.
5. Explain Viterbi Convolutional Decoding Algorithm with appropriate examples.

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1. Fig 1.1 shows a Huffman tree. What is the code word for each symbols A, B, C, D, E, F & G represented by this Huffman tree. What are their individual codeword length.

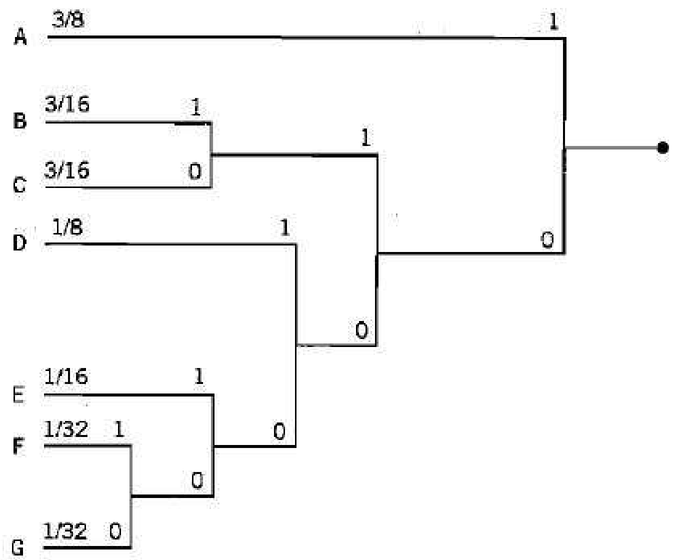

Fig 1.1

2. A *computer* executes four instructions that are designated by the code words (00, 01, 10, 11). Assuming that the instructions are used independently with probabilities (0.5, 0.125, 0.25, 0.125), calculate the percentage by which the number of an optimum source code. Construct a Huffman code to realize the reduction.

3. Write down shot notes on Feedback Communication.

4. (A). Let a *single parity check code*, a single parity bit is appended to a block of k message bits ($m_1, m_2, m_3, m_4, \dots \dots \dots \dots m_k$). The single parity but b_1 is chose so that the code word satisfied the even parity rule :

$$m_1 \oplus m_2 \oplus m_3 \oplus \qquad\qquad \oplus m_k \oplus b_1 = 0$$

For k = 4, set up the 2^k possible code words in the code defined by this rule.

(B). Let consider a Hamming code (7,4) which is define as the generator polynomial

$$g(X) = 1 + X + X^3$$

The code word 0111001 is sent over a noisy channel, producing the received code vector 0101001 that has a single error. Determine the syndrome polynomial s(X) for this received code word and show that it is identical to the error polynomial e(X).

5. Fig 1.2 shows the encoder for a rate r=0.5, constraint length K =4 convolution code. Determine the encoder output produced by the message sequence 10111..........

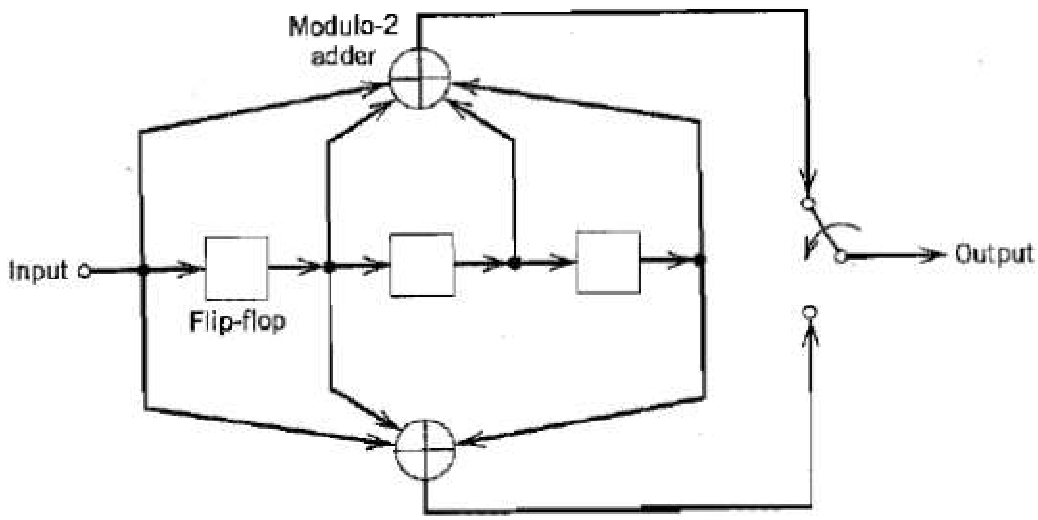

Fig 1.2