Department of Electronics & Communication Engineering

Faculty of Engineering, Integral University, Lucknow

Assignment Sheet 3

Information Theory & Coding (EC-031)

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Due Date : March 10, 2015

Problems : 10

1. Consider 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). How many error can this code can correct.

(III). Is the vector 10101010 is the code vector.

(IV). Is the vector 01011100 is the code vector.

2. 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.

3. The minimum distance for a particular linear block code is 11. Find the maximum error correcting capability, the maximum error detecting capability & maximum erasure correcting capability in the block length.

4. A (15,11) linear block code can be define by the following parity array

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

(I). Design the parity check matrix of the above code.

(II). A received code vector is [Y] = 011111001011011. Compute the syndrome. Assume that a single error is made in the received code vector.

5. Design a feedback shift register encoder for an (8,5) cyclic code with the generator polynomial $G(p) = [\,p^3 + p^2 + p + 1]$. Use the encoder to find the code vector for the message 10101 for the systematic form.

6. Determine which if any of the following polynomial can generate the cyclic code with code vector length $n \leq 7$. Find the (n, k) values of any such codes that can be generated.

(I). $1 + p^3 + p^4$

(II). $1 + p^2 + p^4$

(III). $1 + p + p^3 + p^4$

(IV). $1 + p + p^2 + p^4$

(V). $1 + p^3 + p^5$

7. It is given that K = 3 , rate = 0.5, binary convolution code with partial state diagram

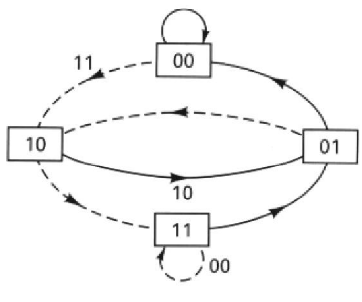

Fig 1 : State diagram

shown in the Fig 1. Find the complete state diagram and sketch a diagram for encoder.

8. Explain the working of Syndrome decoder for block codes & decoder for cyclic codes.
9. Consider the convolutional encoder shown in the Fig 2 as below mention.

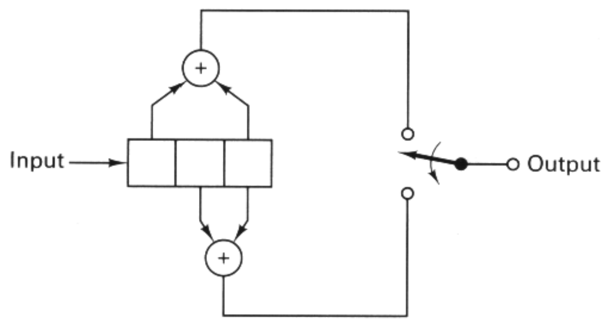

Fig 2

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

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

10. Consider the rate 2/3 convolutional encoder shown in the Fig 3. In this encoder, k=2 bits at a time are shifted into the encoder and n=3 bits are generated at the encoded output. There are kK = 4 stages in the register and the constraint length is K=2 in units of 2 bit bytes. The state of the encoder is defined as the contents of the rightmost K-1 k tuple stages. Draw the state diagram, the tree diagram and the trellis diagram.

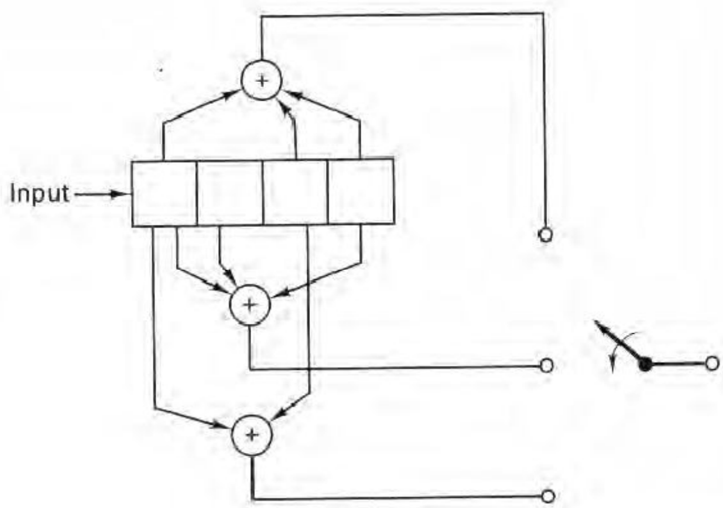

Fig 3