

International Islamic University Chittagong (IIUC)

Dept. of Electronic and Telecommunications Engineering

Final Examination

Program: B.Sc (Engg.)

Semester: Autumn-2018

Course Code: ETE-3505

Course Title: Information Theory & Error Coding

Full Marks: 50

Time: 2.5 Hours

[Group-A]

[Answer any two of the following questions]

- 1 (a) Although in channel coding extra band width is necessary due to the addition of redundant bits, still channel coding is used in all wireless communication systems. Why? Discuss in details. 5
- (b) What do you mean by *waveform coding* and *Structured sequences*? What are the basic differences between Orthogonal codes and Biorthogonal Codes? 5
- 2 (a) Encode the message 1 0 1 in systematic form using polynomial division and the generator $g(x) = 1 + X + X^2 + X^4$ 6
- (b) A (7, 4) Hamming code word received by a receiver is 1010111. Assuming the even parity state whether the received code word is correct or wrong. If wrong locate the bit having error. 4
- 3 Consider a (7,4) code whose generator matrix is 10

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

- i) Find all the codeword of the code.
- ii) Find \mathbf{H} , the parity check matrix of the code.
- iii) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?
- iv) What is error correcting capability of the code?

Part – B

[Answer any three (3) of the following questions]

- 4 Given a $K=3$, rate $\frac{1}{2}$, binary convolutional code with the partially completed state diagram shown in Fig.1 . Find the complete state diagram and sketch a diagram for the encoder. 10

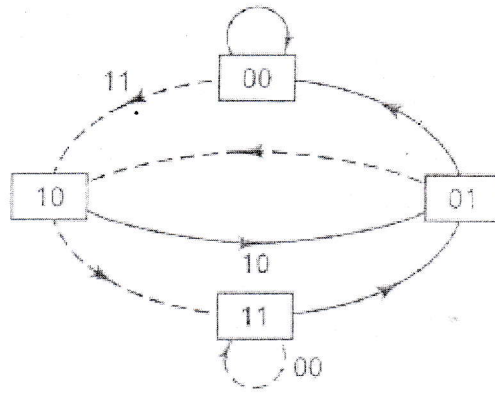


Fig.1

5 Draw the state diagram, tree diagram and trellis diagram for the convolutional encoder characterized by the block diagram in the following Fig.2

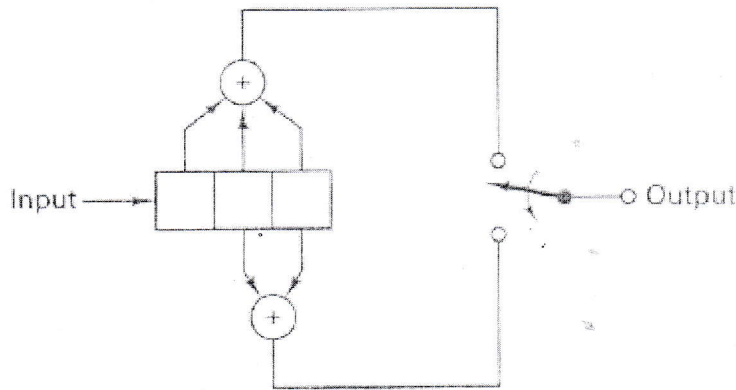


Fig.2

6 (a) What do you mean by hamming weight and hamming distance? 4
 (b) Design a feedback shift register encoder for an (8,5) cyclic code with a generator $g(x)=1+X+X^2+X^3$. Use the encoder to find the codeword for the message 10101 in systematic form. 6

7 (a) Consider a systematic block code whose parity check equations are 6

$$\begin{aligned}
 p_1 &= m_1 + m_2 + m_4 \\
 p_2 &= m_1 + m_3 + m_4 \\
 p_3 &= m_1 + m_2 + m_3 \\
 p_4 &= m_2 + m_3 + m_4
 \end{aligned}$$

Where m_i are message digits and p_i are check digits.

- i. Find the generator matrix for this code
- ii. How many errors can the code correct?

(b) Why do error correcting codes typically yield error performance degradation at low values of E_b/N_0 ? 4