

**R16**

**Code No: 137BE**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech IV Year I Semester Examinations, July/August - 2023**

**CODING THEORY AND TECHNIQUES**

**(Electronics and Communication Engineering)**

**Time: 3 Hours**

**Max.Marks:75**

**Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

- 1.a) Define self-information. [2]
- b) What is information rate? How is it measured? [3]
- c) Define Syndrome and Hamming Bound. [2]
- d) State the theorems related to minimum distance of linear block codes. [3]
- e) What is error trapping decoding? [2]
- f) List the properties of cyclic codes. [3]
- g) What is the advantage of a Trellis diagram? [2]
- h) Differentiate between state diagram and code tree of a convolutional encoder. [3]
- i) Write a note on BCH Bound. [2]
- j) Prove that syndrome components  $S_i$  and  $S_{2i}$  are related by  $S_{2i} = S_i^2$ . [3]

**PART – B**

**(50 Marks)**

2. Given the messages  $x_1, x_2, x_3, x_4, x_5, x_6$  with respective probabilities of 0.4, 0.2, 0.2, 0.1, 0.07, 0.03, construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed. [10]

**OR**

- 3.a) Prove that upper bound on entropy is given as  $H_{\max} \leq \log_2 M$ . Here  $M$  is the number of messages emitted by the source.

- b) Illustrate the error correcting capabilities of block codes. [5+5]

4. Design  $(n,k)$  hamming code with a minimum distance of  $d_{\min} = 3$  and a message length of 4 bits. [10]

**OR**

- 5.a) Derive expressions for block error probability and bit error probability of Linear Block Codes
- b) Draw the general decoding circuit for  $(n,k)$  LBC and explain its operation. [5+5]

6. Shorten the  $(15, 11)$  cyclic hamming code by deleting the 7 leading high-order message digits. The resultant code is  $(8, 4)$  shortened cyclic code. Devise a decoder for this code which eliminates the extra shifts of the syndrome register. [10]

**OR**

- 7.a) Discuss the concept of Majority logic decoding for cyclic codes.

- b) Construct  $H$  matrix for  $(15, 11)$  cyclic code using  $g(x) = 1 + x + x^4$ . Calculate the code polynomial for a message polynomial  $d(x) = 1 + x^3 + x^7 + x^{10}$ . [5+5]

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8. Consider a (3,1,2) convolutional code with  $g^{(1)} = (011)$ ,  $g^{(2)} = (110)$  and  $g^{(3)} = (101)$
- a) Draw the encoder block diagram
  - b) Find the generator matrix.
  - c) Find the code-vector corresponding to the information sequence  $d=10001$
  - d) Find the transfer function matrix.

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- 9.a) Discuss about the Encoding of convolutional Codes.
- b) Draw a (2, 1, 3) convolutional encoder with  $[1, 0, 1, 1]$  and  $[1, 1, 1, 1]$  as the impulse responses. Find the output of the convolutional encoder for input sequence 11011 using transform domain approach. [5+5]

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10. Discuss about the Error Location Polynomials for single error correction. [10]
11. How can BCH codes be decoded? Explain the procedure in detail. [10]

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