CBCS SCHEME

USN | | | | | | | | | | |

20ECS/ESP/ELD23

Second Semester M.Tech. Degree Examination, Jan./Feb. 2023
Error Control Coding

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Mutual Information. Derive and explain the properties of mutual information. **(10 Marks)**

b. Consider a discrete memoryless source with S = (x, y, z) with the state probabilities P = (0.7, 0.15, 0.15) for its output.
(i) Apply Huffman encoding algorithm to find codeword in binary. Find the source efficiency and redundancy.
(ii) Consider the second - order extension of the source. Compute the codeword for this extended source and also find its efficiency. **(10 Marks)**

OR

2 a. Define the following terms:
(i) Group (ii) Field (iii) Properties of field (iv) Characteristics of field. **(10 Marks)**

b. For a set of integers G = {0, 1 ..... m–1} where m is a positive integer. Show that
$(i \boxplus j) \boxplus k = i \boxplus (j \boxplus k)$ where $\boxplus$ denotes module m addition. **(10 Marks)**

Module-2

3 a. In an LBC, the syndrome is given by
$S_1 = r_1 + r_2 + r_3 + r_5$
$S_2 = r_1 + r_2 + r_4 + r_6$
$S_3 = r_1 + r_3 + r_4 + r_7$
(i) Find the parity check matrix [H]
(ii) Draw the encoder circuit.
(iii) Find the codeword for all input sequences.
(iv) How many errors it can detect and correct?
(v) What is the syndrome for the received data 1011011? **(10 Marks)**

b. Write a note on Product codes and Interleaved codes. **(10 Marks)**

OR

4 a. Given the generator matrix for an LBC

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

Find (i) The values of n and k
(ii) Write G in its systematic form
(iii) Find all codewords
(iv) Find d_{min}
(v) Find the error detecting and correcting capability of the code. **(10 Marks)**

b. Form the generator matrix of a second order Reed Muller code RM m = 4, r = 2 of length n = 16. What is the minimum distance of the code? **(10 Marks)**

Module-3

5 a. A (15, 5) linear cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$.
   i) Draw the block diagram of an encoder and syndrome calculator for this code
   ii) Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form
   iii) Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ a code polynomial? **(10 Marks)**

b. Explain the decoding circuit for a cyclic Hamming code. **(10 Marks)**

OR

6 a. With a block diagram, explain the decoding operation of error trapping decoder for n(15, 7) cyclic code generated by $g(x) = 1 + x^3 + x^6 + x^7 + x^8$. **(10 Marks)**

b. Write note on shortened cyclic codes with examples. **(10 Marks)**

Module-4

7 a. With necessary circuit explain the implementation of Galois field Arithmetic addition and multiplication. **(10 Marks)**

b. Give the important parameters and features for RS code. Give the encoding circuit for q-ray R-S code and explain the symbols used in the circuit. **(10 Marks)**

OR

8 a. Explain with suitable diagram type-I . One step majority logic decoder error correction procedure. **(10 Marks)**

b. Explain decoding steps in RS code. **(10 Marks)**

Module-5

9 a. Consider the (3, 1, 2) convolution code with $g^{(1)} = (1\ 1\ 0)$, $g^{(2)} = (1\ 0\ 1)$, $g^{(3)} = (1\ 1\ 1)$.
   (i) Find the constraints length
   (ii) Find the rate
   (iii) Draw the encoder block diagram.
   (iv) Find the generator matrix.
   (v) Find the codeword for the message sequence (1 1 1 0 1) using time-domain and transfer-domain approach. **(10 Marks)**

b. With a flow chart explain ZJ or Stack Algorithm. **(10 Marks)**

OR

10 a. Explain the steps involved in Viterbi algorithm. **(10 Marks)**

b. Consider the received sequence be r = (11, 11, 11, 11, 00, 10, 11). Decode the given received vector using stack algorithm. **(10 Marks)**

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