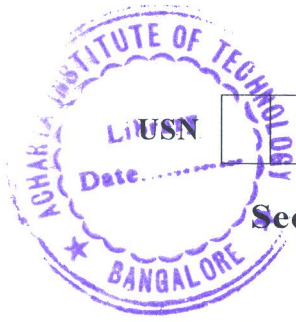


CBCS SCHEME

18ECS23



Second Semester M.Tech. Degree Examination, June/July 2019 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. A discrete memory less source has alphabet of five symbols with their probabilities as given below :

Symbol	S_0	S_1	S_2	S_3	S_4
Probabilities	0.4	0.2	0.2	0.1	0.1

Compute Huffman code by placing composite symbol as high as possible and by placing composite symbol as low as possible. Also find the :

- i) The average code word length
- ii) The variance of the average code word for both of the cases. (10 Marks)

OR

- 2 a. For a set integers $G = \{0, 1, 2, \dots, m-1\}$ where m is any +ve integer, show that $(i \boxplus j) \boxplus k = i \boxplus (j \boxplus k)$ where \boxplus denotes module in addition. (08 Marks)
- b. Explain the construction of Galois field $G^F(2^m)$ a field F . (08 Marks)
- c. Let V be a vector space over a field F .
Prove that for any C in F and any V in V $(-C) \cdot (V) = C \cdot (-V) = -(C \cdot V)$. (04 Marks)

Module-2

- 3 a. The syndrome of a (7, 4) linear code is given by :
 $S_0 = r_0 + r_3 + r_5 + r_6$
 $S_1 = r_1 + r_3 + r_4 + r_5$
 $S_2 = r_2 + r_4 + r_5 + r_6$
Find the following :
i) Find the generator matrix draw the encoder circuit
ii) Draw syndrome circuit
iii) Find all possible code vectors
iv) How many errors can it detect and correct?
v) Detect and correct errors if $r = 1001010$. (14 Marks)
- b. If $C = DG$ is a valid code vector prove that $CH^T = 0$ where H^T is transpose of parity check matrix H . (06 Marks)

OR

- 4 a. Write a note on product codes and interleaved codes. (10 Marks)
- b. Form the generator matrix of a second order reed Muller code $RM(r=2, m=4)$ of length 16. What is the minimum distance of the code? (10 Marks)

Module-3

- 5 a. A (15, 5) binary cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$.
- Draw the encoder block diagram
 - Find the code polynomial for message polynomial $d(x) = 1 + x^2 + x^4$ in systematic form.
 - Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ is a code polynomial? If not find the syndrome of $v(x)$. (10 Marks)
- b. With a block diagram, explain the decoding operation of error trapping decoder for a(15, 7) cyclic code generated by $g(x) = 1 + x^4 + x^6 + x^7 + x^8$. (10 Marks)

OR

- 6 With a block diagram explain decoding circuit for (31, 26) cyclic Hamming code generated by $g(x) = 1 + x^2 + x^5$. If the above Hamming code is shortened by three digits. Draw and explain the decoding circuit for resultant (28, 23) shortened cyclic code. (20 Marks)

Module-4

- 7 a. Give the circuit for Galois field $GF(2^4)$ adder and multiplier (for multiplying $GF(2^4)$ by α^3) and explain their operation. What is requirement of these circuits? (10 Marks)
- b. Give the important parameters and features of 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. Example with suitable diagram type-I one step majority logic decoder error correction procedure. (10 Marks)
- b. Draw and explain type-2, two step majority logic $g(x) = 1 + x + x^3$.

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

(10 Marks)

Module-5

- 9 a. For a rate $\frac{1}{2}$ convolutional encoder with a transfer function :
 $G(x) = [1 + x^2 + x^3, 1 + x + x^2 + x^3]$, draw the encoder circuit and state diagram, hence evaluate the codeword produced by the input sequence 1 0 1 1 1. (10 Marks)
- b. With a flow chart explain ZJ or stack algorithm. (10 Marks)

OR

- 10 a. Explain the steps involved in viterbi algorithm. (06 Marks)
- b. Consider the convolutional encoder with $g(x) = [1 + x, 1 + x^2, 1 + x + x^2]$. If the received sequence $v = [110, 110, 110, 111, 010, 101, 101]$. Using Viterbi algorithm find the transmitted bit sequence. Assume that the codeword is transmitted over BSC channel. (14 Marks)
