CBCS Scheme

USN | | | | | | | | | |

16/17ECS/ELD22

Second Semester M.Tech. Degree Examination, June/July 2018

Error Control Coding

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define mutual information of the channel and state the properties. **(08 Marks)**

b. Define a group, and construct the group under module–5 addition and multiplication over GF(5). **(08 Marks)**

OR

2 a. Define channel capacity of a discrete memory less channel consider a binary symmetric channel with equal source input probabilities, for conditional error probability of 'p' show that the channel capacity C is given by $C = 1 - H(p)$. **(06 Marks)**

b. Construct a table for $GF(2^4)$ based on the primitive polynomial $p(X) = 1 + X + X^4$. Display the power polynomial and vector representations of each element. **(06 Marks)**

c. Given the matrix G write the parity check matrix H and $G = \begin{bmatrix} 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$.

Show that the raw space of G is the null space of H. **(04 Marks)**

Module-2

3 a. For a systematic (7, 4) linear block code the priority matrix is given by P :

i) Draw the encoding circuit
ii) Draw the syndrome calculation circuit
iii) Detect and correct the error in the received vector R = [1 0 1 1 1 0 0].

$$p = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}.$$ **(10 Marks)**

b. Discuss the reed Muller code and its properties. **(06 Marks)**

OR

4 a. For a (6, 3) linear code generated by the G matrix :

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

i) Construct the standard array (with one bit error)
ii) Determine the probability of decoding error if the transition probability for a BSC is $p = 10^{-2}$
iii) Correct any errors in the received vector. $\gamma_1 = (010110)$ and $\gamma_2 = (011101)$. **(10 Marks)**

b. Construct the generator matrix and parity check matrix with n = 5 for
i) Single parity check code ii) Repetition code. **(06 Marks)**

Module-3

5 a. Design an encoder for a (7, 4) cyclic code with $g(x) = 1 + x + x^3$. Find the code word for the message (1010) with shift register contents. **(06 Marks)**

b. Write the decoding circuit for the (7, 4) cyclic code generated by $g(x) = 1 + x + x^3$. Describe the error correction process for the received word $\gamma = (1011011)$, shift into the shift register from left end. **(10 Marks)**

OR

6 a. Prove that an (n, k) linear code C is cyclic if every cyclic shift of a code word in C is also a code word in C. **(06 Marks)**

b. With a neat diagram explain the principle of operation of (31, 26) decoding circuit for a cyclic hamming code, generated by $g(x) = 1 + x^2 + x^5$ what modification is required for (28, 23) shortened cyclic code. **(10 Marks)**

Module-4

7 a. Describe the parameters of binary primitive BCH codes and determine g(x) for double error correction and triple error correction. **(08 Marks)**

b. Write the Galoisfield implementation of multiplying an arbitrary element in $GF(2^4)$ by 2^3 with $\phi(X) = 1 + X + X^4$. **(08 Marks)**

OR

8 a. Evaluate the syndrome for the double error correcting (15, 7) BIH code with received vector $\gamma = (1000\ 0000\ 1000\ 000)$. **(08 Marks)**

b. With a neat block diagram explain the operational steps of general type – II one step majority logic decoders. **(08 Marks)**

Module-5

9 a. i) Develop the convolutional encoder with k = 4, rate ½
$g_1(x) = 1 + x^2 + x^3$, $g_2(x) = 1 + x + x^2 + x^3$

ii) Determine the code word for the message m = 11101 with initial condition as zero. **(10 Marks)**

b. Discuss the feedback decoding method to decode the convolutional code at the receiver. **(06 Marks)**

OR

10 a. Write the convolutional encoder with k = 3, rate ½
$g_1(x) = 1 + x + x^2$, $g_2(x) = 1 + x^2$

b. Write the state diagram

c. Write the decoding trellis diagram

d. Correct the error in the received sequence Z = 1101011001 using viterbi algorithm. **(16 Marks)**

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