CBCS SCHEME

USN

18ECS/ELD23

Second Semester M.Tech. Degree Examination, Aug./Sept.2020
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 Entropy of a source and show that

$$H(s) = \sum_{k=0}^{k-1} p_k \log_2\left(\frac{1}{p_k}\right)$$

where $S = \{s_0, s_1, s_2, \ldots s_{k-1}\}$ and $P = \{p_0, p_1, p_2, \ldots .p_{k-1}\}$. **(06 Marks)**

b. Determine the entropy of the second extension of the source. With source alphabets $S = \{s_0, s_1, s_2\}$ with the respective probabilities $P = \{¼, ¼, ½\}$ and show that $H(s^{(2)}) = 2H(s)$. **(08 Marks)**

c. Define field and the basic properties of fields. **(06 Marks)**

OR

2 a. Discuss the Shannon's source coding theorem. **(06 Marks)**

b. Show that the channel capacity of a binary symmetric channel is given by C = 1 – H(p) where 'p' represents the conditional probability of error. **(06 Marks)**

c. Construct the modulo – 7 addition and multiplication tables for GF(7). **(08 Marks)**

Module-2

3 a. The parity matrix P for a systematic (7, 4) linear block code is given by

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

(i) Find all possible code vectors.
(ii) Draw the encoding circuit.
(iii) Detect and correct error in $\gamma = (1001001)$ **(14 Marks)**

b. Write the general decoder for a linear block code and explain the error correcting procedure. **(06 Marks)**

OR

4 a. Define Hamming weight, Hamming distance and minimum distance of code vectors with examples. **(06 Marks)**

b. Write the G and H matrices for the single parity check code and repetition code. **(04 Marks)**

c. Discuss the parameters of Hamming codes. Construct the H matrix for (7, 4) Hamming code. Also obtain the shortened Hamming code and show that the minimum distance is 4. **(10 Marks)**

Module-3

5 a. Construct the generator matrix and parity check matrix for a (7, 4) cyclic code given by $g(x) = 1 + x + x^3$ in both systematic and non systematic form. **(10 Marks)**

b. With a neat block diagram, explain the working of general cyclic decoder (Meggitt Decoder). **(10 Marks)**

OR

6 a. Construct a (7, 4) cyclic encoder with $g(x) = 1 + x + x^3$ suppose the message u = (1011), determine the complete code word and the code polynomial. Show the register contents when each of the data bits is shifted into the encoder. **(10 Marks)**

b. Explain the principle of operation of a complete decoding circuit for a cyclic Hamming code in steps. **(10 Marks)**

Module-4

7 a. Let α be a primitive element of the $GF(2^4)$ such that $1 + \alpha + \alpha^4 = 0$. Determine the generator polynomial for the double error and triple error correcting BCH code. **(10 Marks)**

b. Device a circuit to multiply an arbitrary element β of GF (2^4) by the element α^3, where α is the primitive element with minimal polynomial $\phi(x) = 1 + x + x^4$. **(10 Marks)**

OR

8 a. With a neat block diagram, explain the principle of operation of general type-I one step majority logic decoder. **(10 Marks)**

b. Draw the block diagram of general type II one step majority logic decoder and explain the error correction process. **(10 Marks)**

Module-5

9 a. For the convolutional encoder shown in Fig.Q9(a), find the output for the message (10111) using :

(i) Time domain approach

(ii) Transform domain approach and verify the result

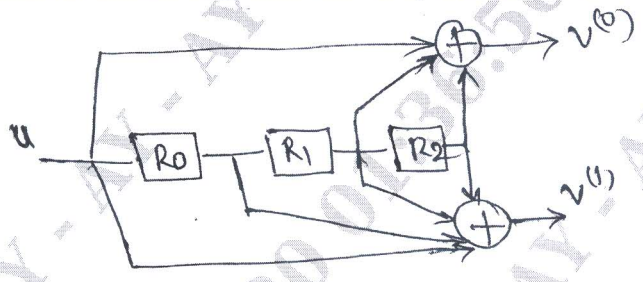

Fig.Q9(a) **(14 Marks)**

b. Write the block diagram of suitable catastrophic encoder and explain. **(06 Marks)**

OR

10 a. The convolutional encoder is as shown in Fig.Q10(a).

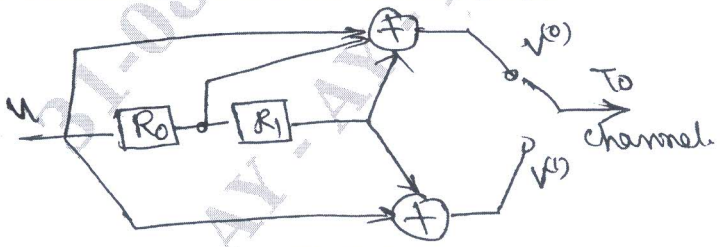

Fig.Q10(a)

(i) Write the state table

(ii) Write the state diagram

(iii) Trellis diagram (encoder) and trace the code output code for the message (1101) **(15 Marks)**

b. Discuss the viterbi convolutional decoding algorithm. **(05 Marks)**

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