G/E/TX

Reg. No: 21BEC2280

Final Assessment Test – May 2024

VIT® Vellore Institute of Technology

Course: **BECE313L - Information Theory and Coding**

Class NBR(s): **1199 /1203 / 1206 / 1209 / 1213** Slot: **A2+TA2**

Time: **Three Hours** Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

(10 X 10 = 100 Marks)

1.(a) Compute the missing probability value of *c* and identify the type of probability matrix M_1. Calculate all the entropies, when the channel is characterized by M_1.

$$M_1 = \begin{bmatrix} \frac{1}{5} & 0 & 0 & 0 \\ \frac{3}{40} & \frac{9}{40} & 0 & \frac{1}{20} \\ 0 & \frac{1}{15} & \frac{2}{15} & 0 \\ 0 & 0 & c & \frac{1}{15} \\ 0 & 0 & \frac{1}{15} & 0 \end{bmatrix}$$

OR

1.(b) A communication system is described by a Probability matrix M_2 as shown below. Identify the type of probability matrix. Compute H(X), H(Y), H(X, Y), H(Y/X) and H(X/Y). The probabilities of occurrence of received symbols are given as {0.17, 0.23, 0.6}.

$$M_2 = \begin{bmatrix} 0.12 & 0.35 & 0.17 \\ 0.59 & 0.43 & 0.5 \\ 0.29 & 0.22 & 0.33 \end{bmatrix}$$

2. Identify the channel from the noise transition matrix as given in Figure 1. Determine the mutual information $I(X,Y)$ and channel capacity for the same in which a source delivers **0** and **1** with equal probability into a binary erasure channel.

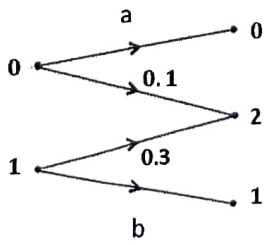

Figure 1 Noise Transition matrix

3. a) Apply Shannon Fanos encoding for the given messages generated by the source X and calculate the average length of the code word, codeword and also efficiency. Given : [5]

$X = \{X_1, X_2, X_3, X_4, X_5, X_6\}$

$\{0.4, 0.25, 0.15, 0.1, 0.07, 0.03\}$

b) The source emits symbols {a, b, c, d, e, f} with probability of occurrence of symbols {0.67, 0.11, 0.07, 0.06, 0.05, 0.04}. Apply arithmetic encoding to the message given below. [5]

abaaae

4. Design a Ternary Huffman code for the following symbols and calculates its code efficiency and redundancy.

Symbol	A	B	C	D	E	F	G
Probability	0.21	0.19	0.15	0.125	0.125	0.10	0.10

5.(a) Apply adaptive Huffman coding algorithm for the following message

ferrari

OR

5.(b) Given the Initial dictionary in Table 1, using LZW method decode the sequence for the encoder output [3, 1, 2, 1, 4, 6, 1, 5, 5, 7, 9, 7, 3]

Table 1

Index	String
1	A
2	L
3	M
4	Y

6. Construct the MPEG-4 Video coding model with proper justification of each block and show the motion compensated prediction of second frame from first frame.

7. Consider a (7,4) linear block code:

(i) Determine whether it is a Hamming code or not?

(ii) Find the parity check matrix H of the code in systematic form.

(iii) What is the minimum hamming distance of the code? How many error can be detected and corrected?

(iv) Draw the encoder circuit.

(v) Suppose the received vector R = [1 1 0 1 0 1 1], then decode the code vector.

8. Given a systematic (7, 4) cyclic code with generator polynomial $g(x) = x^3 + x + 1$.

(i) Find code vectors for the following data words: (A) 1010 (B) 1111

(ii) Draw an encoder arrangement for the above code through proper explanation.

(iii) Determine the data vectors transmitted for the received vector

[1101 101]

9. Consider the trellis diagram as provided in Figure 2 below related to a $\frac{1}{3}$ convolutional encoder. Suppose the received sequence is $r = 010000100001\ldots$ Find the transmitted sequence using Viterbi algorithm.

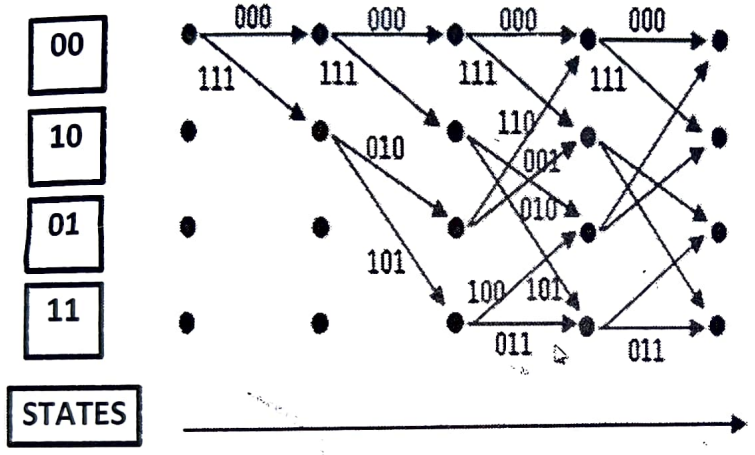

Figure 2 Trellis Diagram

10. Write short note on Message passing decoding on Tanner graph.

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