


VIT

 Vellore Institute of Technology
Established by the Vellore Institute of Technology Society, Vellore, Tamil Nadu, India
Final Assessment Test – May 2024

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

 Class NBR(s): **1197 / 1200 / 1201 / 1204 / 1212**
1216

 Slot: **A1+TA1**

 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**

General Instruction : Assume your data if any data is missing
Answer ALL Questions
(10 X 10 = 100 Marks)

- 1.(a) The joint probability of transmitted and received messages of a communication system is given below in Figure 1. Find all entropies

1/4	0	1/10	0
0	1/4	0	1/20
0	0	1/10	1/20
0	1/20	0	1/10
0	0	0	1/20

Figure 1
OR

- 1.(b) Consider two sources S_1 and S_2 emitting messages $\{X_1, X_2, X_3\}$ and $\{Y_1, Y_2, Y_3\}$. Given $P(X) = \{9/27, 16/27, 2/27\}$. The $P(Y/X)$ is given below in Table 1.

Table 1

$P(Y/X)$	Y_1	Y_2	Y_3
X_1	0	4/5	1/5
X_2	1/2	1/2	0
X_3	1/2	2/5	1/10

Find all entropies.

2. i) Identify the channel from the Figure 2 and also determine its capacity. [5]

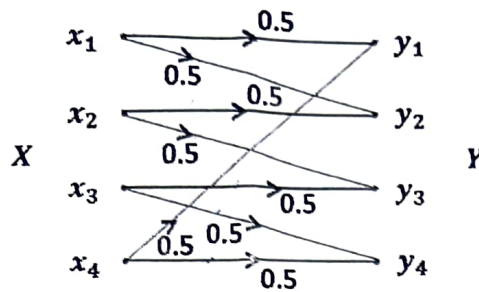


Figure 2

- ii) Compute mutual information if symbol emitted by sources are equiprobable. [5]

3. i) Apply Shannon Fano Elias Coding for the source generating 5 symbols $\{x_1, x_2, x_3, x_4, x_5\}$ and their corresponding probability of occurrence are $\{0.2, 0.15, 0.15, 0.25, 0.25\}$. Compute the code word and efficiency of the code. [5]

- ii) The source emit symbols $\{A, B, C, \#\}$ with probability of occurrence of symbols are $\{0.4, 0.3, 0.1, 0.2\}$. Apply arithmetic decoding to decode the encoded four symbols when the code word in decimal format is 0.23608. [5]

4. Design a Quaternary Huffman code for the following symbols in Table 2 and calculates its code efficiency.

Table 2 : Symbol and Probability

Symbol	A	B	C	D	E	F	G	H
Probability	0.20	0.18	0.16	0.14	0.12	0.10	0.05	0.05

- 5(a) Assume source is generating only lower case English alphabets. Encode the following string using adaptive Huffman encoding procedure.

bigboss

OR

- 5.(b) Two young British soldiers during the First World War, who are ordered by General Erinmore to deliver a message to Colonel Mackenzie during Operation Alberich in 1917. This message is especially important to one of the young soldiers, as his brother is taking part in the pending attack. The message is encoded as [2, 7, 5, 7, 6, 3, 5, 8, 2, 1, 5, 11, 4, 4, 16, 18, 20, 4] using LZW algorithm with the following initial dictionary as shown in Table 3. Help Colonel Mackenzie to decode the message.

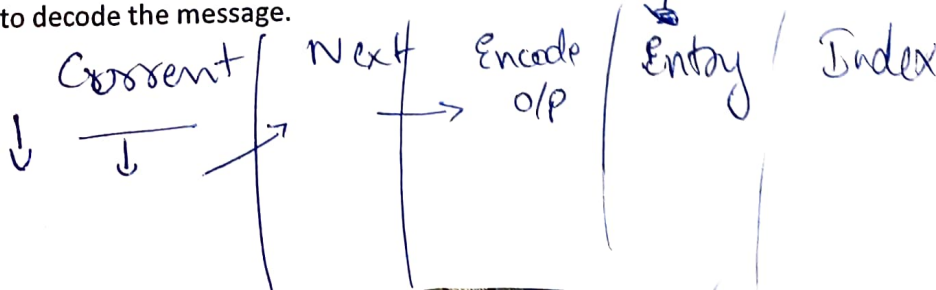


Table 3: Initial dictionary

1	A
2	C
3	E
4	F
5	L
6	N
7	O
8	-

6. Construct the MPEG audio coding model with proper justification of each block and show the frame structure for Layer 1, Layer 2 and Layer 3.

7. Consider a $(5,1)$ linear block code defined by the generator matrix

$G = [1 \ 1 \ 1 \ 1 \ 1]$ which is in the form of $[I_k \ P]$

- Find the parity check matrix of the code in systematic form.
- Compute the code words.
- Compute the minimum distance d_{min} of the code. How many errors can the code detect and correct?
- Design an encoder circuit.
- Draw the syndrome generator diagram.

$d_{min} \leq 5$
 $t \leq 2$

8. The message $[1 \ 0 \ 0 \ 1 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0]$ is said to be transmitted in a cyclic code with generator polynomial $g(x) = x^2 + 1$.

(a) How many check bits does the encoded message contain?

(b) Calculate the transmitted code word.

(c) Sketch the encoder circuit to obtain the remainder bits.

Syndrome polynomial

9. Consider a $(2,1,3)$ convolutional encoder shown below in Figure 3:

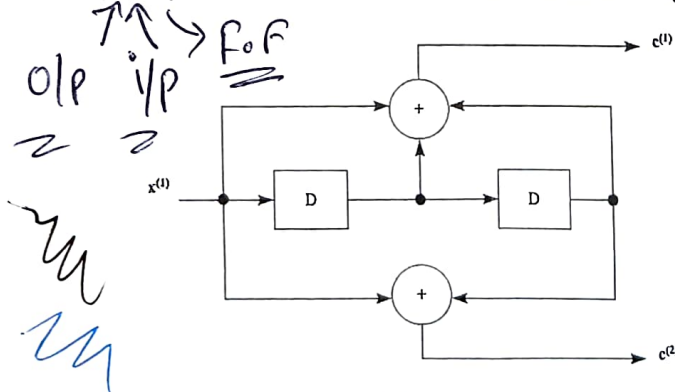


Figure 3

Draw the state diagram, code tree for $t=4$. From the state diagram compute the encoded output for the input sequence 1011.

10. Write short note with suitable illustrations and explain Polar Code.

$\Leftrightarrow F/E/TX \Leftrightarrow$