UNIT-V (5 marks)

1) What are the different methods of decoding of convolutional codes? Explain?

A) There are three different methods:-

a) Viterbi Algorithm

b) Sequential decoding

c) Feedback decoding.

a) Viterbi Algorithm :-

i) First of all we have to draw trellis diagram for the code word.

ii) Find the minimum distance path.

Step-1 :- We have to take the code what we received.

Step-2 :- Now we have to draw the state diagram based on x_1 & x_2 equations.

Step-3 :- Then we have to draw the trellis diagram based on the next values.

Step-4 :- Next we have to represent like if value is 0 then "——" and if value is 1 then "-·-·--·-":

Step-5 :- Now we have to compare the received code values with values and then find minimum distance b/w them.

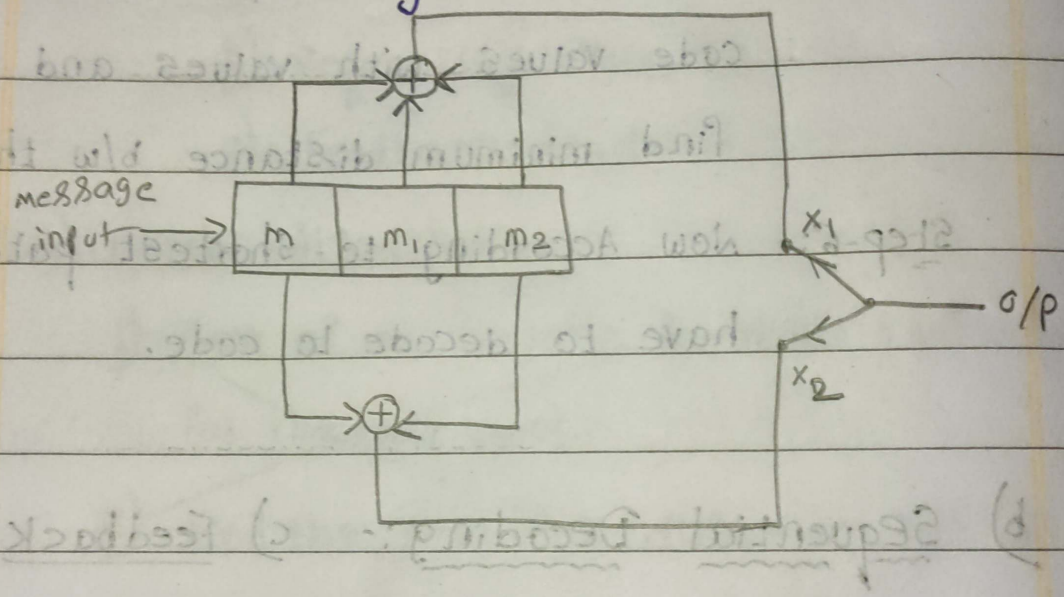
Step-6 :- Now According to shortest path we have to decode to code.

b) Sequential Decoding :- c) Feedback Decoding :-

Both b & c are not there in our syllabus.

2) Explain the trellis diagram decoding using viterbi decoding algorithm?

Ans Now let us take the 3rd question figure and for that figure we have to draw state table and trellis diagram..



Let us write the equations for above figure

$$X_1 = m \oplus m_1 \oplus m_2$$

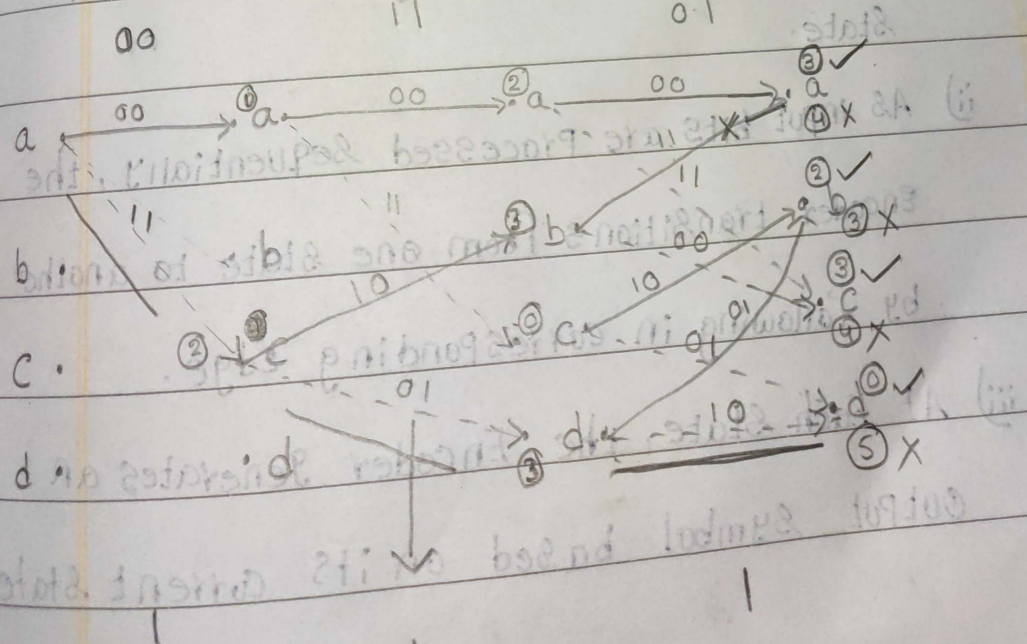
$$X_2 = m \oplus m_2.$$

Now Draw the State table.

a - 00
b - 01
c - 10
d - 11

	m	m_1	m_2	x_1	x_2	next State.
a	0	0	0	0	0	a
	1	0	0	1	1	c
b	0	0	1	1	1	a
	1	0	1	0	0	c
c	0	1	0	1	0	b
	1	1	0	0	1	d
d	0	1	1	0	1	b
	1	1	1	1	0	d.

Let us take one code i.e 00 11 01



3) Already we draw the state table in the 2nd Question, for 3rd Question.

4) Briefly describe the code tree, Trellis and state Diagram?

→ * Code Tree :-

The main components of a code tree

a) Nodes
b) Edges
c) depth.

The Encoding process :-

i) The Encoding process begin from initial state.

ii) As input bits are processed sequentially, the encoder transitions from one state to anothe by following in corresponding edge.

iii) At Each State, the Encoder generates an output symbol based on its current state.

* Trellis diagram :-

The components of a Trellis diagram :-

a) Nodes
b) Edges
c) Branch Metrics.

Process to draw a trellis diagram :-

→ First of all we have to observe the code tree diagram.

→ After that we have to maintain "x_1" and "x_2" Equations in place of x_1 & x_2 we can replace any other variables.

→ After that we have to draw the state table.

→ Then after we have to find the x_1 & x_2 and Next State values.

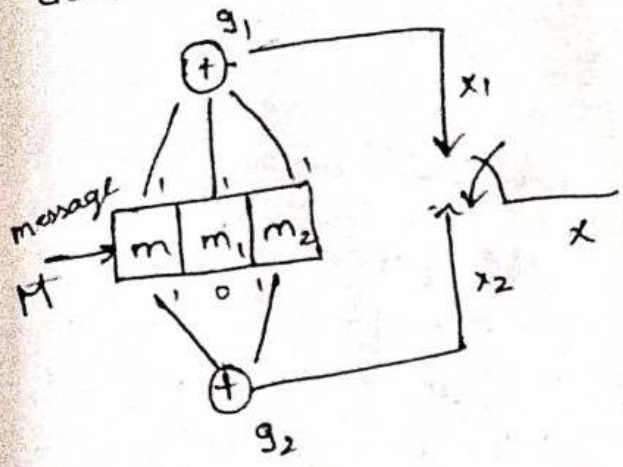
→ The Next Step is we have to draw the trellis diagram based on input values either "0" or "1".

5) With an Example, Explain decoding using viterbi algorithm?

→ You can refer 2nd Question.

Transform Approach:-

In tranform approach binary code is represented in polynomial expression for the given circuit the details are as shown.



$M = 1101$

for given M,

$M(P) = P^3 + P^2 + 1$

$X_1(P) = M(P)\, G_1(P)$

$X_2(P) = M(P)\, G_2(P)$

from the circuit, generators

$G_1 = [1\ 1\ 1] = G_1(P) = P^2 + P + 1$

$G_2 = [1\ 0\ 1] = G_2(P) = P^2 + 1$

for $X_1(P) = M(P)\, G_1(P)$

$= (P^3 + P^2 + 1)(P^2 + P + 1)$

$= P^5 + P^4 + P^2 + P^4 + P^3 + P + P^2 + P + 1$

$= P^5 + P + 1$

for $X_2(P) = M(P)\, G_2(P)$

$= (P^3 + P^2 + 1)(P^2 + 1) = P^5 + P^3 + P^4 + P^2 + P^2 + 1$

$= P^5 + P^4 + P^3 + 1$

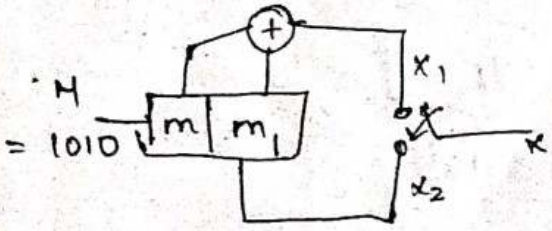
$X_1(P) = 100011$

$X_2(P) = 111001$

code word $X = [x_1 x_2 x_1 x_2]$

$X = [110101001011]$

2) $M = 1010$



code rate = 1/2

constraint length = 4

$M = 1010$

$M(P) = P^3 + P$

$X_1(P) =$

Verify the code word using time & Traform approach.

$M = 1010$

$x_1 = m \oplus m_1$

$x_2 = m_1$

m	m_1	x_1	x_2
0	0	0	0
1	0	1	0
0	1	1	1
1	0	1	0
0	1	1	1
0	0	0	0

Code word

$x = [x_1\ x_2\ x_1\ x_2 \cdots]$

$x = [1011101100]$

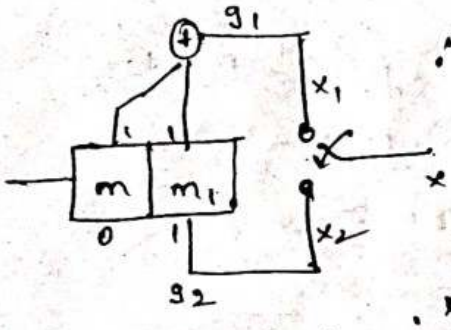
$\therefore$ code word length

$n = 2[4+2-1]$

$= 2[5]$

$= 10$

Transfer Approach :-



$\therefore g_1 = [1\ 1] \Rightarrow g_1(p) = p+1$

$g_2 = [0\ 1] \Rightarrow g_2(p) = 1$

$M(p) = p^3 + p$

$x_1 = M(p)\,g_1(p)$

$= (p^3+p)(p+1)$

$= p^4 + p^3 + p^2 + p$

$= 11110$

$x_2 = M(p)\,g_2(p)$

$= p^3 + p$

$x_2 = 01010$

Code word :- $x = [x_1\ x_2\ x_1\ x_2 \cdots]$

$x = [1011101100]$