Mod 4 - ITC

Cyclic Codes

→ **Basics**

① Linearity Property
② Cyclic shifting

→ **Non - Systematic codes**

$C(x) = m(x) \cdot g(x)$ $\quad C = [msg, parity]$ ✗

① Get $m(x)$ using msg
② Get $g(x)$
③ Get $C(x)$
④ Convert to bits

→ **Systematic codes**

$C(x) = x^{n-k} m(x) + P(x)$ $\quad C = [msg, parity]$ ✓

where,

$$P(x) = \text{remainder} \left[\frac{x^{n-k} m(x)}{g(x)} \right]$$

→ **Generator Matrix**

$[G] = [I : P]$

(n, k) $\quad n \rightarrow$ col

$k \rightarrow$ rows

1st row : $\text{Rem} \left[\frac{x^{n-1}}{g(x)} \right]$

2nd row : $\text{Rem} \left[\frac{x^{n-2}}{g(x)} \right]$

⋮

→ Encoder designing & Syndrome calculation

Create diagram based on $g(x)$

Then make table → For 7,4 atleast

m	P_1	P_2	P_3
	$m \oplus P_3$	$P_3 \oplus P_1$	P_2
	0	0	0
,			
,			
,			

Extra:

For Syndrome

$S = [P_3 \; P_2 \; P_1]$

→ CRC

① Data & Divisor given

② Append Divisor length-1 '0' to Data

③ XOR continuously

④ Last 3 bits are CRC

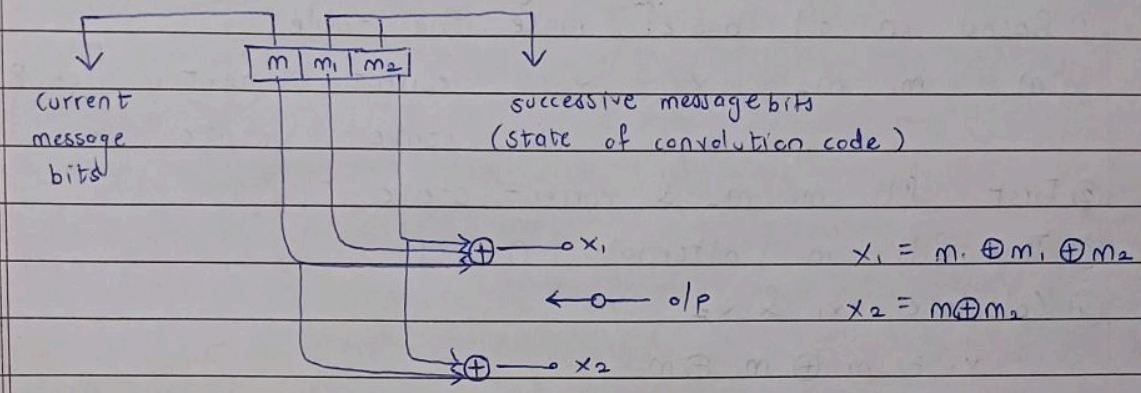
⑤ T_x = Data : CRC

For error,

just check if CRC ≠ 0

Convolution codes

→ Basics



State Table

m_1	m_2	state
0	0	a
0	1	b
1	0	c
1	1	d

k = no. of msg bits = 1

n = no. of encoded o/p bits = 2

K = constraint length = 3

r = code rate = $\frac{k}{n}$ = $\frac{1}{2}$

(n, k) = ~~codst~~ code dimensions = (2, 1)

→ Code tree

① One i/p will be given

② Draw shift register diagram at each step, inputting bits one by one

③ Find x_1 x_2 at each register

④ Determine state - a, b, c, d at each shift register

⑤ Add one extra register with m = – & shifted m_1, m_2, also find its state.

⑥ Draw code tree

a) start with horizontal line
   - down step : i/p 1
   - up step : i/p 0

b) write state at each step up/down

c) Write x_1 x_2 at each line

→ Code trellis & State diagram

① Based on all basics, make the table

m	m_1	m_2	x_1	x_2	current state	next state

[of 8 rows]

② First fill m_1, m_2 & current state

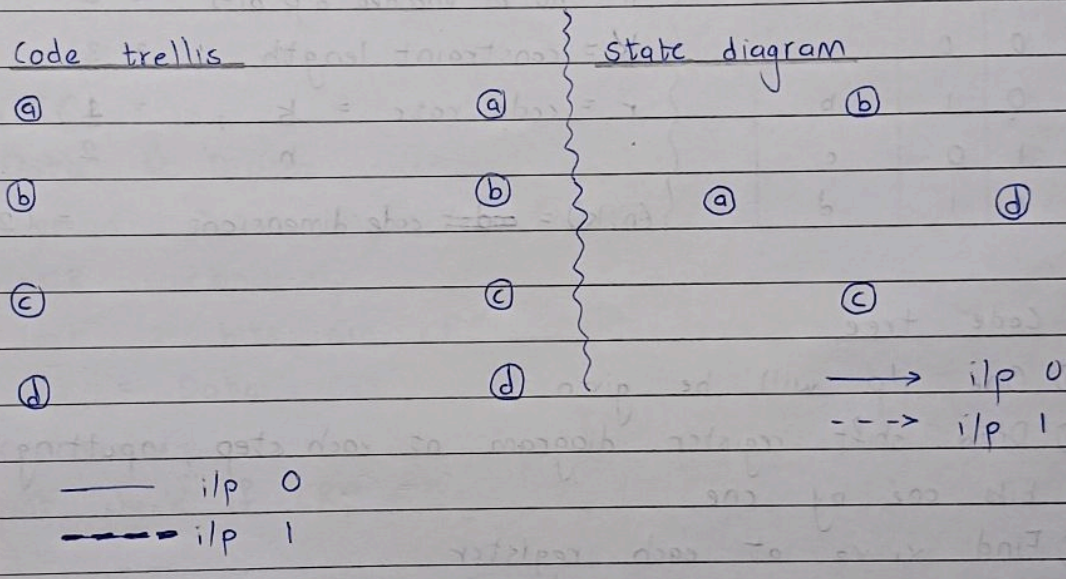
③ Then fill m, alternate 0 & 1

④ Calculate x_1 & x_2

$x_1 = m \oplus m_1 \oplus m_2$

$x_2 = m \oplus m_2$

⑤ Calculate next state by considering m → m_1 → m_2 →



⑥ Write $x_1 x_2$ value on each line