LBC: Encoder and Decoder

(7,4) Block Coder

$$C_5 = m_1 \oplus m_2 \oplus m_3$$

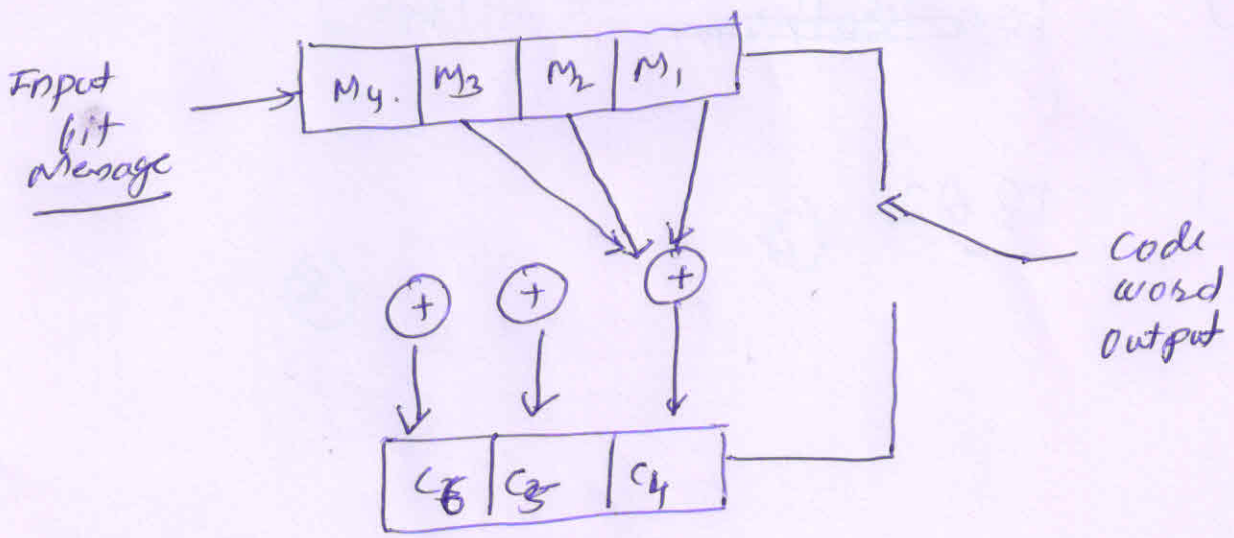
$$C_6 = m_1 \oplus m_2 \oplus m_4$$

$$C_7 = m_1 \oplus m_3 \oplus m_4.$$

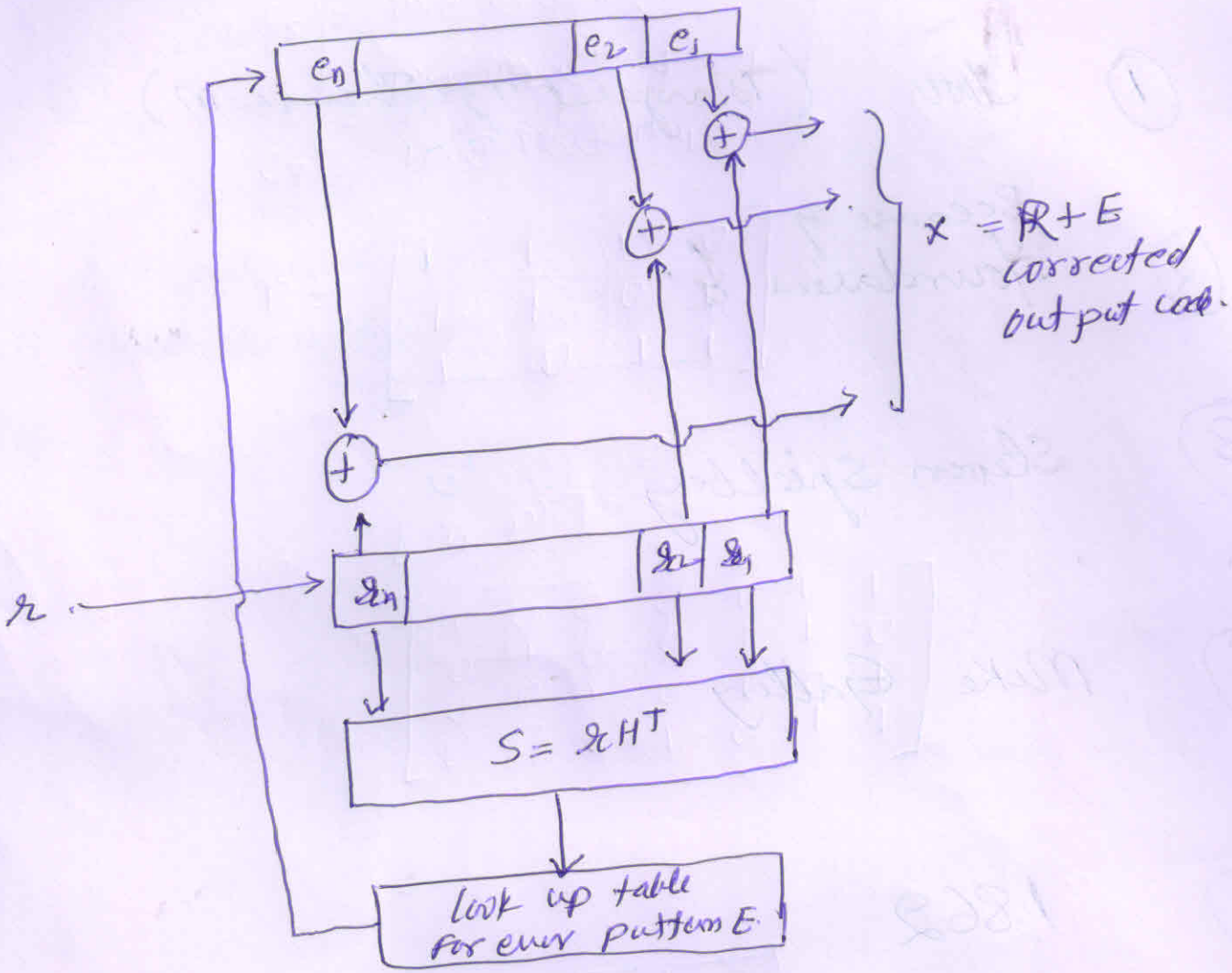
$$P = \begin{bmatrix} 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

$$G = [I_4 \; P^T]$$

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



Syndrome Decoder for (n,k) Block code



Q. The parity check bits of (8, 4) block code are generated

$$C_5 = d_1 + d_2 + d_4$$
$$C_6 = d_1 + d_2 + d_3$$
$$C_7 = d_1 + d_3 + d_4$$
$$C_8 = d_2 + d_3 + d_4$$

(i) Find P, G, H

(ii) List all code vector.

(iii) Find d_{min}, t_d and t_c

Conversion of Non-systematic Generator Matrix into Systematic Matrix.

(5, 3) Linear Block Code.

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

(a) Determine systematic form of G.

(b) for d = 011, generate codeword ~~for~~ with both Systematic G & Non-systematic G.

Sol

(a)
$$G = \begin{matrix} x \\ \checkmark \\ x \end{matrix}\begin{bmatrix} 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

$\Downarrow R_3 \rightarrow R_3 + R_2$

to

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

$\Downarrow R_1 \rightarrow R_1 + R_3$

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

(b) $c = dG$.

$$c = [0\ 1\ 1]\begin{bmatrix} 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix} = [0\ 0\ 1\ 1\ 1]$$

$$c = [0\ 1\ 1]\begin{bmatrix} 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 \end{bmatrix} = [0\ 1\ 1\ 1\ 0]$$