

Q Determine the single error correcting code for the BCD no 1001 using even parity.

Soln:- Step 1:- Find the no of parity bits

$$2^p \geq m+p+1$$

$m \rightarrow$  data bits  $p =$  parity bits.

$$p = 0$$

$$2^0 = 1 \quad \cdot \quad m+p+1$$
$$4+0+1 \quad \times$$

$$p = 1$$

$$2^1 = 2 \quad \quad 4+1+1 \quad \times$$

$$p = 2$$

$$2^2 = 4 \quad \quad 4+2+1 \quad \times$$

$$p = 3$$

$$2^3 = 8 \geq 4+3+1 \quad \checkmark$$

$$p = 3$$

3 bits are sufficient.

$$\text{Total code bits} = 4+3 = 7.$$

Step 2:- Construct a bit position table, and enter the information bits. Determine the Parity bits.

D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	P <sub>2</sub>	P <sub>1</sub>
1	0	0	1	1	0	0
7	6	5	4	3	2	1

Parity bit position

$$2^p \quad \{p=0, 1, \dots, p\}$$

$$2^0 = 1 \quad 2^1 = 2 \quad 2^2 = 4$$

$$P_1 = 3 \ 5 \ 7$$

$$P_2 = 3 \ 6 \ 7$$

$$\underline{0} \quad 1 \ 0 \ 1$$

$$0 \quad 1 \ 0 \ 1$$

$$P_4 = 3 \ 5 \ 6 \ 7$$

$$\underline{1} \quad 0 \ 0 \ 1$$

Q Determine the single error correcting code for the instruction code 10110 for odd parity

Step 1:-  $m = 5 \rightarrow$  Apply  $2^p \geq m + p + 1$

$$p = 0$$

$$p = 1 \times$$

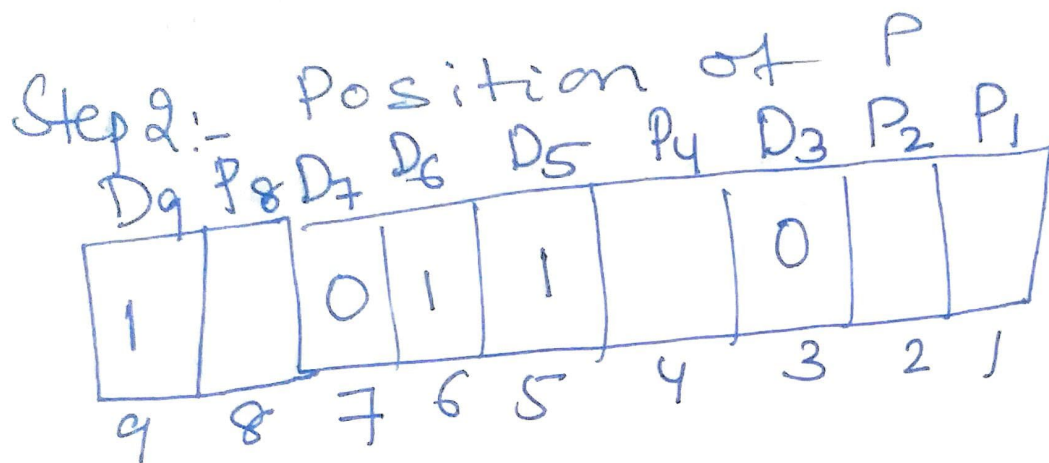
$$2^0 = 1 \quad 5 + 0 + 1$$

$$p = 2 \times$$

$$p = 3 \times$$

$$2^4 = 16 \geq 5 + 4 + 1 \quad \underline{\underline{p = 4}}$$

∴ The total no. of bits are  
 $5+4=9$



1001

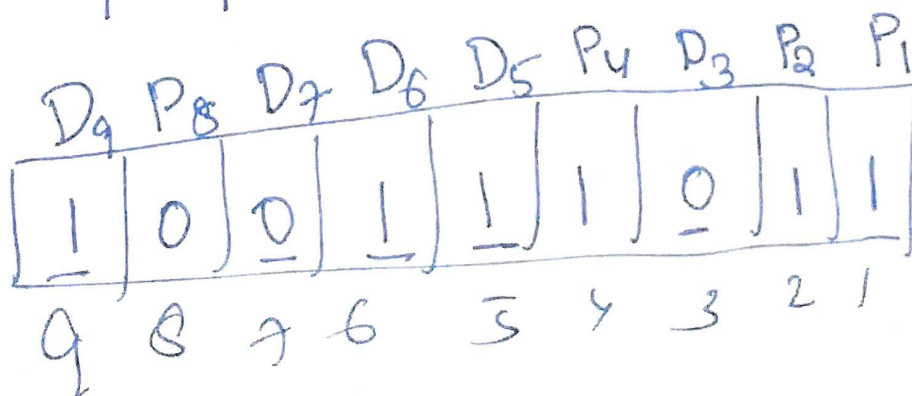
$2^0 = \underline{1}$  ,  $2^1 = \underline{2}$  ,  $2^2 = \underline{4}$  ,  $2^3 = \underline{8}$   
 $\quad \quad \quad P_1 \quad \quad \quad P_2 \quad \quad \quad P_4 \quad \quad \quad P_8$

$P_1 = \begin{matrix} 3 & 5 & 7 & 9 \\ \underline{1} & 0 & 1 & 0 & 1 \end{matrix}$

$P_2 = \begin{matrix} 3 & 6 & 7 \\ \underline{1} & 1 & 1 & 0 \end{matrix}$

$P_4 = \begin{matrix} 5 & 6 & 7 \\ \underline{1} & 1 & 1 & 0 \end{matrix}$

$P_8 = \begin{matrix} 9 \\ \underline{0} & 1 \end{matrix}$





## Detecting and Correcting an Error

Q Assume that the code word (0011001) is transmitted and that 0010001 is received. The receiver does not know what was transmitted and must look for proper parities to determine if the code is correct. Designate any error that has occurred in transmission if even parity is used:-

Soln:-

Step 1:- Start with the group checked by  $P_1$

Step 2:- Check the group for proper parity

A 0 represents a good parity check and 1 represents a bad check.

Step 3:- Repeat step 2 for each parity

Step 4:- The binary no formed by the result of the parity check designates the position of the code bit that is error

This is error position code

	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	P <sub>4</sub>	D <sub>3</sub>	P <sub>2</sub>	P <sub>1</sub>
	0	0	1	0	0	0	1
	7	6	5	4	3	2	1

$$P_1 = 3 \ 5 \ 7$$

$$1 \quad 0 \quad 1 \quad 0$$

Parity check is good  $\rightarrow P_1 \rightarrow 0$

$$P_2 = 3 \ 6 \ 7$$

$$0 \quad 0 \quad 0 \quad 0$$

Parity check is good  $\rightarrow P_2 \Rightarrow 0$

$$P_4 = 5 \ 6 \ 7$$

$$0 \quad 1 \quad 0 \quad 0$$

Parity check is wrong  $\rightarrow P_4 = 1$

Binary Code (P<sub>4</sub> P<sub>2</sub> P<sub>1</sub>)

1 0 0 = 4 bit position

It is 0 which should be 1

	D <sub>7</sub>	D <sub>6</sub>	D <sub>5</sub>	P <sub>4</sub>	D <sub>3</sub>	P <sub>2</sub>	P <sub>1</sub>
	0	0	1	1	0	0	1
	7	6	5	4	3	2	1

Q Determine single-error-correcting code for the information 0110 using even parity

Q If the Hamming code sequence 1100110 is transmitted and due to error in one bit position is received 1110110, locate the position of error, assuming even parity.



# Boolean Algebra

↳ Set of rules, used to simplify the given logic expression without changing its functionality.

↳ It is used when no. of variables are less

↳ For more Variables K-Map are used

↳ To check the functionality Truth Table

↳ <sup>is used.</sup> Switching theory  
↳ ~~It~~ Set of Rules or laws

i) ~~Law~~ Idempotent law

$$a \cdot a = a$$

$$a + a = a$$

$$2) \quad A + 0 = A \quad \begin{array}{l} 1 + 0 = 1 \\ 0 + 0 = 0 \end{array}$$

3) Complement Rule

A complement =  $\overline{A}$  or not(A)

$$\overline{0} = 1, \quad \overline{1} = 0$$

$$\overline{\overline{A}} = A$$

ii) AND

$$A \cdot A = A$$

$$A \cdot 0 = 0$$

$$A \cdot 1 = A$$

$$A \cdot A' = 0$$

iii) OR

$$A + A = A$$

$$A + 0 = A$$

$$\boxed{A + 1 = 1} \text{ Imp.}$$

$$A + A' = 1$$

$$0 + 1 = 1$$

$$1 + 1 = 1$$

A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

iv) Distributive Law

$$A \cdot (B + C) = A \cdot B + A \cdot C$$

$$\boxed{A + (B \cdot C) = (A + B) (A + C)}$$

Imp.

$$* A + \bar{A}B$$

$$= (A + \bar{A})(A + B)$$

$$= (A + B)$$

$$A + \bar{A}B = (A + B)$$

Imp.

$$v) \bar{A} + AB = (\bar{A} + B) \text{ Imp.}$$

v) Commutative Law

$$A + B = B + A$$

$$AB = BA$$



vi) Associative law

$$(A \cdot B) \cdot C = A \cdot (B \cdot C)$$

Priority  $\rightarrow$  NOT, AND, OR  
 $\downarrow$   
Complement

vii) De Morgan's law

$$\overline{A+B} = \bar{A} \cdot \bar{B}$$

$$\overline{A \cdot B} = \bar{A} + \bar{B}$$

$$\text{Ex:- } B \underline{A} C' + B' \underline{A} C' + B C' = (A+B) \cdot C'$$

$$\Rightarrow A C' [B + B'] + B C'$$

$$\Rightarrow A C' + B C'$$

$$\Rightarrow C' [A + B]$$

H.W

i)  $(A+B+C) (A+B'+C) (A+B+C')$   
 $= AB + AC$

2)  $Y = (A+B) (A+B') (A'+B) (A'+B')$