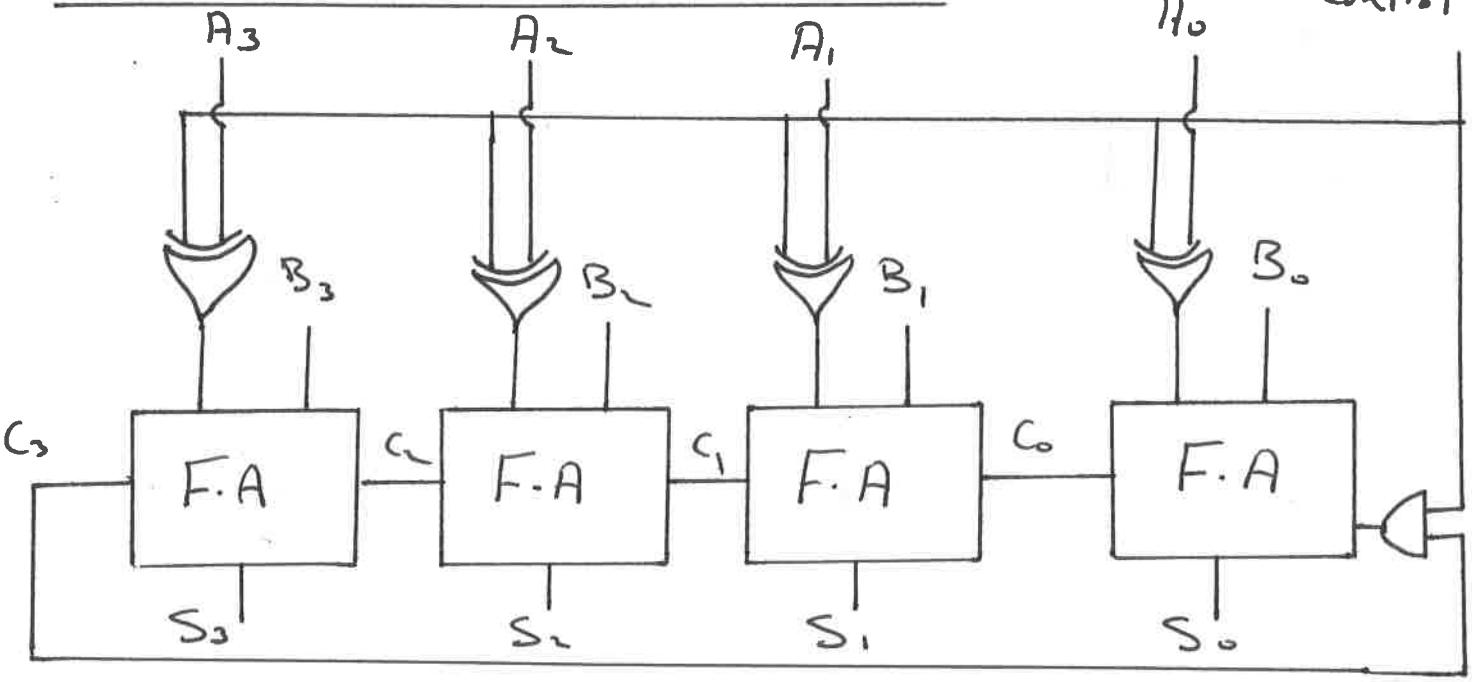
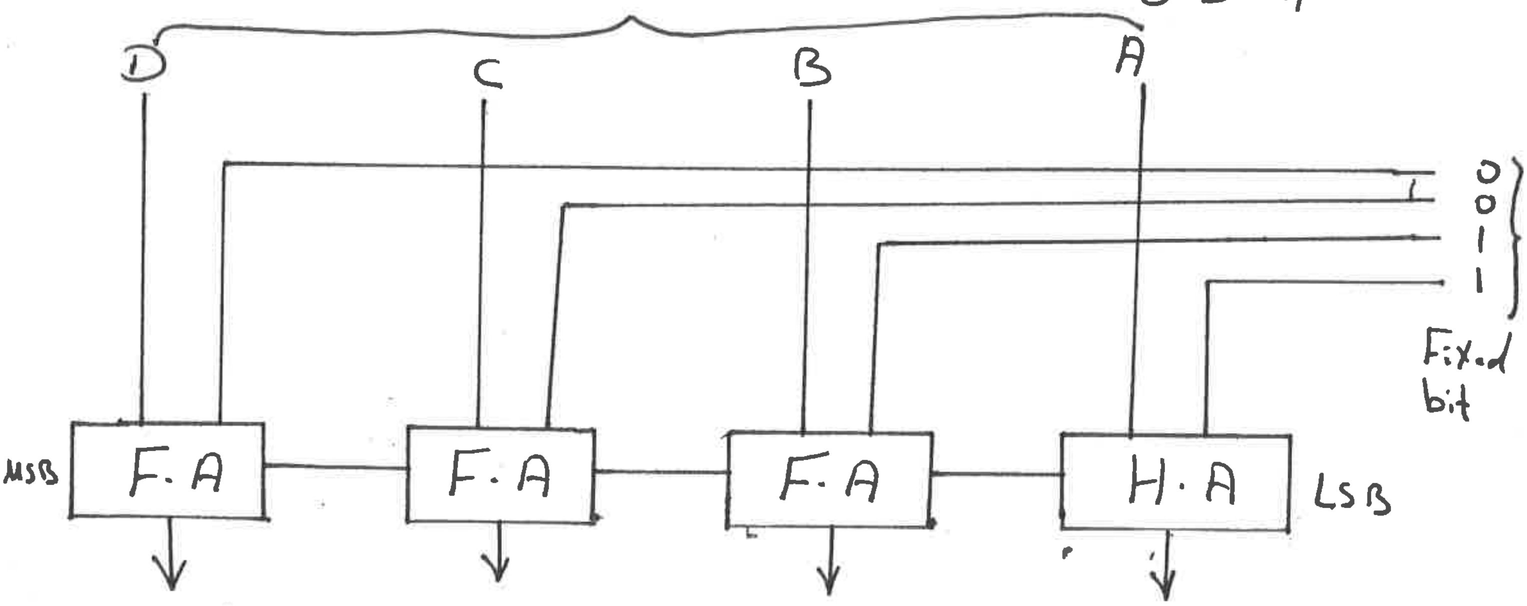
Four Bit Binary Adder / Subtractor



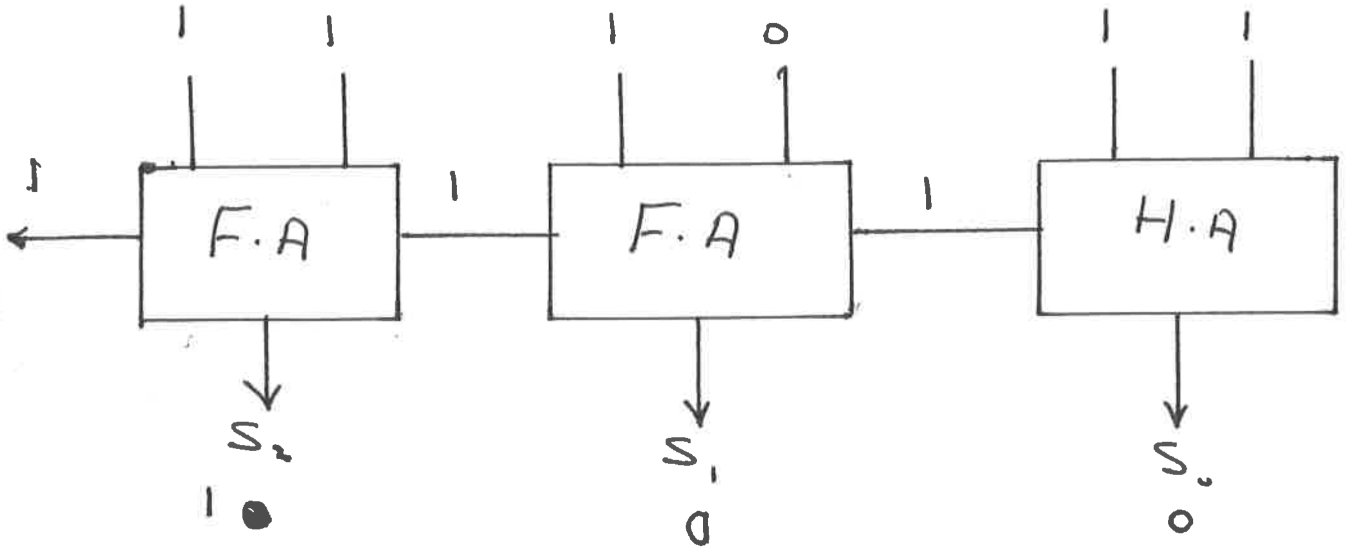
Control: Adder → 0
Subtractor → 1

BCD to EX-3

It easy to build A BCD to EX-3 by mean's of using Adders. By adding a fixed bit equall to (0011) to each Adder.

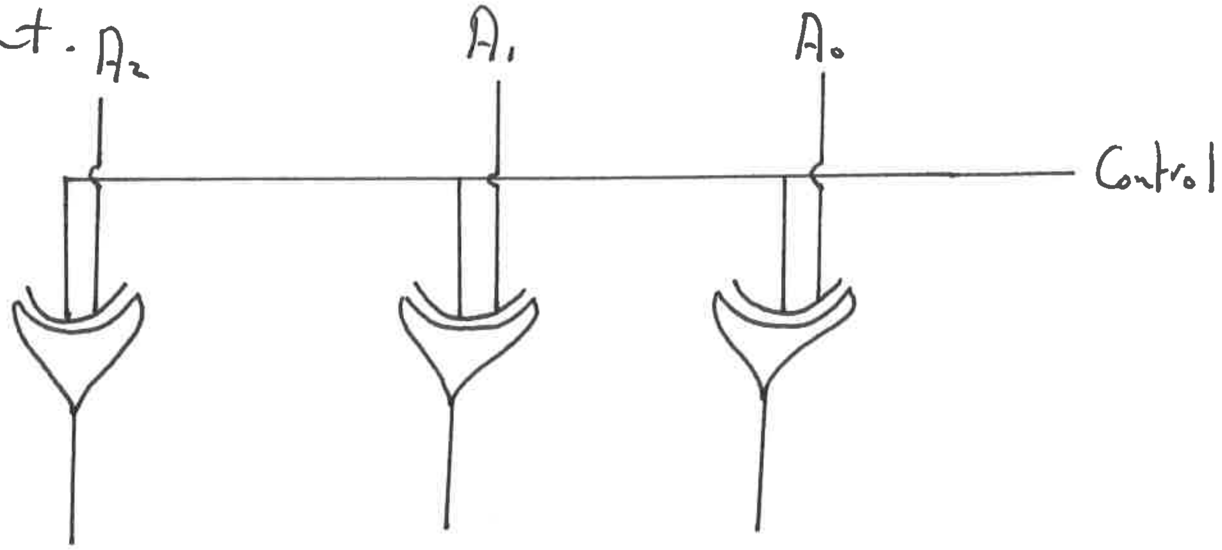


Ex) Find the sum of the cct shown below?

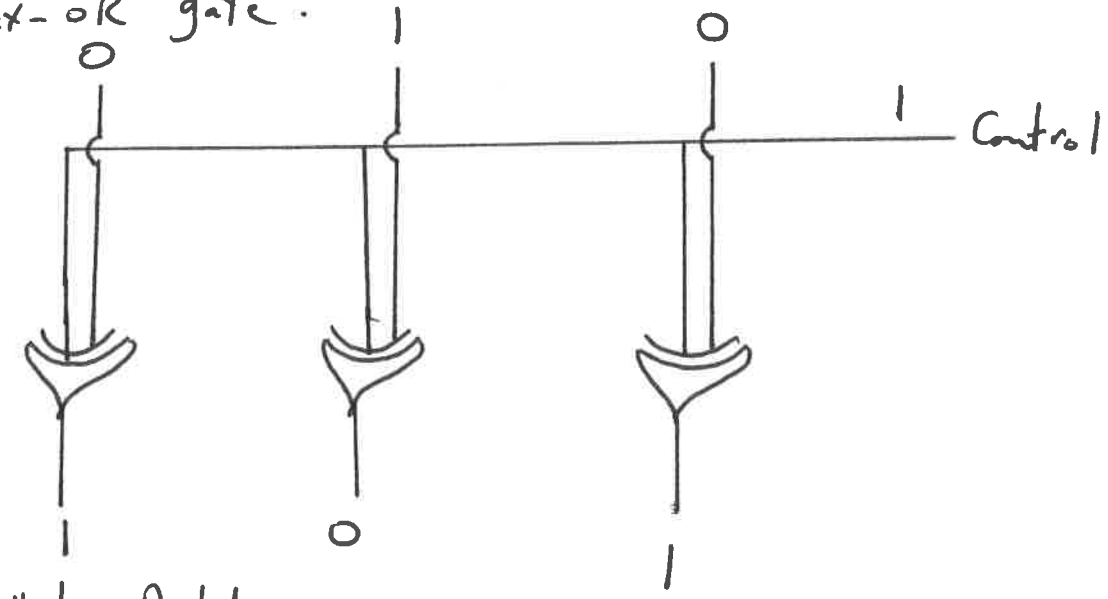


Control Inverter :-

It could be use the Ex-OR circuit that obtain the 1's complement in certain case and let the o/p same to the i/p in the other case. when the o/p of the Ex-OR gate is zero, then we can obtain that the i/p's are Identical, and when the o/p of Ex-OR gates is one we can obtain that the inputs are different.



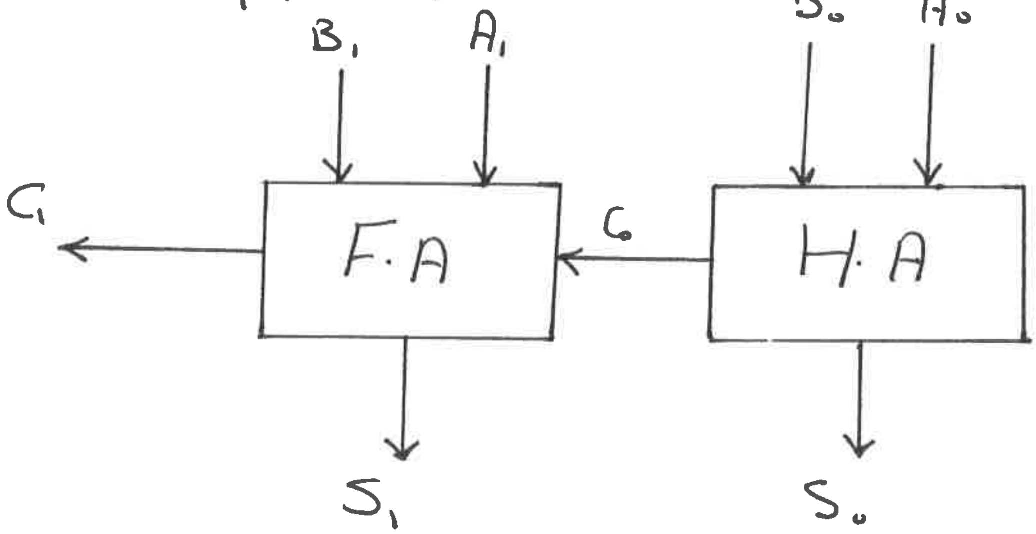
Ex) Given $A = A_2A_1A_0$, obtain it's (1's) complement using Ex-OR gate.



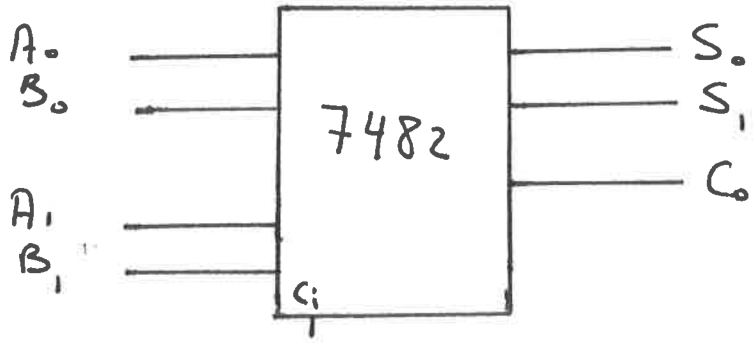
Binary Parallel Adder

The Sum of two bit and previous carry can be done using Full-adder, For the two bits numbers two adders are needed, for three bits numbers, three adders are needed, and so on, the carry of each concuted to the carry input of the next higher adder.

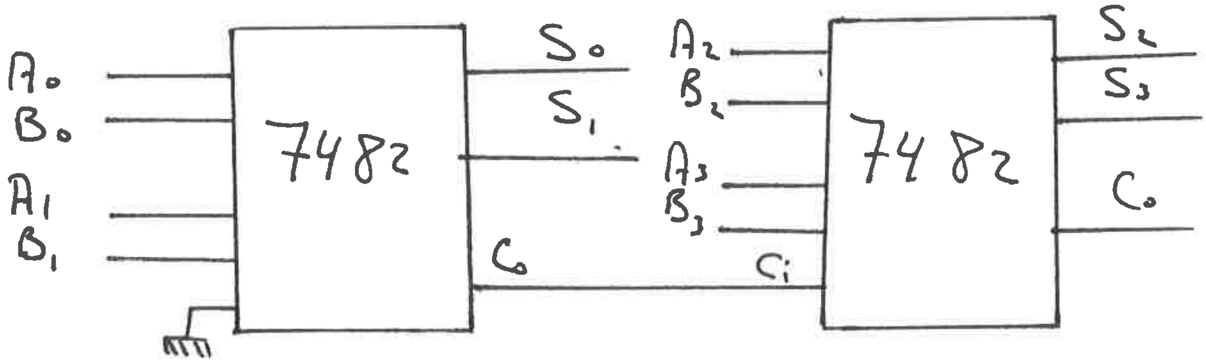
Ex) $A_1A_0 + B_1B_0$



There are an Ic's named 7482 which can add two boundary numbers, each number consist of two bits.



Ex) show how we can use two 7482 to add two numbers each one are consist of four bits?

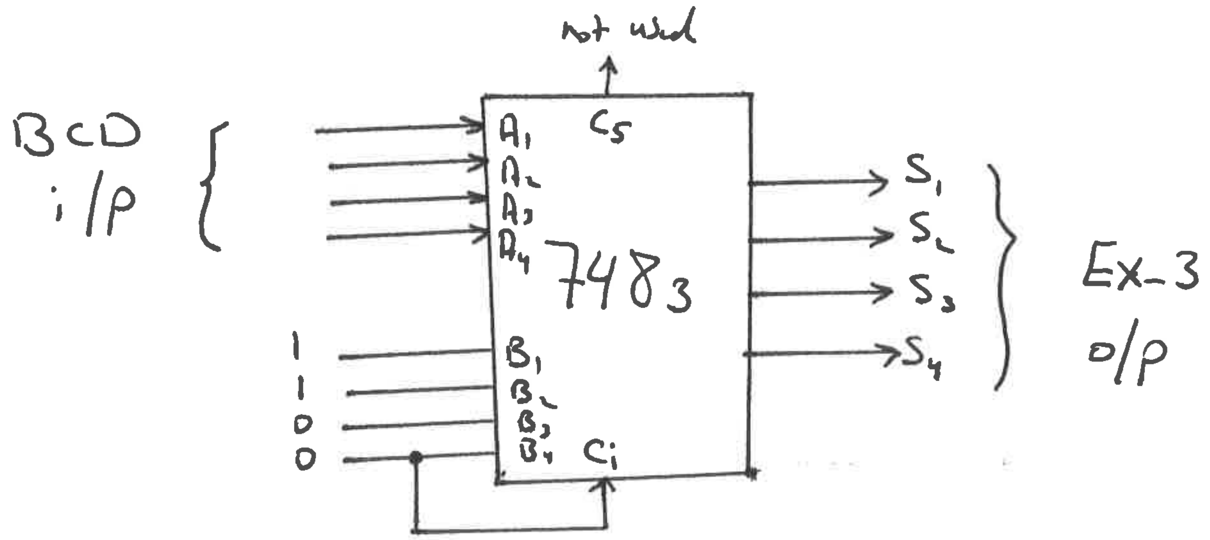


$A = A_3 A_2 A_1 A_0$

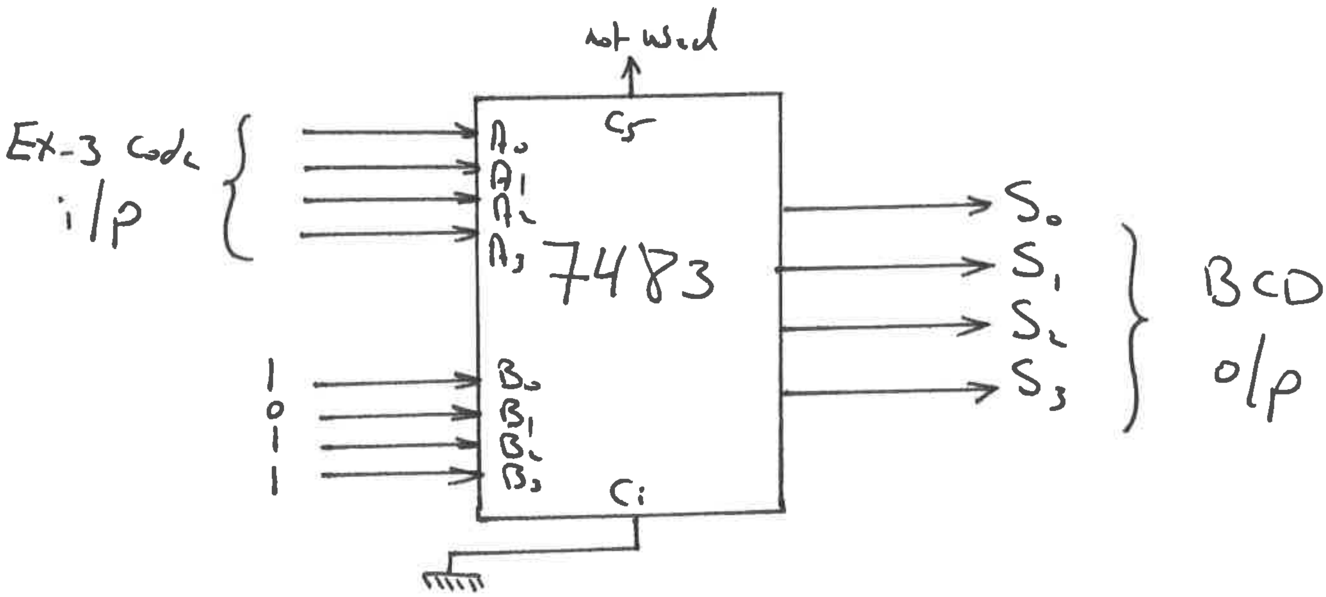
$B = B_3 B_2 B_1 B_0$

7483 Ic (Four bit adder)

Ex) Use Full adder block diagram of Ic 7483 to convert BCD code to Ex-3 code?



Ex) Use a full adder block diagram of Ic 7483 to convert Ex-3 code to BCD code ?



Exclusive -OR- and Exclusive -NOR Function:-

Exculsive -OR (Ex-OR) and equivalance (Ex-NOR), denoted by $\oplus$ and $\odot$ respectively, are binary operation that Perform the Following Boolean Function:-

$$x \oplus y = x\bar{y} + \bar{x}y$$

$$x \odot y = xy + \bar{x}\bar{y}$$

Function of three or more variable can be Expressed as

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

The two Functions are particalerly useful in arithmatic operations and in error detection and correction:

Ex Design an Ex-OR gate by using NAND gate only?

The Function can be expressed in terms of Ex-OR operation - the Four variables. This is Justified by the following algebraic manipulation.

$$A \oplus B \oplus C \oplus D$$

$$= (A\bar{B} + \bar{A}B) \oplus (C\bar{D} + \bar{C}D)$$

$$= (A\bar{B} + \bar{A}B)(CD + \bar{C}\bar{D}) + (AB + \bar{A}\bar{B})(C\bar{D} + \bar{C}D)$$

$$= \Sigma\ 1, 2, 4, 7, 8, 11, 15, 14$$

AB \ CD	00	01	11	10
00		1		1
01	1		1	
11		1		1
10	1		1	

$F = A \oplus B \oplus C \oplus D$

$$A \odot B \odot C \odot D = (\bar{A}\bar{B} + AB) \odot (\bar{C}\bar{D} + CD)$$

$$= \Sigma\ 0, 3, 5, 6, 9, 10, 12, 15$$

AB \ CD	00	01	11	10
00	1		1	
01		1		1
11	1		1	
10		1		1

$$F = A \odot B \odot C \odot D$$

Ex-oR and equivalance (Ex-NoR) Functions are very useful systems requiring error-detection and error correction codes.

Parity Generation (checking) in Codes.

Parity bit is an Extra bit included with a binary message make the number of (1's) either odd or even. The massage including the parity bit is transmitted and then checked at the receiving end for errors. An error is detected if the checked parity bit in the transmitter is called a (a parity Genertor), the circuit that checks the parity in receiver is called (a parity checker).

- Odd parity Generation

In this example Three-bit message.

Three-bit message

x	y	z	P (Parity bit Generator)
0	0	0	1
0	0	1	0
0	1	0	0
0	1	0	1
1	0	1	0
1	0	0	1
1	1	1	1
1	1	0	0

$P(odd) = \Sigma\ 0,3,5,6$

Next example a four bits parity checker

Four-bits received				parity-error check
A	B	C	P	Z
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

$Z(odd) = \Sigma\ 0,3,5,6,9,10,12,15$

A parity bit is an extra bit included to the message to make the total number of (1's) is either even or odd.

- In this example a BCD code with parity bit odd and even.

BCD code A	B	C	D	Parity bit P(even)	Parity bit P(odd)
0	0	0	0	0	1
0	0	0	1	1	0
0	0	1	0	1	0
0	0	1	1	0	1
0	1	0	0	1	0
0	1	0	1	0	1
0	1	1	0	0	1
0	1	1	1	1	0
1	0	0	0	1	0
1	0	0	1	0	1

$P(even) = \sum 1,2,4,7,8$

$P(odd) = \sum 0,3,5,6,9$

Ex) Design a Logic cct for 3 bit massage using

1- odd parity.

2- even parity.

Sol:-

3-bit massage A	B	C	P(even)	P(odd)
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0

$P(even) = \Sigma\ 1,2,4,7$

$P(odd) = \Sigma\ 0,3,5,6$

A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$	0	1 (1)	3	1 (2)
A	1 (4)	5	1 (7)	6

$$P(even) = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

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

$$= \bar{A}(B \oplus C) + A(\overline{B \oplus C})$$

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

A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$	1		1	
A		1		1

$$P(odd) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C}$$

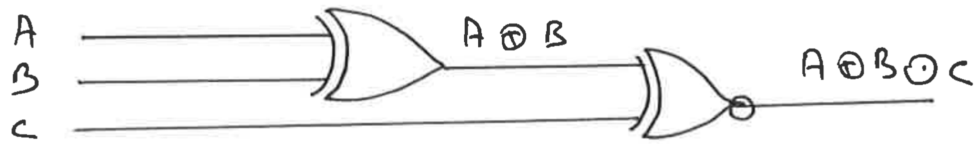
$$= \bar{A}(\bar{B}\bar{C} + BC) + A(\bar{B}C + B\bar{C})$$

$$= \bar{A}(\overline{B \oplus C}) + A(B \oplus C)$$

$= A \odot B \oplus C$ أو $A \oplus B \odot C$

Logic cct :-

لـ P(odd)



لـ P(even)