16/4/24

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BATCH : S23
MPL

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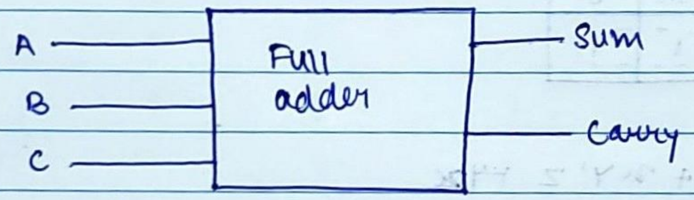
MPL Assignment 1

Q] Implement Full adder and full subtractor using basic gates and universal gates

Ans

Full Adder is the adder that adds three inputs and produces two outputs. The first two inputs are A and B and the third input is an input carry - C-IN



A	B	C	Sum	Carry
0	0	0	0	0
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	1

Using K-map for sum

x \ yz	y'z'	y'z	yz	yz'
x'	0	1	0	1
x	1	0	1	0

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$\text{sum } (F) = x'y'z + x'yz' + xy'z' + xyz$

$= x \oplus y \oplus z$

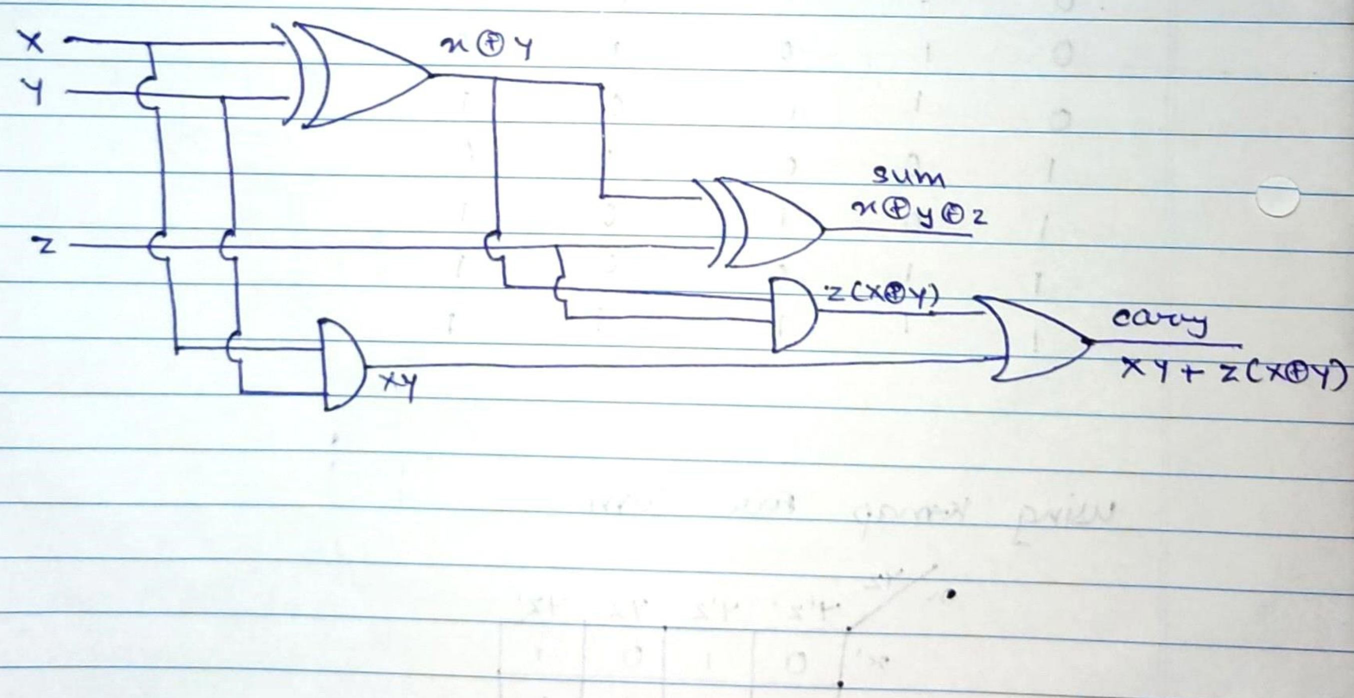
using k-map for carry

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	0
x	0	1	1	1

$\text{carry } (F) = x'yz + xy'z + yx$

$= xy + z(x \oplus y)$

Logic Diagram



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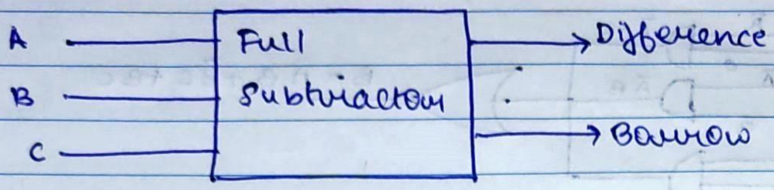
Full Subtractor



A	B	C	Sub	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

using Kmap for 8 Difference

A \ BC	00	01	11	10
0	0	1	0	1
1	1	0	1	0

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

using Kmap for Barrow

A \ BC	00	01	11	10
0	0	1	1	1
1	0	0	1	0

Barrow (s) = $A'C + A'B + BC$

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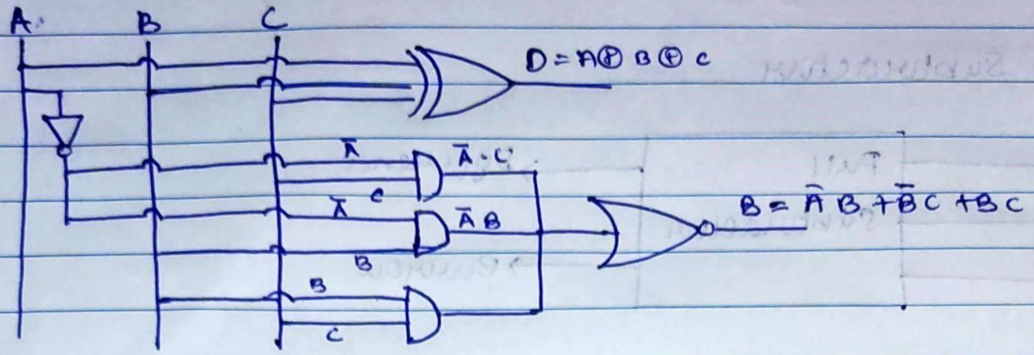

Full subtractor.

Q] Write a short note on different types of flip flop with their ~~A~~ truth table and characteristics equations.

Ans Flip flop is a ~~diage~~ digital circuit that stores a binary bit. In flip flop the clock signal controls the state of device. It is also called as memory element or binary storage device.
There are basically 4 types of flip flop in digital electronics

1. SR flip flop
2. JK flip flop
3. D flip flop
4. T flip flop

SR: This is the most common flip flop among all. The simple flip flop circuit ~~that~~ has a set inputs(S) and reset input (R). In this, when you set 'S' as active the output 'Q' would be high and Q' ~~wor~~ would be low. Once the outputs are established, the wiring of the circuit is maintained until 'S' or 'R' go high or power is turned off.

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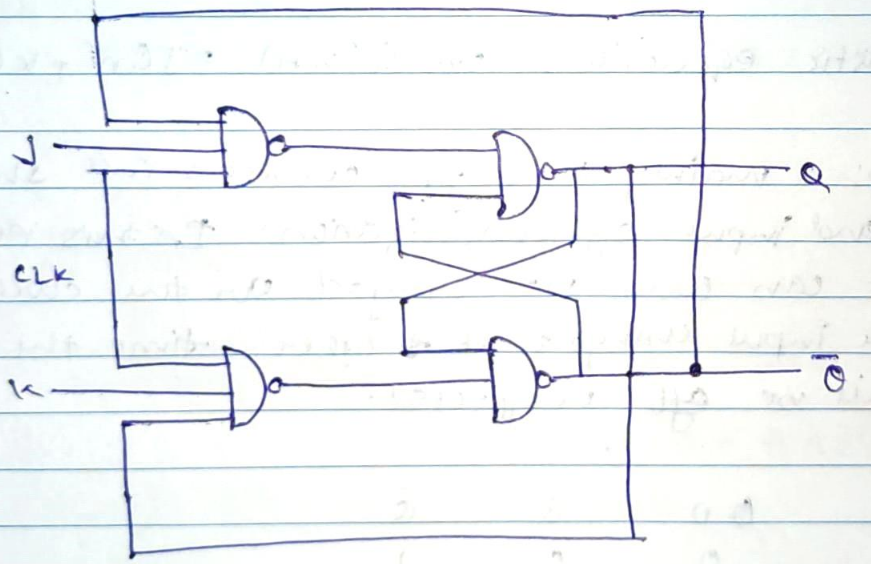
S	R	Q	$\bar{Q}$
0	0	0	1
0	1	0	1
1	0	1	0
1	1	∞	∞

Characteristic equation is $Q_n \bar{R} + S$ or
$Q(n+1) = S + \bar{R} Q_n$

2. JK flip flop

Due to the undefined state in the SR flip flop another flipflop is required in electronics. The JK flip flop is an improvement on these where $S = R = 1$ is not problem



The input condition for $J = K = 1$ gives an output ~~to~~ inverting the output state. However the outputs are the same when one tests the circuit practically in simpler

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words. If J and k ~~at~~ data are different ie High and low then the output Q takes the values of J and ~~at~~ w the next clock edge. If ~~tat~~ J and k both are low then no change occurs

J	K	Q	$\bar{Q}$
0	0	0	0
0	1	0	0
1	0	0	1
1	1	0	1
0	0	1	1
0	1	1	0
1	0	1	1
1	1	1	0

Characteristic equations is $Q(n+1) = J\bar{Q}_n + \bar{K}Q_n$

D Flip Flop:- mainly used for counters and shift register and input synchronization. In this flip flop the output can only be changed on the clock edge and if the input changes at other time the output will be ~~off~~ unaffected.

Clock	D	Q	$\bar{Q}$
↓ 0	0	0	1
↑ 1	0	0	1
↓ 0	1	0	1
↑ 1	1	1	0

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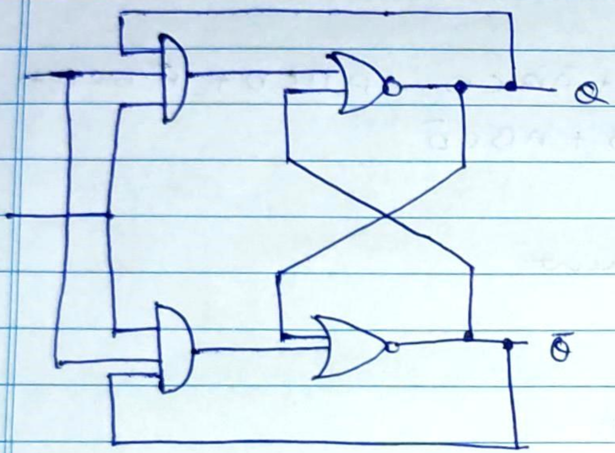
T Flip Flop: A T Flip Flop is like a JK Flip flop. there are bassically single input version of JK Flip flop. This modified from the JK is obtained by connecting inputs J & K together



T	Q	Q(T+1)
0	0	0
1	0	1
0	1	1
1	1	0

$Q(n+1) = \bar{T}Q_n + T\bar{Q}_n$

Q8] Implement using Kmap

1. $f(\,) = m(1,3,5,6,9,10,13) - d(0,2,14,15)$

	00	01	11	10
00	X	1	1	X
01	0	1	0	1
11	0	1	X	X
10	0	1	0	1

Boolean Alg.
$C\bar{D} + \bar{A}\bar{B} + \bar{C}D$

$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} +$
$A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}D + ABC\bar{D}$

ii. $f(\,) = \Sigma m(1,3,5,6,9,10,13) + d(0,2,7,14,15)$

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

$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}BC\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} +$
$A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}D + ABC\bar{D}$

Q7] Perform using 2's complement

i) $(52)_{10}$ ~~⇒~~ $(65)_{10}$

$(52)_{10} \rightarrow 0110100$

$(65)_{10} \Rightarrow 1000001$

$-(65)_{10} \rightarrow 0111111$

$$\begin{array}{r} 0110100 \\ +\ 0111111 \\ \hline 1110011 \end{array}$$

1110011 → 2's complement

$-(0001101) = -13$

(ii) $(27)_{10}$ ~~to~~ $-(32)_{10}$

$27 \rightarrow 011011$

$32 \rightarrow 100000$

$-32 \rightarrow 100000$

$$\begin{array}{r} 011011 \\ +\ 100000 \\ \hline 111011 \end{array}$$

111011 → 2's complement

$-(000101) = -(5)$