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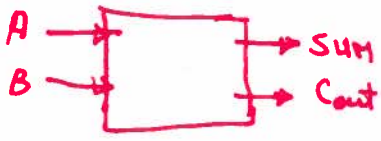
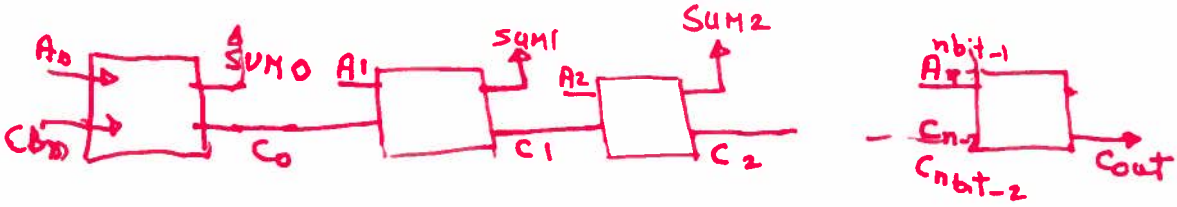
Q6

a) See class notes

b)

Component HalfAdder





This is an incrementer when

$C_{in} = 0$ Output = A

$C_{in} = 1$ Output = A+1

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Q3

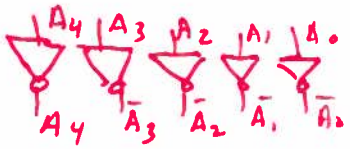
+5 = 0101 −5 = 1011

Booth encoding

1 1 1 0 1 1 0

(−1 over the first 1 1 1 0; −1 under the last 1 0)

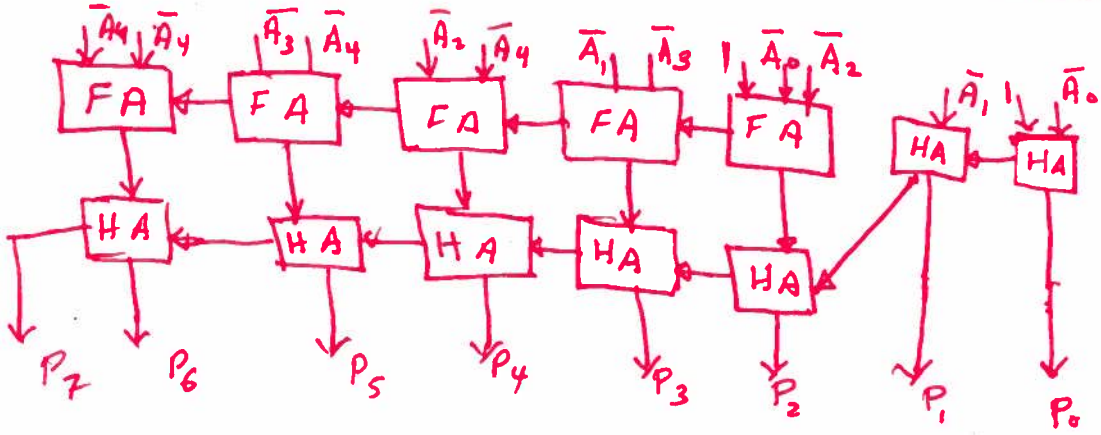
Using the above encoding



$\bar{A}_4\ \bar{A}_4\ \bar{A}_4\ \bar{A}_3\ \bar{A}_2\ \bar{A}_1\ \bar{A}_0$

$\bar{A}_4\ \bar{A}_3\ \bar{A}_2\ \bar{A}_1\ \bar{A}_0\ 0\ 1$

1



7 HA 5 FA

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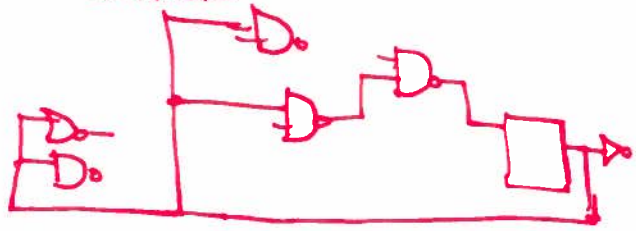
There are 11 paths of which Path 1 & Path 2 shown here are good candidates

a) Path 1

1.5 + 5 * 0.3 + 1 * 0.1
4 x 0.1 x 2
2 x 0.24
0.05 * 2 + 0.2
0.05 * 2 + 0.2

4.98 Path delay



Path 1

Path 2

1.5 + 0.04 x 1.5
5 x 0.3 + 0.3 * 1 + 0.15 + 0.1 * 2
+ 0.4 + 0.35 +
0.12 * 2

5.1 Path Delay

Critical Path

b) Cycle Time = 5.1 + 1.5 − 0 = 6.6 ns Frequency of operation 151 MHz

c) Temperature effect. $T_J = (P * \theta) + T_a = 1 * 36 + 70 = 106°C$

$K_J = \left(\frac{T_J}{T_a}\right)^M = \left(\frac{106+273}{70+273}\right)^2 = 1.22$

For t_{cs} of −1.5 ns between the two Flip Flops

$T_{clock} = 5.1 - (-1.5) + 1.5 = 8.1$ Frequency of operation = 123.45 MHz

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Q2

For this Question is best to start with a state Table.

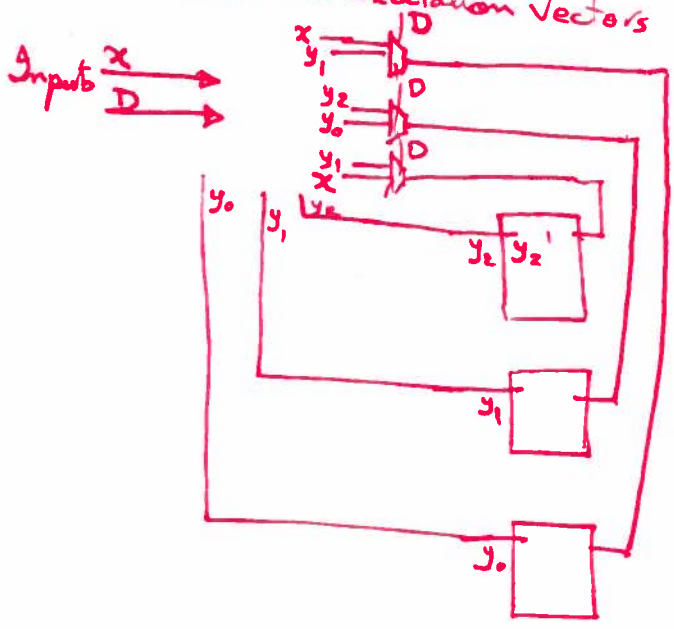
assume D=0 Right to Left shift
D=1 Left to Right shift.

x is the fill-in

Present State $y_2\ y_1\ y_0$	Next State D=0 $y_2^+\ y_1^+\ y_0^+$	Next State D=1 $y_2^+\ y_1^+\ y_0^+$
0 0 0	0 0 x	x 0 0
0 0 1	0 1 x	x 0 0
0 1 0	1 0 x	x 0 1
0 1 1	1 0 x	x 0 1
1 0 0	0 1 x	x 1 0
1 0 1	1 0 x	x 1 0
1 1 0	1 1 x	x 1 1
1 1 1	1 1 x	x 1 1

$$y_2^+ = \bar{D}\, y_1 + D x$$
$$y_1^+ = \bar{D}\, y_0 + D\, y_2$$
$$y_0^+ = \bar{D}\, x + D\, y_1$$

Reading directly from the Table gives the excitation Vectors



The effect skew time change, affects set up time & hold time of the flip flop and consequently the clock frequency has to be adjusted to accomodate the skew time variation

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Q1

a) $G = \bar{A} + \bar{B} \longrightarrow \bar{A} + A\bar{B}$

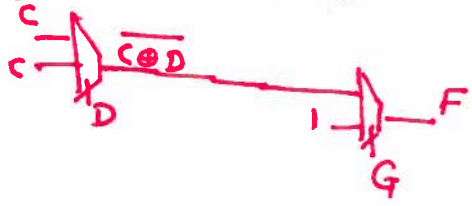
$F = \bar{A} + BCD + B\bar{C}D + A\bar{B}$

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

$= B\overline{(C \oplus D)} + G$

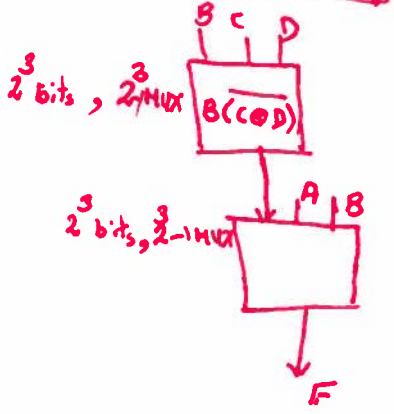
Minimizing F, using Boolean Algebra

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

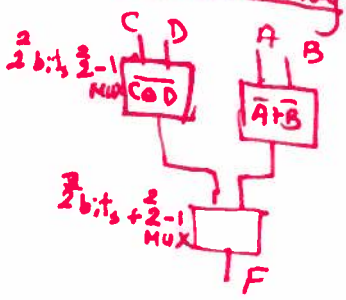


b)

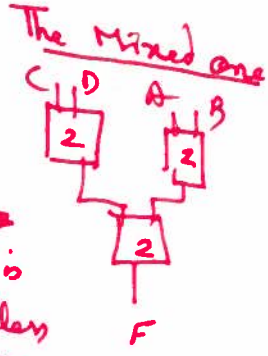
3 Variables Only



2 Variables Only



The Mixed one.



Because it is faster & less Muxes

Requires 14 Muxs + 2 Tables of 2^3 with 6 Mux delay + 2, Eight bit reads time

Requires 9 Muxes + 3 Tables of 2^3 with 4 Mux delay + 2 four bit read time

Q4/

A = 2.25 B = −17.75 or A = 10.01 = 1.001 * 2^1

B = 10001.11 = 1.000111 * 2^4

for A, Bias is $2^{e-1} - 1 = 2^{3-1} - 1 = 3$

$S_A = 0$ $E_A = 3 + 1 = 4$ $M_A = 0010$ ignored

for B

$S_B = 1$ $E_B = 3 + 4 = 7$ $M_B = 0001$

$E_D = 7 - 4 = 3$

$$\begin{array}{r} 0111 \\ +\ 1100 \\ \hline 00011 \end{array} = 3$$

$M_A - M_B$

$$\begin{array}{r} 1.0001 \\ -\ .0010 \\ \hline \end{array}$$ 2's Complement

$$\begin{array}{r} 0.1111 \\ +\ .0010 \\ \hline 1.0.0.01. \end{array} \times 2^4$$

-ve number Complement 0.1111×2^4

Result 

Converting back to decimal $R = 1.111 * 2^3 = 1111.0 = 15_{10}$

The loss of 0.5 is due to the limit of 4 bits for the significance

d) from the class notes