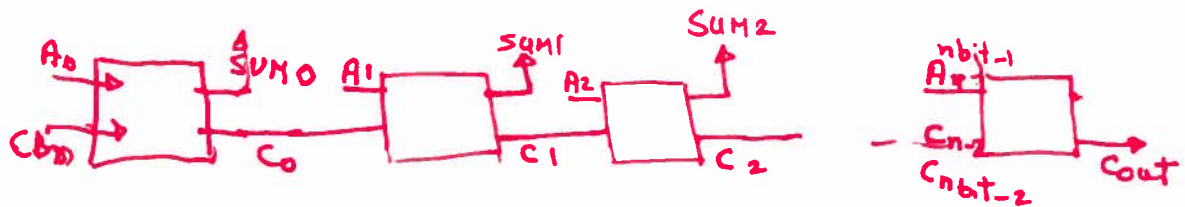
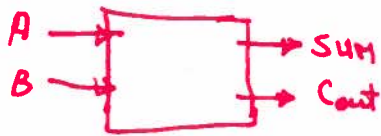


Q.6

d) See class notes

b)

Component Half Adder



This is an incrementer when

$$C_{in} = 0$$

$$\text{Output} = A$$

$$C_{in} = 1$$

$$\text{Output} = A + 1$$

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Q3

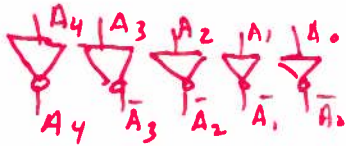
$$+5 = 0101$$

$$-5 = 1011$$

Booth encoding

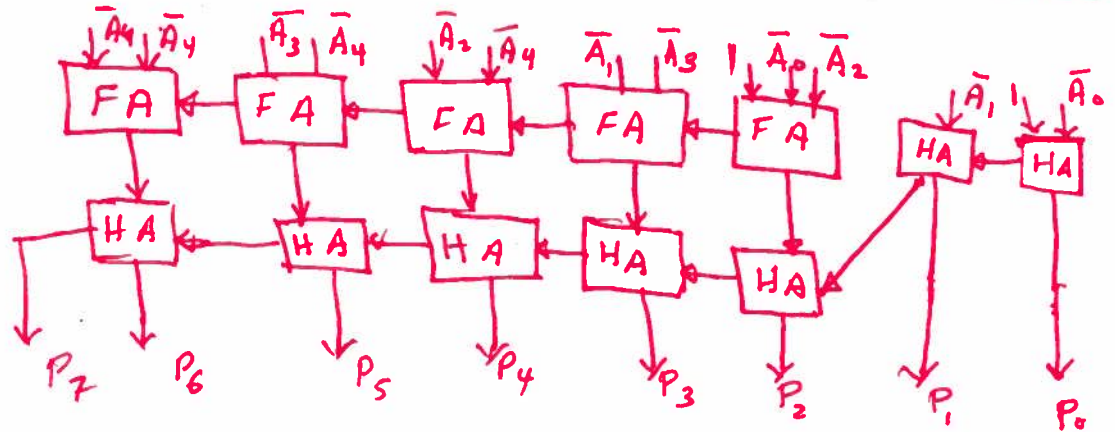
111⁻¹011⁻¹0

Using the above encoding



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

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



7 HA 5 FA

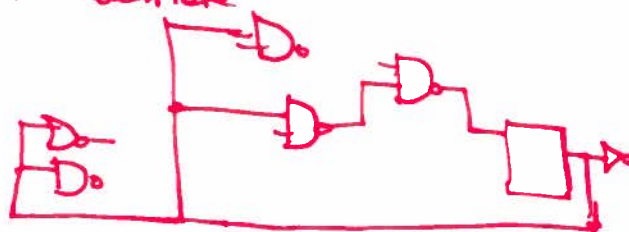
Q4 / COEN 6501 Dec 2017

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

Path 1

d) $1.5 + 5 \times 0.3 + 1 \times 0.1$
 $4 \times 0.1 \times 2$
 2×0.24
 $0.05 \times 2 + 0.2$
 $0.05 \times 2 + 0.2$

4.98 Path delay



Path 1



Path 2

Critical Path

$1.5 + 0.04 \times 1.5$
 $5 \times 0.3 + 0.3 \times 1 + 0.15 + 0.1 \times 2$
 $+ 0.4 + 0.35 +$
 0.12×2

5.1 Path Delay

b) Cycle Time = $5.1 + 1.5 - 0 = 6.6 \text{ ns}$ Frequency of operation 151 MHz

c) Temperature effd. $T_J = (P \times \theta) + T_a = 1 \times 36 + 70 = 106^\circ\text{C}$
 $K_J = \left(\frac{T_J}{T_a}\right)^n = \left(\frac{106 + 273}{70 + 273}\right)^2 = 1.22$

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

$T_{\text{clock}} = 5.1 - (-1.5) \pm 6.5 = 8.1$ Frequency of operation = 123.45 MHz

Q2

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

assume

 $D=0$ $D=1$

Right to Left shift
Left to Right shift.

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

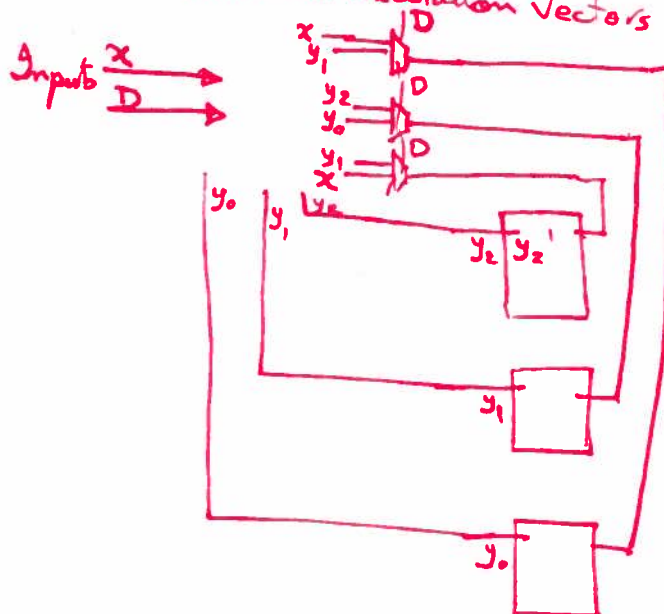
x is the fill-in

$$y_2^+ = \bar{D}_0 y_1 + D x$$

$$y_1^+ = \bar{D}_0 y_0 + D y_2$$

$$y_0^+ = \bar{D}_1 x + D y_1$$

Reading directly from the Table gives the excitation vectors



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

Q1

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

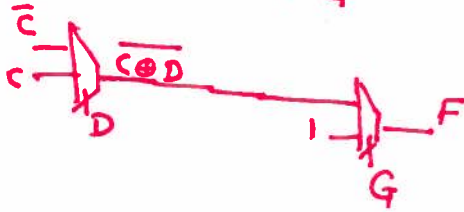


$$F = \bar{A} + BCD + B\bar{C}\bar{D} + A\bar{B}$$

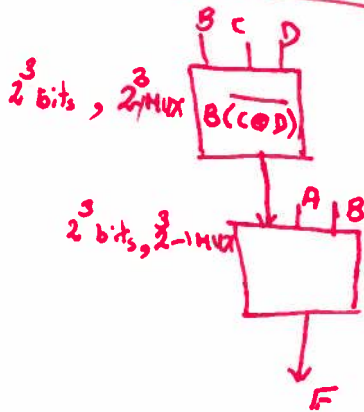
$$= B(\overline{C \oplus D}) + \bar{A} + A\bar{B}$$

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

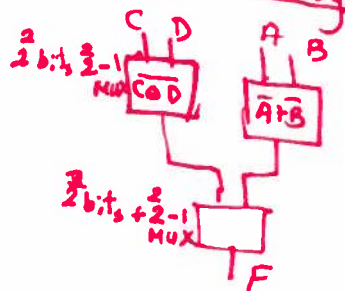
Minimizing F, using Boolean Algebra
 $= B(\overline{C \oplus D}) + \bar{A} + \bar{B} = \overline{(C \oplus D)} + \bar{A} + \bar{B}$



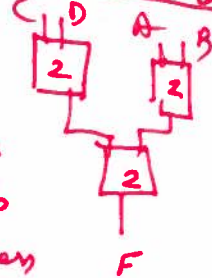
b) 3 Variables Only



2 Variables Only



The Mixed one



Because it is faster & less Muxes

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

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

Q4/

$A = 2.25 \quad B = -17.75$

or $A = 10.01 = 1.001 \times 2^1$
 $B = 10001.11 = 1.000111 \times 2^4$

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

$S_A = 0 \quad E_A = 3+1 = 4 \quad M_A = 0010$ (ignored)



for B

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



$E_D = 7 - 4 = 3$

$$\begin{array}{r} 0111 \\ 1100 \\ \hline 0011 \end{array} = 3$$

$M_A - M_B$

$$\begin{array}{r} 1.0001 \\ .00010 \\ \hline \end{array} \quad 2^1 \text{ Complement}$$

0.1111
 $.0010$
 $\hline 1.0001 \times 2^4$
 -ve number complement 0.1111×2^4



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

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

d) from the class notes