

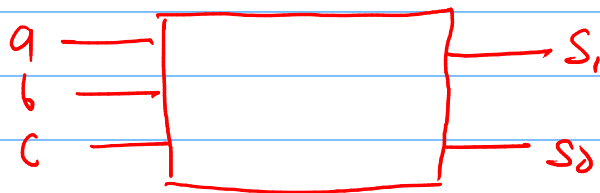
Lecture # 4

#

$$\begin{array}{r}
 a \quad 1 \ 1 \ 1 \ 1 \\
 b \quad 1 \ 0 \ 1 \ 1 \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{cccc}
 q_3 & q_2 & q_1 & q_0 \\
 b_3 & b_2 & b_1 & b_0
 \end{array}$$

$$\begin{array}{ccccc}
 a & a[3] & a[2] & a[1] & a[0] \\
 b & b[3] & b[2] & b[1] & b[0]
 \end{array}$$

a	b	c	S_1	S_0
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



a	b	c	S_0	
0	0	0	0	
0	0	1	1	m_1
0	1	0	1	m_2
0	1	1	0	
1	0	0	1	m_3
1	0	1	0	
1	1	0	0	
1	1	1	1	m_4

$S_0 =$

$$a \oplus b \oplus c$$

$$m_1 + m_2 + m_3 + m_4$$

$$a'b'c + a'b'c' + a'b'c' + abc = S_0$$

$$\begin{array}{ccc} 1 & 1 & 0 \\ 0 & 0 & 1 \end{array}$$

a	b	c	S_1	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	1	m_1
1	0	0	0	
1	0	1	1	m_2
1	1	0	1	m_3
1	1	1	1	m_4

$$a'b'c + a'b'c' + abc' + abc = S_1$$

$$bc(a' + a) + ab'c + abc'$$

$$bc + ab'c + abc'$$

$$= c[a'b + ab'] + abc'$$

$$= cb + ca + abc' = cb + a[c + bc]$$

$$\begin{array}{c} a \\ b \end{array} \Rightarrow \boxed{\text{HA}} \begin{array}{l} S_1 = ab \\ S_0 = ab' + a'b \end{array}$$

$$\begin{array}{c} a \\ b \\ c \end{array} \Rightarrow \boxed{\text{F.A}} \begin{array}{l} S_1 = ab + bc + ca \\ S_0 = a \oplus b \oplus c \end{array}$$

A
B

$$\begin{array}{cccc} a_3 & a_2 & a_1 & a_0 \\ b_3 & b_2 & b_1 & b_0 \end{array} \Rightarrow$$

$$\begin{array}{c} \overline{a \oplus b} \\ a \oplus b \end{array} \quad \begin{array}{c} 0 \\ 1 \end{array}$$

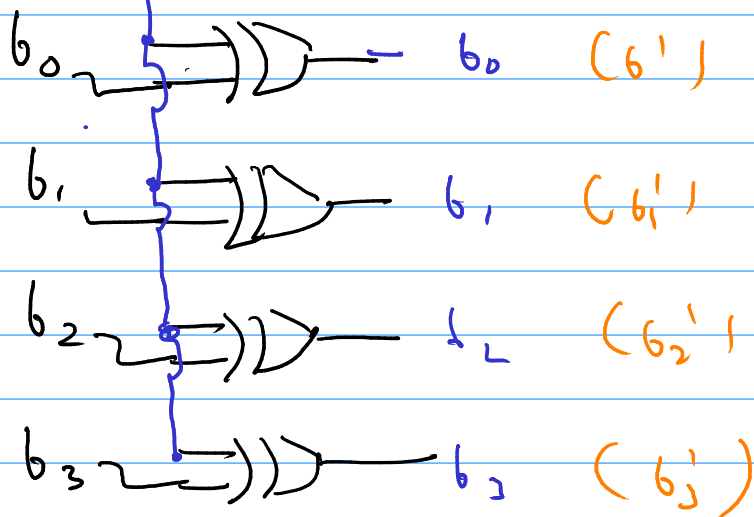
$$\begin{array}{|c|c|c|c|} \hline 1 & 0 & 1 & 1 \\ \hline 0 & 1 & 0 & 0 \\ \hline \end{array} = \text{'is'}$$

X Y Z

if $Y=0 \Rightarrow \boxed{Z=X} \quad \cdot \quad \boxed{Z = X Y' + Y X'}$

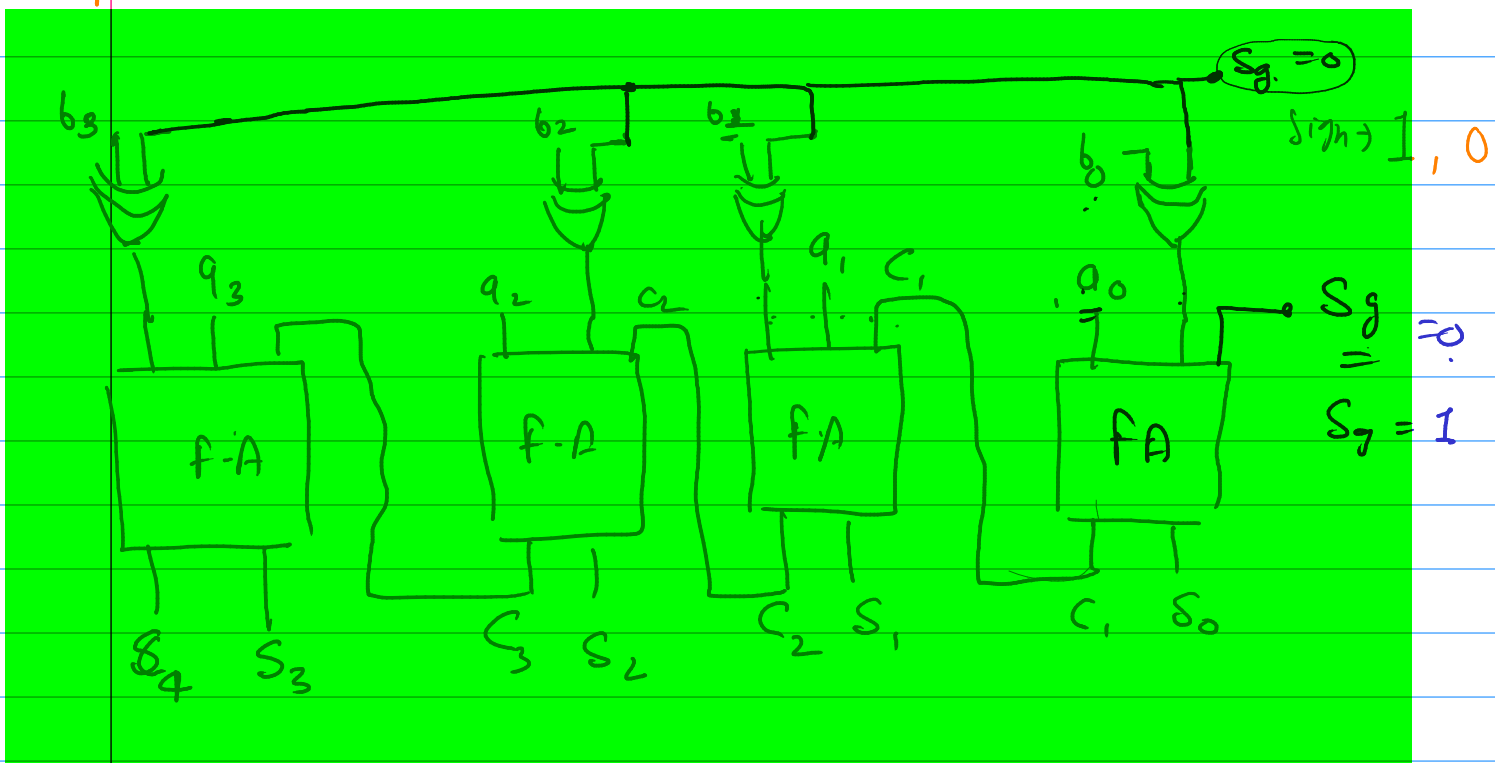
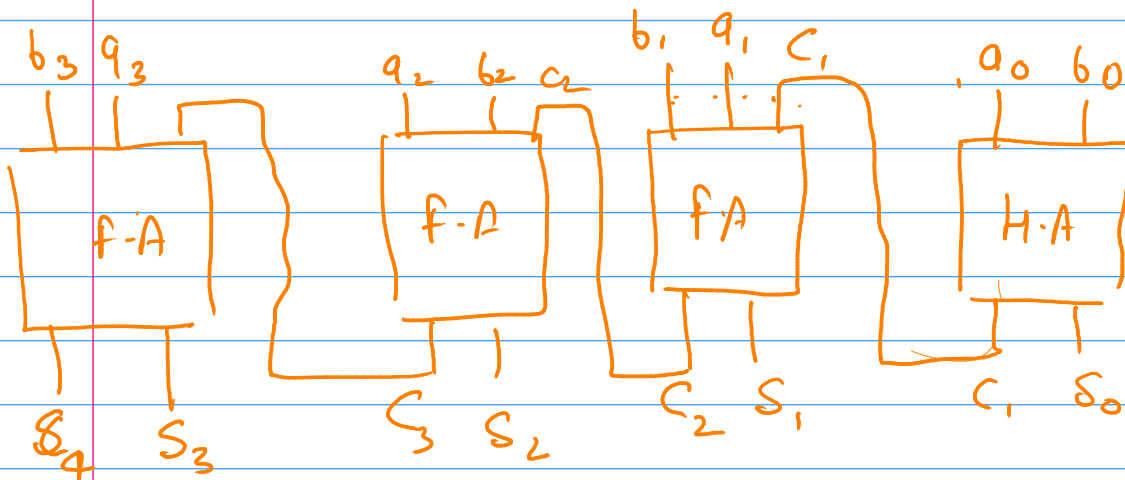
$Y=1 \Rightarrow Z = X'$

Sign (0) = 1 →



$$\begin{array}{cccc}
 c_3 & c_2 & c_1 & c_0 \\
 q_3 & q_2 & q_1 & q_0 \\
 b_3 & b_2 & b_1 & b_0 \\
 \hline
 s_3 & s_2 & s_1 & s_0
 \end{array}
 \approx$$

$$\begin{array}{cccc}
 1 & 0 & 1 & 0 \\
 1 & 1 & 1 & 1 \\
 \hline
 & & & 1
 \end{array}$$



$$\begin{array}{cccc}
 q_3 & q_2 & q_1 & q_0 \\
 b'_3 & b'_2 & b'_1 & b'_0 \\
 \hline
 & & & + 1
 \end{array}
 \approx$$

$$2^n$$

$$n \Rightarrow \text{---}$$

n bits

$$q$$

$$\Rightarrow \left. \begin{array}{c} q \\ a' \\ 1 \\ 0 \end{array} \right\} 4$$

$$\begin{array}{cc} \underline{a} & \underline{b} \end{array}$$

$$\begin{array}{cccccc} 1 & a & a' & ab' & ab & a+b \\ 0 & b & b' & a'b & a'b' & a'+b' \end{array}$$

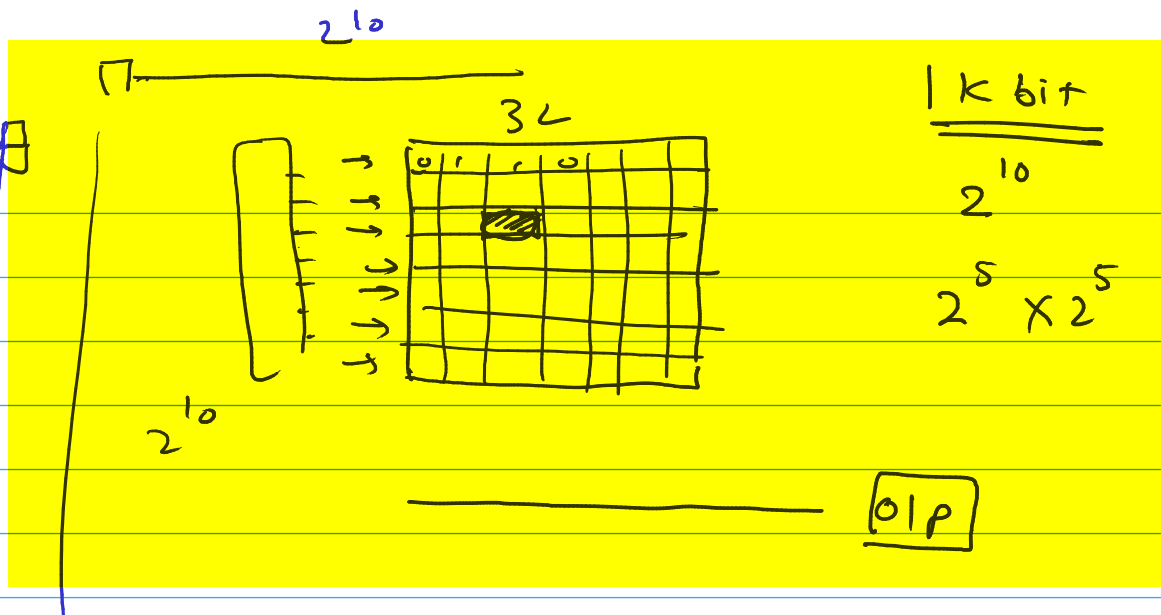
$$a \oplus b, a \odot b$$

\rightarrow

$$\begin{array}{cc} a & b \\ \hline 0 & 0 \\ \hline 0 & 1 \\ \hline 1 & 0 \\ \hline 1 & 1 \end{array}$$

$$\begin{array}{c} 2^n \\ 2 \end{array}$$

#



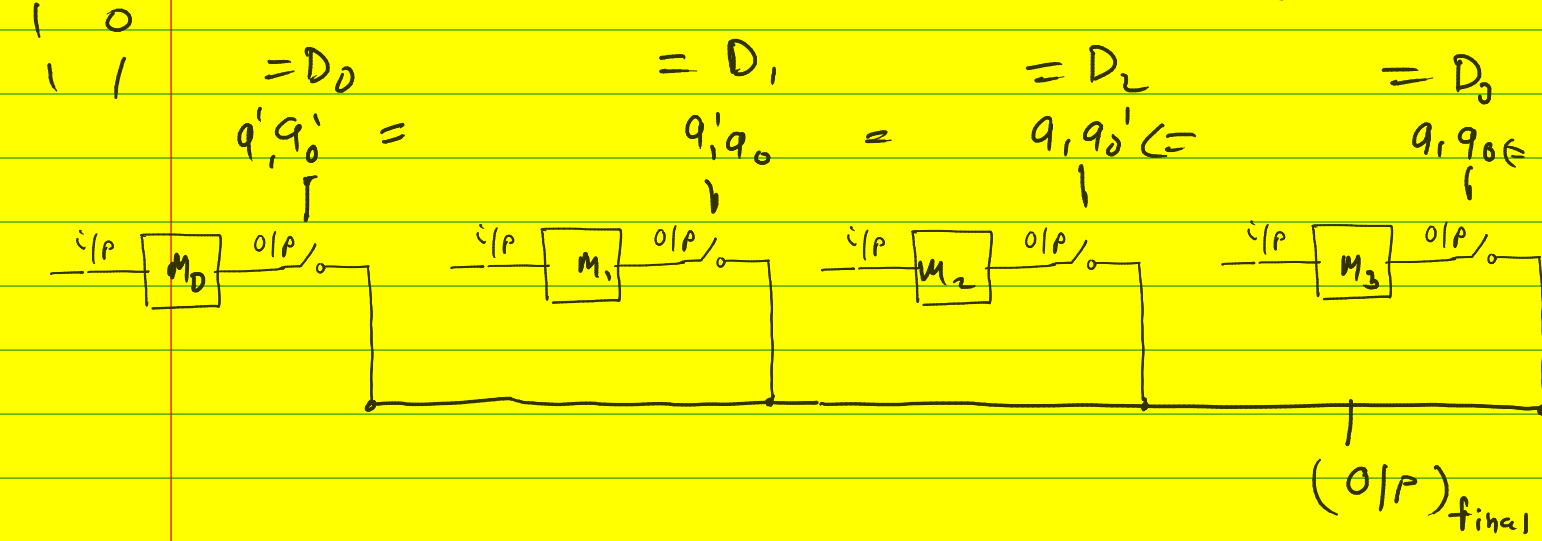
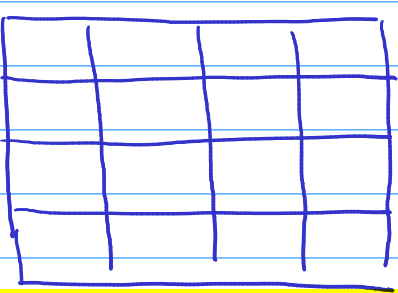
q_4
 q_3
 q_2
 q_1
 q_0

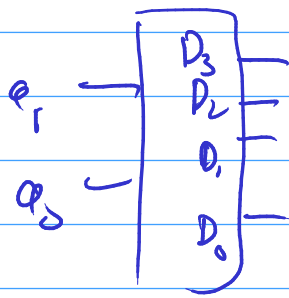
\leq $\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \end{bmatrix}$ -
 $00 \ 001$ -
 $00 \ 010$ -

32

q_1, q_0
 $\begin{bmatrix} 0 & q_1 & 0 & q_0 \end{bmatrix} = 1 \Rightarrow$
 $0 \ 1$

$q'_1 q'_0 = 1$





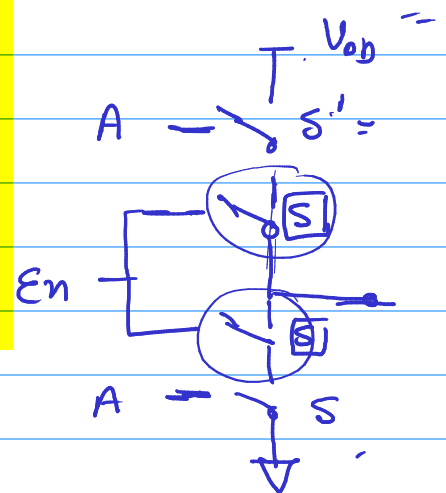
q_1	q_0	D_3	D_2	D_1	D_0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

$$D_0 = q_1' q_0'$$

$$q_1' q_0 = D_1$$

Tri State Buffer / inverter

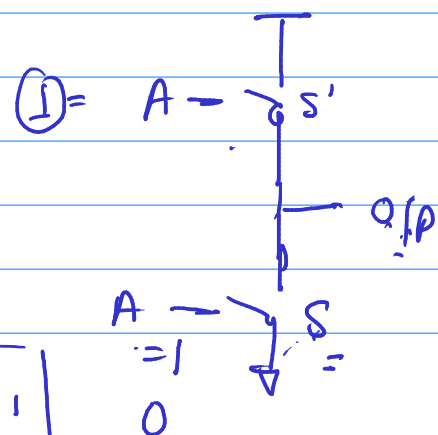
A	<u>En</u>	O/P
\boxed{A}	<u>1</u>	A'
X	<u>0</u>	\boxed{Z}



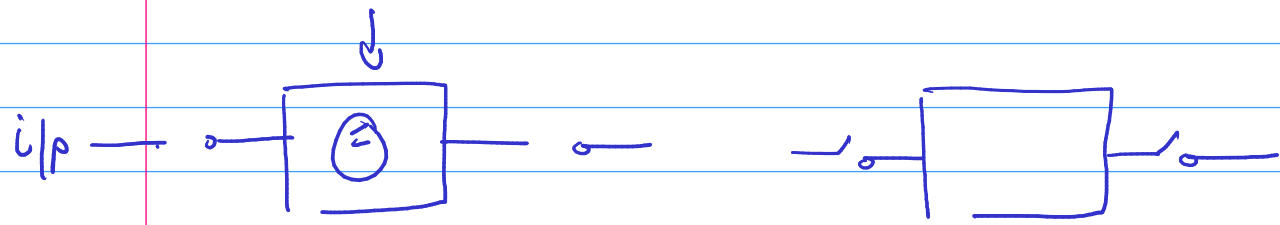
Control
 $S \Rightarrow$ i/p = 1 i/p = 0
 ON OFF

S' Control
 i/p = 0 i/p = 1
 ON OFF

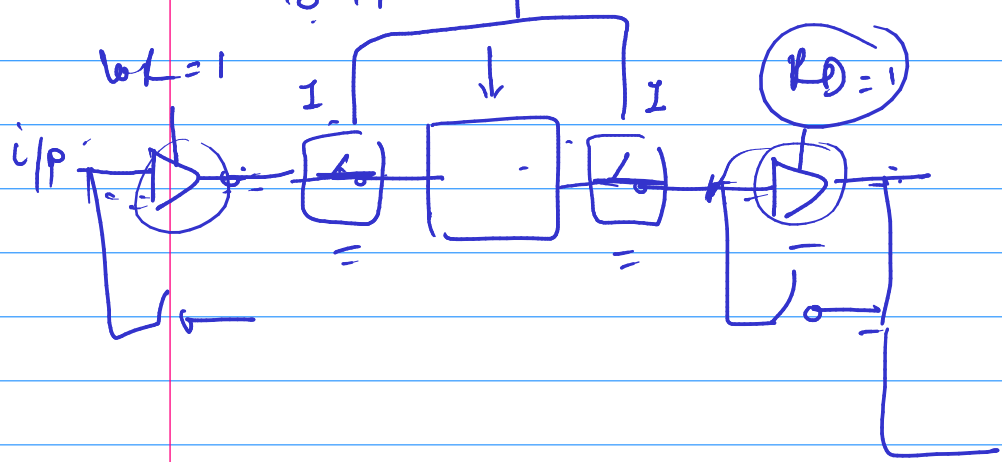
$En = 1$, $\boxed{O/P = A'}$



$$c_n = 0$$



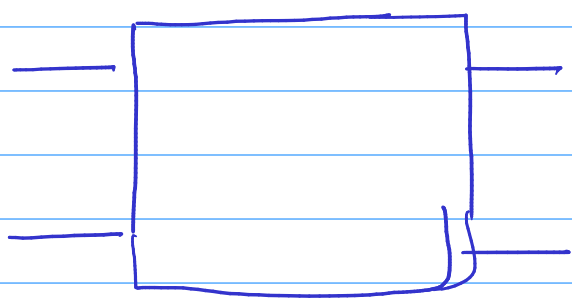
$q_0' q_1'$ Decoder



$RD = 0$
 $WR = 0$

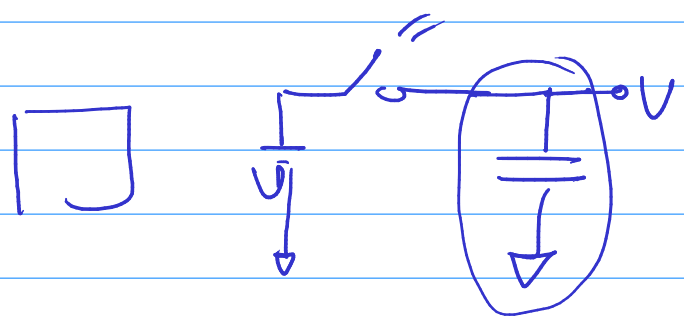


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Wire =

reg.



Module (a, b)

wire q

assign a = b } arch.

in

b, c

so ns q = b and c ;

1 - - - - -

0 =

Songs

q

q | w

q

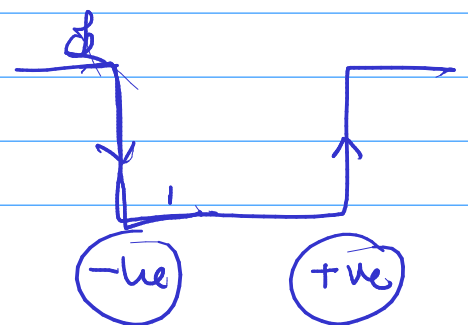
always @ (b, c)

q = b or c ;

—
—
—

End

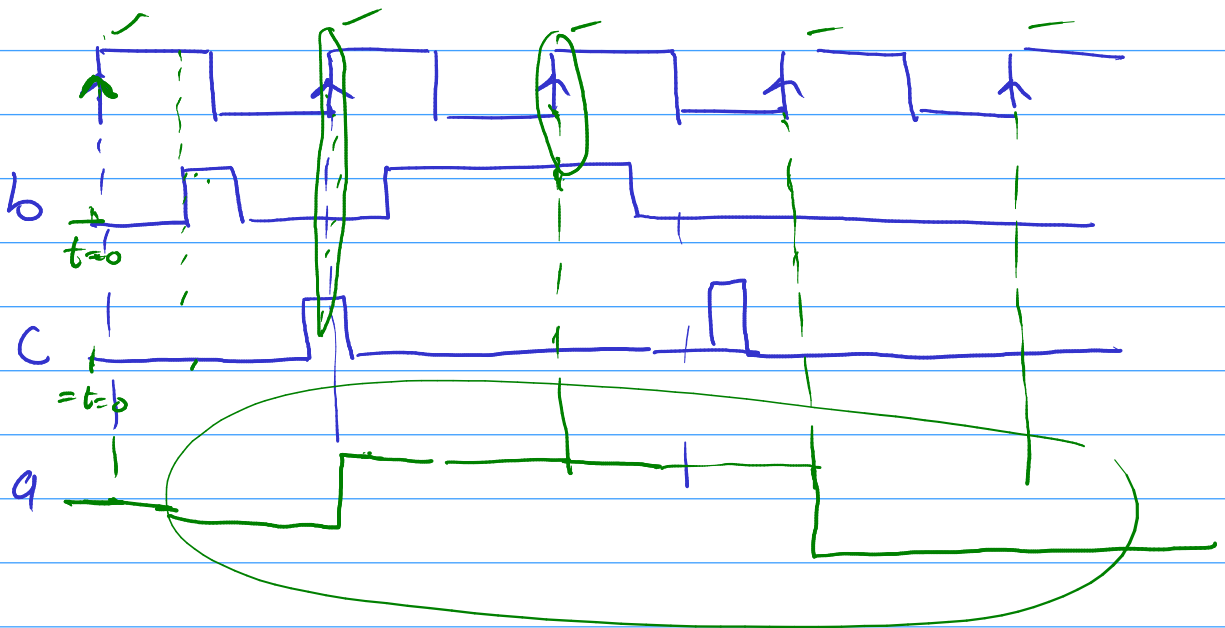
q



always @ (posedge clk)

q = b or c

end



ω ω