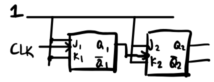
A6

6.11) a) 2 JKs → T ff



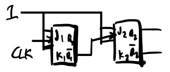
CLK	Q_2	Q_1
0	0	0
1	1	1
2	1	0
3	0	1
4	0	0

change

T ff toggle → 0 → 3 → 2 → 1 → 0

∴ down counter

b)



CLK	Q_2	Q_1
0	0	0
1	0	1
2	1	0
3	1	1
4	0	0

$\bar{Q}_1 = 0$

toggle → 1 → 2 → 3 → 0

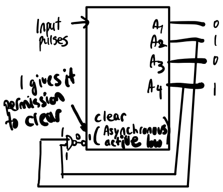
∴ up counter

6.13)

BCD (Base 10): 10 → 0

1010 → 0000

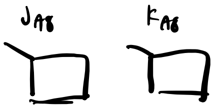
$A_4 A_3 A_2 A_1$



6.19)

Present $A_8 A_4 A_2 A_1$	Next $A_8^* A_4^* A_2^* A_1^*$	FF Inp (a) $J_{A8}K_{A8}$ $J_{A4}K_{A4}$ $J_{A2}K_{A2}$ $J_{A1}K_{A1}$	(b) D_{A8} D_{A4} D_{A2} D_{A1}
0000	⋮	Use excitation table	
0001			
⋮			

J_{A8} K_{A8}



...

Compare:

$J_{A8} = A_4 A_2 A_1$ $K_{A8} = A_1$

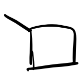
$J_{A4} = A_2 A_1$ $K_{A4} = A_2 A_1$

$J_{A2} = A_8' A_1$ $K_{A2} = A_1$

$J_{A1} = 1$ $K_{A1} = 1$

∴ 4 AND = 4 total

D_{A8}



...

$D_{A8} = A_8 A_1' + A_4 A_2 A_1$ $D_{A2} = A_4 \oplus A_2 A_1$

$D_{A4} = A_2 A_1' + A_8' A_2' A_1$ $D_{A1} = A'$

∴ 5 AND, 2OR, 1 XOR = 8 total

∴ JK is more efficient

6.27 a)

Present A_4 A_2 A_1	Next A_4^* A_2^* A_1^*	FF Inp ~~JK_{A8} JK_{A2} JK_{A1}~~
		excitation table

Excitation Tables

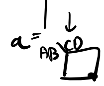
Q	Q^*	S R	D	J K	T
0	0	0 X	0	0 X	0
0	1	1 0	1	1 X	1
1	0	0 1	0	X 1	1
1	1	X 0	1	X 0	0

Equations: $\bar{Q} = S + \bar{R}Q$ NOR, $Q = \bar{S}Q + R$ NAND; $Q^* = D$; $Q^* = J\bar{Q} + \bar{K}Q$; $Q^* = T \oplus Q$

A4

4.9) 0→7 = 4 inputs

ABCD	abcdefg



...

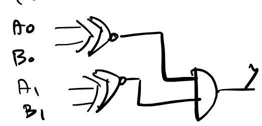
4.21) $A = A_3 A_2 A_1 A_0$

$B = B_3 B_2 B_1 B_0$

AB	Y
00	1
01	0
10	0
11	1

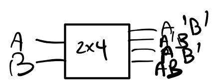
} XNOR

$y = (A_3 \oplus B_3)'(A_2 \oplus B_2)'(A_1 \oplus B_1)'(A_0 \oplus B_0)'$

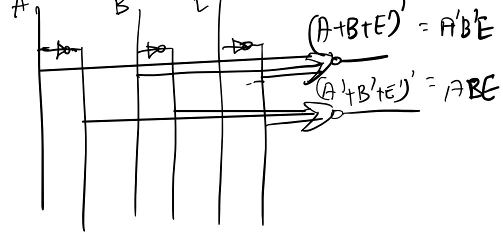


⋮

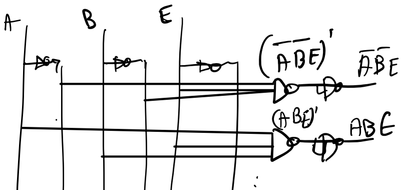
4.23)



a)



b)

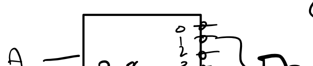


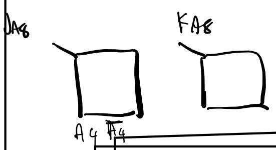
:

SOP	POS
OR	NOR
NAND	AND

bubble

4.27)

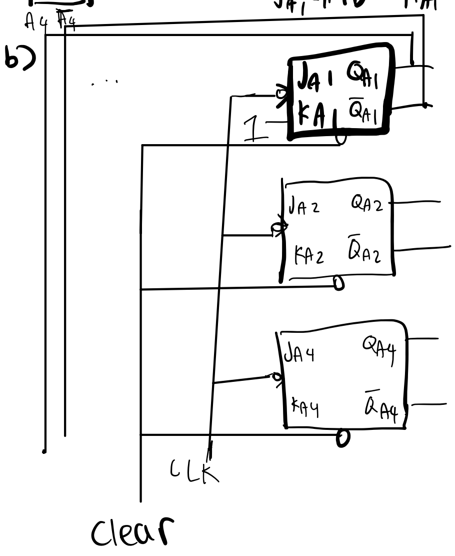


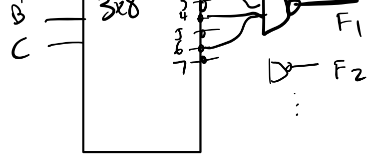


$J_{A4} = BC$ $K_{A4} = B$
$J_{A2} = C$ $K_{A2} = A + C$
$J_{A1} = A' + B'$ $K_{A1} = 1$

$C = A_1$
$B = A_2$
$A = A_4$

b)

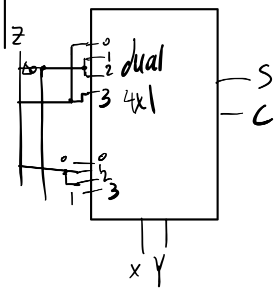




4.33)

Inp x y z	out S C	
0 0 0		$S = z$ $C = 0$
0 0 1		
0 1 0		$S = z'$ $C = z$
0 1 1		
1 0 0		$S = z'$ $C = z$
1 0 1		
1 1 0		$S = z$ $C = 1$
1 1 1		

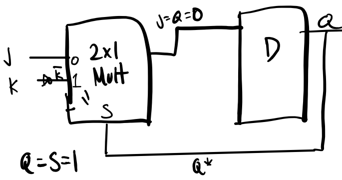
S = sum
C = carry



A5

SOP	POS	
OR	NOR	= Active high
NAND	AND	= Active Low (bubbles)

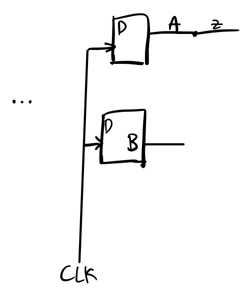
5.2) $\bar{D} = J\bar{Q} + \bar{K}Q$



Assume
$Q = 1$
$\bar{Q} = 0$

$Q = S = 1$

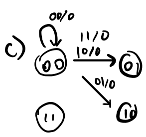
5.6) a)



b)

Present A	B	Inp x	y	Next A^*	B^*	output Z
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0						
0						
0						
0						

c)



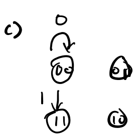
5.9) a) $\overset{JK}{Q^*} = J\bar{Q} + \bar{K}Q$

$A^* = x\bar{A} + \bar{B}A$ $B^* = x\bar{B} + AB$

b)

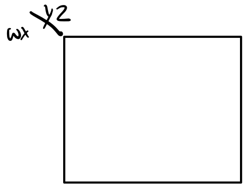
Present A	B	Inp x	Next A^*	B^*
0	0	0	0	0
0	0	1	1	1
0	1	0		
0	1	1		

c)



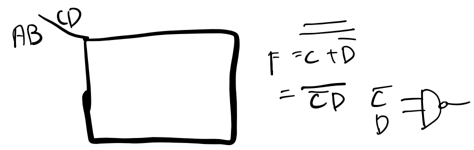
A3

3.10a)



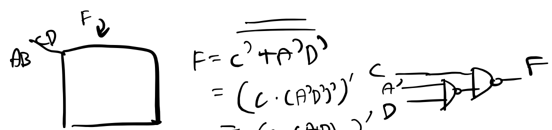
$F = xz + wx + x'z'$
ep $= xz, wx, x'z'$

3.16a) F



$F = \overline{\overline{C + \bar{D}}}$
$= \overline{\bar{C}D}$

c)



$F = \overline{\overline{C' + A'D'}}$
$= (C \cdot (A'D')')'$
$= (C \cdot (A+D))'$
$= (C \cdot (A+D)')'$

A2

2.14 a) $F = xy + x'y' + y'z$

b) $F = (x'+y')' + (x+y)' + (y+z')'$ w/ inverters
c) $F = [(xy)'(x'y')'(y'z)']'$ w/ inverters
d) (c) w/ NAND
e) (b) w/ NOR

A1

1.3 a) $\Rightarrow (\quad)_{10}$

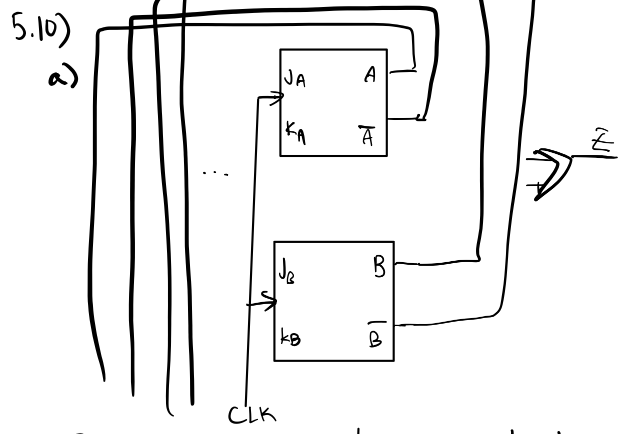
$4 \times 5^3 + 3 \times 5^2 + 1 \times 5^1 + 0 \times 5^0$

1.7) $(64CD)_{16}$
$= (0110\ 0100\ 1100\ 1101)_2$
$= (62315)_8$

1.14 a)
1s 0110 1111 swap all
2s 0111 0000 change once you hit 1

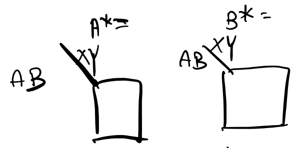
5.10)

a)



b)

Present		Inp		Next	output	
A	B	x	y	A*	B*	Z
0	0	0	0	Eq.		
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1					
0	1					
0	1					
0	1					



5.12)

d = h
b = e
c = a

Present	Next x=0	Next x=1	output x=0	output x=1
a	f	b	0	0
b	d	c ← a	0	0
d	g	a	1	0
f	f	b	1	1
g	g	h ↑ d	0	1

1.16a) $(1100\ 0011\ 1010\ 1111)_2$

1s $(0011\ 1100\ 0101\ 0000) \to 15s$ $(3C50)_{16}$

2s $(0011\ 1100\ 0101\ 0001) \to 16s$ $(3C51)_{16}$

1.17a) 5297 = 05297

$$\begin{array}{r} 99999 \\ -\ 05297 \\ \hline 94702 \\ +1 \\ \hline 94703 \end{array} \qquad \begin{array}{r} 6473 \\ +\ 94703 \\ \hline \underline{1}\ 01176 \\ = 01176 \end{array}$$

⊕

b) 1800 = 01800

$$\begin{array}{r} 99999 \\ -\ 01800 \\ \hline 98199 \\ +1 \\ \hline 98200 \end{array} \qquad \begin{array}{r} 125 \\ +\ 98200 \\ \hline \underline{0}98325 \end{array} \qquad \begin{array}{r} 125 \\ -1800 \\ \hline 1675 \end{array}$$

⊖ so get magnitude

−1675

1.18a) 10010 = 010010

$$\begin{array}{r} 010010 \\ \hline 001110 \end{array}\ 2s \qquad \begin{array}{r} 10011 \\ +\ 001110 \\ \hline \underline{1}\ 00001 \end{array}$$

+ $= (00001)_2$

b) 100110 = 0100110

$$\begin{array}{r} 0100110 \\ \hline 0011010 \end{array}\ 2s \qquad \begin{array}{r} 100\ 010 \\ 0011\ 010 \\ \hline \underline{0}\ 111\ 100 \end{array}$$

⊖ so 2s complement

$\Rightarrow -(000100)_2$

c) 110101 = 0110101

$$\begin{array}{r} 0110101 \\ \hline 0001011 \end{array}\ 2s \qquad \begin{array}{r} 1001 \\ 0001011 \\ \hline \underline{0}010100 \end{array}$$

⊖ so 2s

$-(101100)_2$