Computer Logic and Digital Circuit Design Midterm 1

Ty Carlson

Chapter 1

1) a) Duty cycle = $\left(\frac{t_w}{T}\right)100\%$

duty cycle D_1 = 50%
duty cycle D_2 = 50%
duty cycle D_3 = 50%

for all, half of each pulse is spent in high state

b)

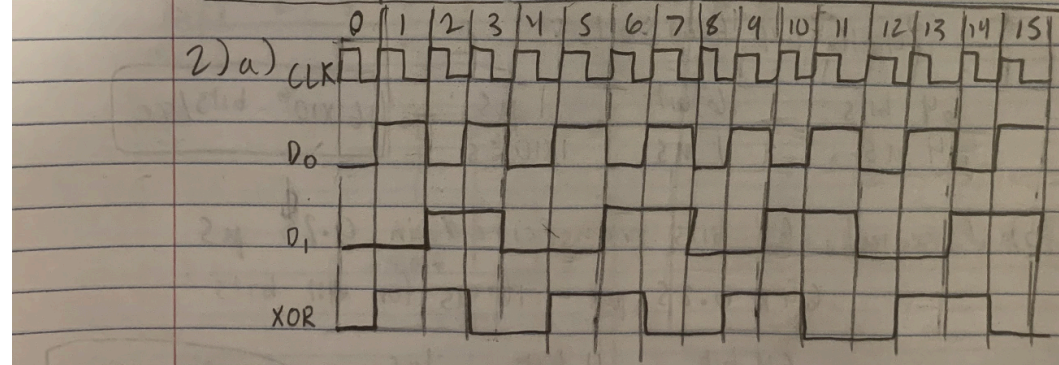
CLK	D_i
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

for all D_i

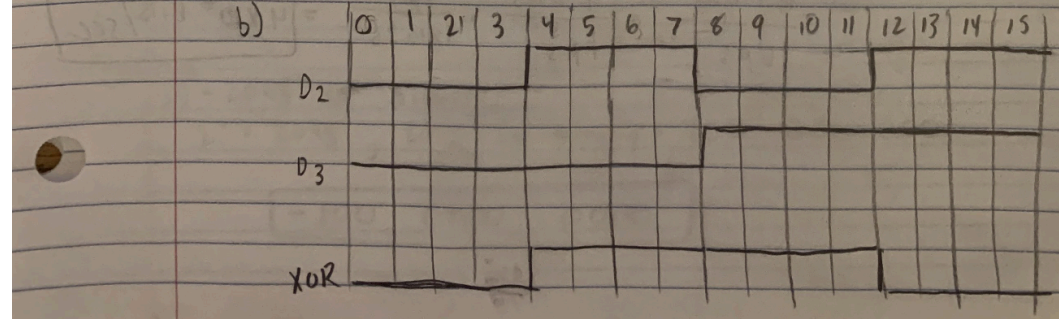
0 0 0 0
↑ ↑ ↑ ↑
D_3 D_2 D_1 D_0

This sequence of numbers is counting from 0 to 15 in binary, resetting every 16 pulses as there are only 4 waves, giving a 4 digit binary number.

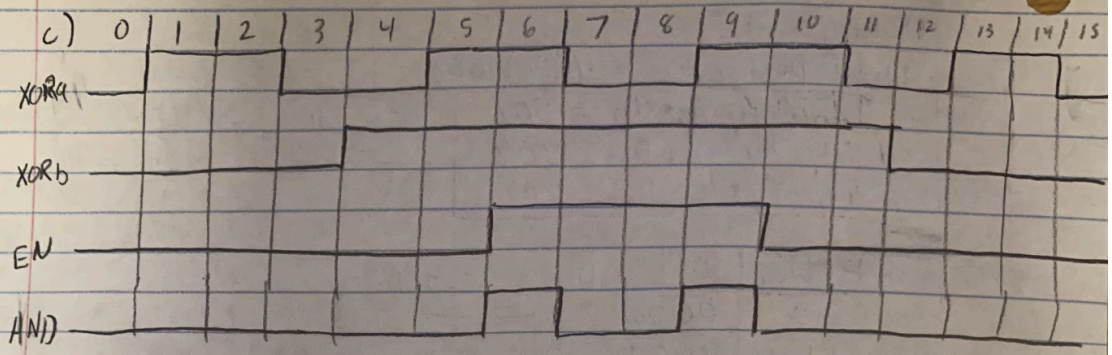
2) a)



b)



c)



3) a) D_j is 4 bit streams, each with 16 bits

$f = 4\,MHz$

$T = \frac{1}{f} = \frac{1}{4\,MHz} = 0.25\,\mu s$

it takes $0.25\,\mu s$ to transfer each set of bits

$16 \times 0.25\,\mu s = 4\,\mu s$ for all bits

$4 \times 16 = 64$ total bits

$$\frac{64\text{ bits}}{4\,\mu s} = \frac{16\text{ bits}}{1\,\mu s} \cdot \frac{1\,\mu s}{1 \times 10^{-6}\,s} = \boxed{16 \times 10^6\text{ bits/sec}}$$

b) if serial, 64 bits transferred in $0.25\,\mu s$

$64 \times 0.25\,\mu s = 16\,\mu s$ for all bits

$$\frac{64\text{ bits}}{16\,\mu s} = \frac{4\text{ bits}}{1\,\mu s} \cdot \frac{1\,\mu s}{1 \times 10^{-6}\,s} = \boxed{4 \times 10^6\text{ bits/sec}}$$

2 Chapter 2

1) a) convert 1024 to binary

pow of 2	val. index	# of power used for make tol.
2^0	1	0
2^1	2	0
2^2	4	0
2^3	8	0
2^4	16	0
2^5	32	0
2^6	64	0
2^7	128	0
2^8	256	0
2^9	512	0
2^{10}	1024	1

= **10 0000 0000**

b) convert 0xBBBB to binary

hex	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
dec	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

B B B B

$11 \times 16^3 = 45056$

$11 \times 16^2 = 2816$

$11 \times 16 = 176$

11

$45056 + 2816 + 176 + 11 =$ **48059**

c) -2048 to binary

$2^{11} = 2048$, 2048 in binary = 100 000 000

-100 0000 0000

2) a) convert 65535 to hex

n	16^n
1	16
2	256
3	4096
4	65536

$65535 < 16^4$

65535 / 4096 = 15 R 4095 → F
4095 / 256 = 15 R 255 → F
255 / 16 = 15 R 15 → F
F

0x FFFF

b) convert 1000 1000 1000 1000 to hex

each 4 bits is one digit of hex

1000 1000 1000 1000
8 8 8 8

0x 8888

3) a)

binary change	# bit changes
000 → 001	1
001 → 010	2
010 → 011	1
011 → 100	3
100 → 101	1
101 → 110	2
110 → 111	1
111 → 000	3

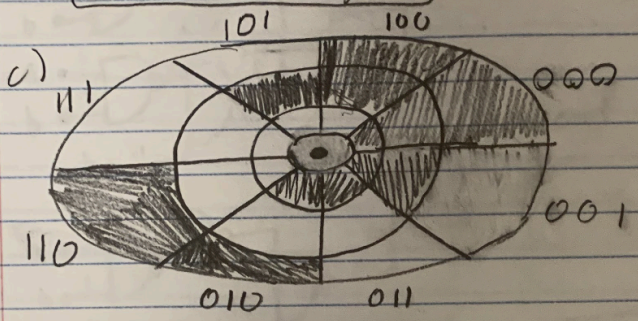
1 + 2 + 1 + 3 + 1 + 2 + 1 + 3
= **14 bit changes**

2 Chapter 2

3) b) gray code changes by 1 bit per int. increase

8 bit changes

c)

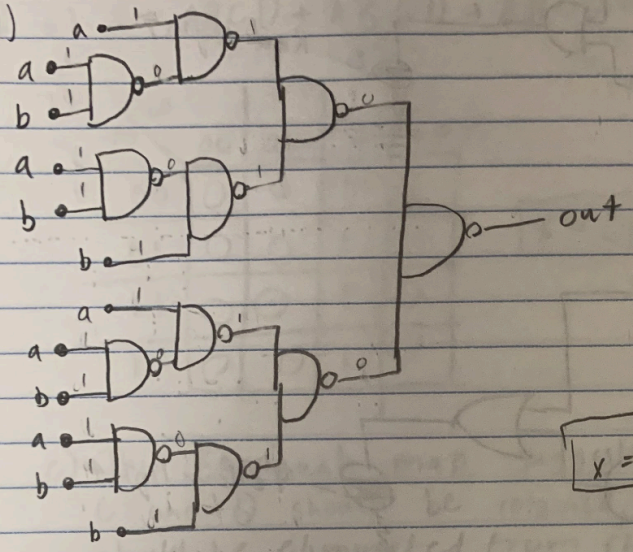


d) $2^8 = 256$

$\frac{360}{256} \approx 1.4063^\circ$

3 Chapter 3

1)

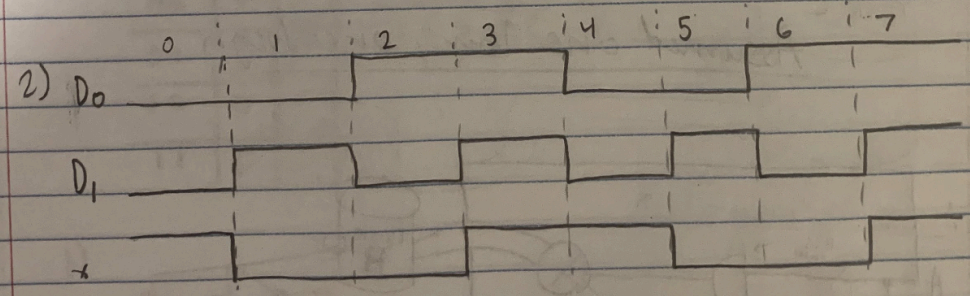


A	B	x
0	0	1
0	1	0
1	0	0
1	1	1

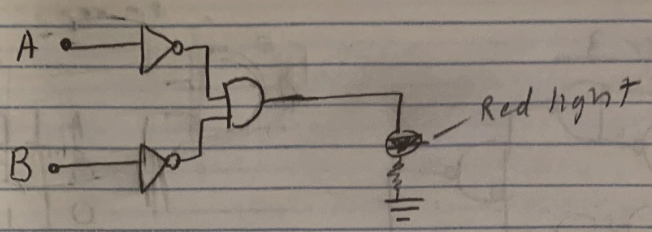
XNOR gate

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

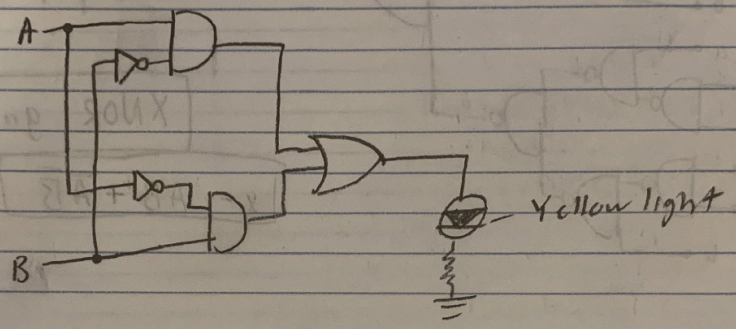
2)



3) a)

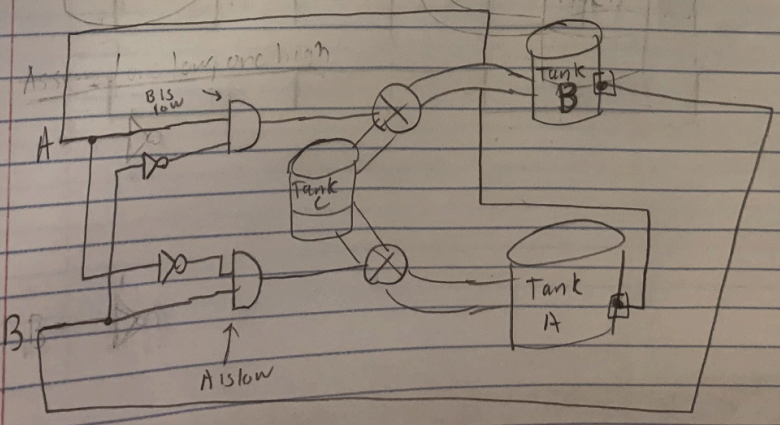


b)



c) ⊗ = valve, when fed HIGH is open

Assumed one low, one high



4 Chapter 4

1) a) $X = ABCD + \bar{A}\bar{B}CD + \bar{A}BCD + A\bar{B}CD$

b)

AB \ CD	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	1	0
10	0	0	1	0

$X = CD$

c) This Karnaugh map suggests that only stocks C and D should be retained, while stocks A and B should be eliminated from the portfolio. This is due to the fact that profit only increases when both C and D are active.

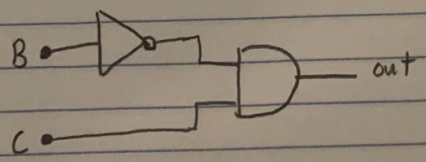
2) a)

AB \ C	0	1
00	0	1
01	0	0
10	0	1
11	0	0

$X = \bar{A}\bar{B}C + A\bar{B}C$

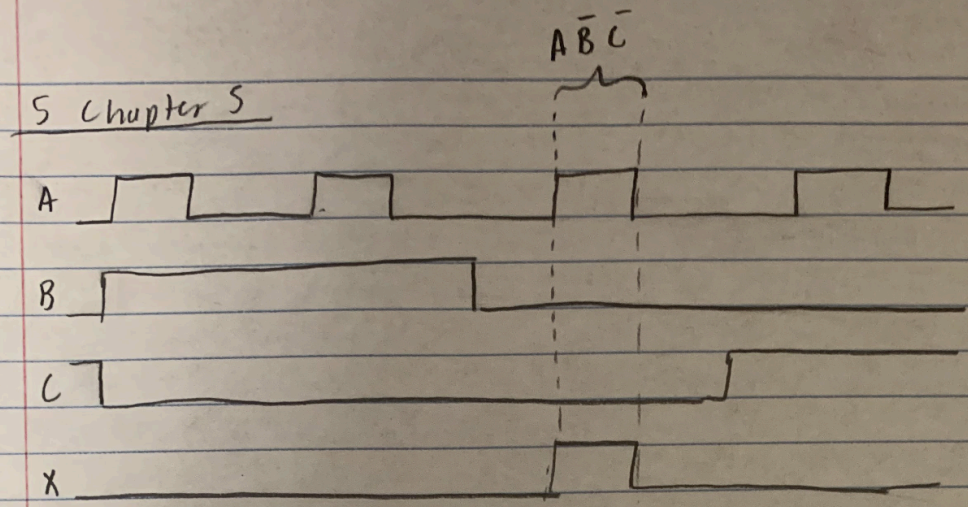
$X = \bar{B}C$

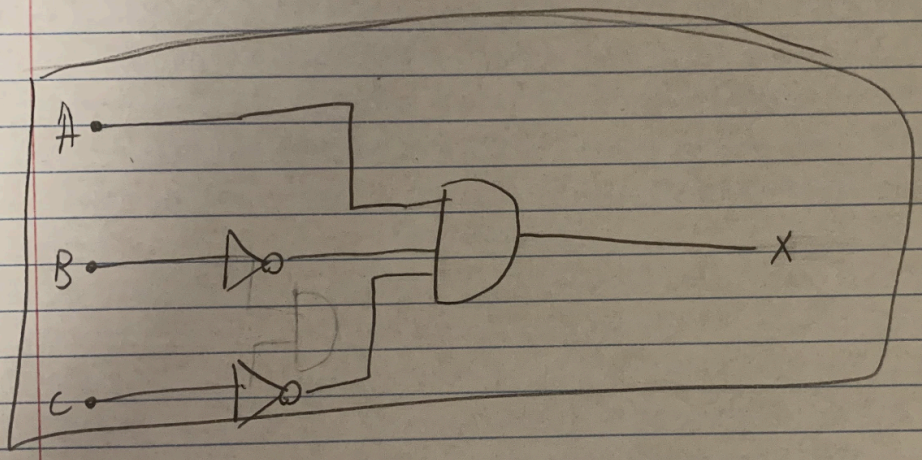
b)



S Chapter 5

1)





2)