Final 2018 COEN 212

Q1

a)

$-5+3$

$5 = 0101$ $3 = 0011$

$-5 = 1010 + 1$

$-5 = 1011$

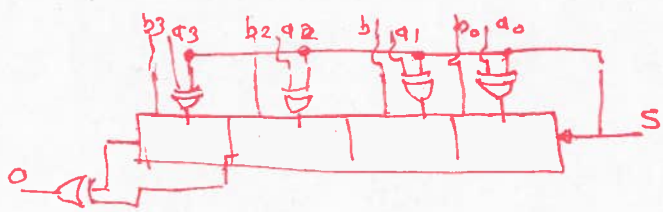
$-5+3 =$

$$\begin{array}{r} 1011 \\ 0011 \\ \hline 1110 \end{array}$$

This a −ve number convert it to +ve to get its value

1110 Complement and 1 $= 000\cancel{1} + 0001 = 0010$ ← This 2 with the −ve sign $= -2$

b)



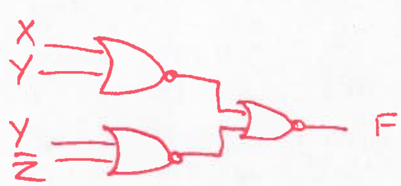
c $F(X,Y,Z) = XY + X\bar{Z} + YZ$ using Consensus theorm

$= X\bar{Z} + YZ$

xy \ z	00	01	11	10
0	0	0	1	1
1	0	1	1	0

$F = (X+Y)(Y+\bar{Z})$

$F = \overline{\overline{(X+Y)(Y+\bar{Z})}} = \overline{\overline{(X+Y)} + \overline{(Y+\bar{Z})}}$ By De Morgan's theorm



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Q2

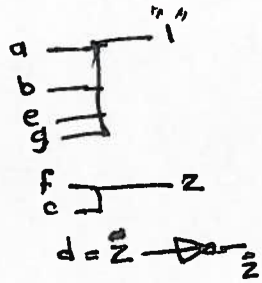
a)

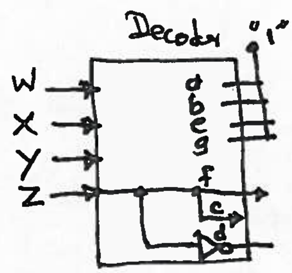
m	W	X	Y	Z	E/O	a	b	c	d	e	f	g
0	0	0	0	0	E	1	1	0	1	1	0	1
1	0	0	0	1	O	1	1	1	0	1	1	1
2	0	0	1	0	E	1	1	0	1	1	0	1
3	0	0	1	1	O	1	1	1	0	1	1	1
4	0	1	0	0	E	1	1	0	1	1	0	1
5	0	1	0	1	O	1	1	1	0	1	1	1
6	0	1	1	0	E	1	1	0	1	1	0	1
7	0	1	1	1	O	1	1	1	0	1	1	1
8	1	0	0	0	E	1	1	0	1	1	0	1
9	1	0	0	1	O	1	1	1	0	1	1	1

E → c, f = 0 O → d = 0

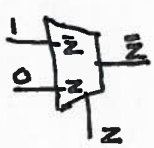
a = b = e = g = 1

f = c = Z $d = \bar{Z}$





b) The decoder has only one inverter to be implemented by a 2→1 MUX



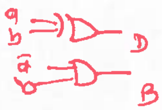
Q3
a − b

a)

a	b	D	B
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Half Subtractor

$$\begin{cases} D = a \oplus b \\ B = \bar{a} b \end{cases}$$



m	a	b	B_-	D	B
0	0	0	0	0	0
1	0	0	1	1	1
2	0	1	0	1	1
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	0
6	1	1	0	0	0
7	1	1	1	1	1

B_- \ ab	00	01	11	10
0	0	2 1	6	4 1
1	1 1	3	7 1	5

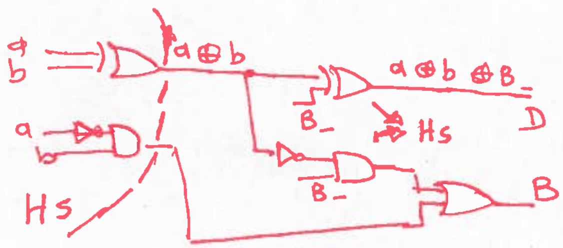
$D = (\bar{a} b + a \bar{b}) \bar{B}_- + (\bar{a}\bar{b} + ab$

B_- \ ab	00	01	11	10
0		1		
1	1	1	1	

$B = \bar{a} b + B_- (ab + \bar{a}\bar{b})$

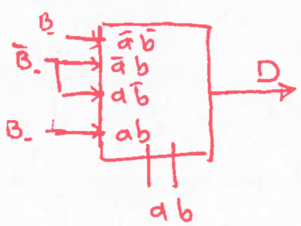
$\therefore\ D = a \oplus b \oplus B_-$

b) $B = \bar{a} b + B_- (\overline{a \oplus b})$

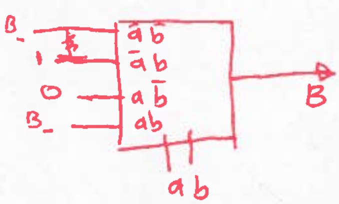


2 Half Subtractor & OR gate as shown above make a full subtractor

c) $D = \bar{a} b \bar{B}_- + a \bar{b} \bar{B}_- + \bar{a}\bar{b} B_- + a b B_-$



$B = \bar{a} B_- + \bar{a} b + b B_-$



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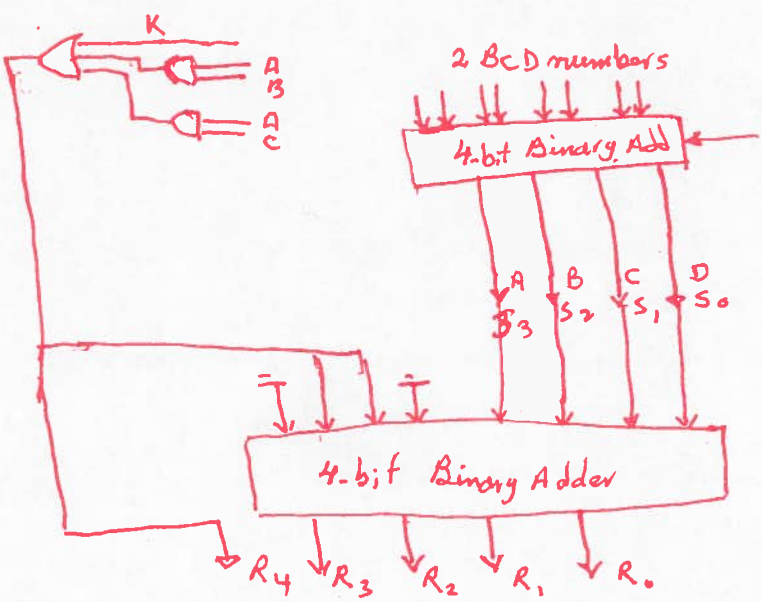
Q4

	Results Binary of Addition					Result BCD Addition					
	K	A	B	C	D		a	b	c	d	
0		0	0	0	0		0	0	0	0	
1		0	0	0	1		0	0	0	1	
2		0	0	1	0		0	0	1	0	
3		0	0	1	1		0	0	1	1	
4		0	1	0	0		0	1	0	0	
5		0	1	0	1		0	1	0	1	
6		0	1	1	0		0	1	1	0	
7		0	1	1	1		0	1	1	1	
8		1	0	0	0		1	0	0	0	
9		1	0	0	1		1	0	0	1	
10		1	0	1	0	9+ 1	0	0	0	0	10
11		1	0	1	1	1	0	0	0	1	11
12		1	1	0	0	1	0	0	1	0	12
13		1	1	0	1	1	0	0	1	1	13
14		1	1	1	0	1	0	1	0	0	14
15		1	1	1	1	1	0	1	0	1	15
16	1	0	0	0	0	1	0	1	1	0	16
17	1	0	0	0	1	1	0	1	1	1	17
18	1	0	0	1	0	1	1	0	0	0	18
19	1	0	0	1	1	1	1	0	0	1	19

To change the binary to BCD sum we have to add 6 to the group of 9+ as shown in the table above i.e. whenever

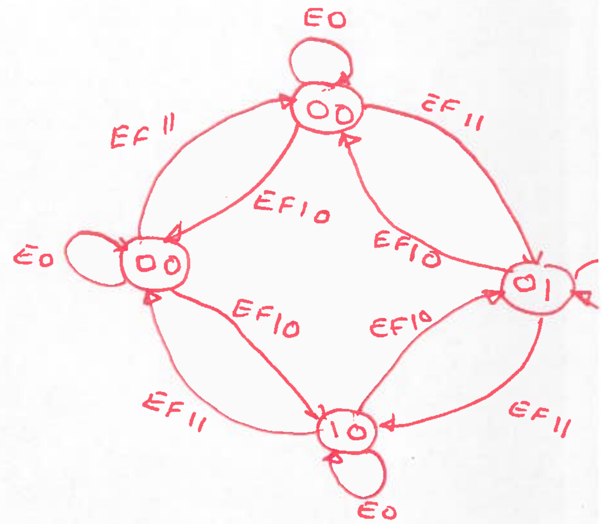


BCD SUM

Final 2018 COEN 2018

Q5

$Y_A\,Y_B$ \ EF	00	01	11	10
0 0	0 0	0 0	0 1	1 1
0 1	0 1	0 1	1 0	0 0
1 1	1 1	1 1	0 0	1 0
1 0	1 0	1 0	1 1	0 1



Y_AY_B \ EF	00	01	11	10
00	0	0	0	1
01	0	0	1	0
11	1	1	0	1
10	1	1	1	0

Y_A

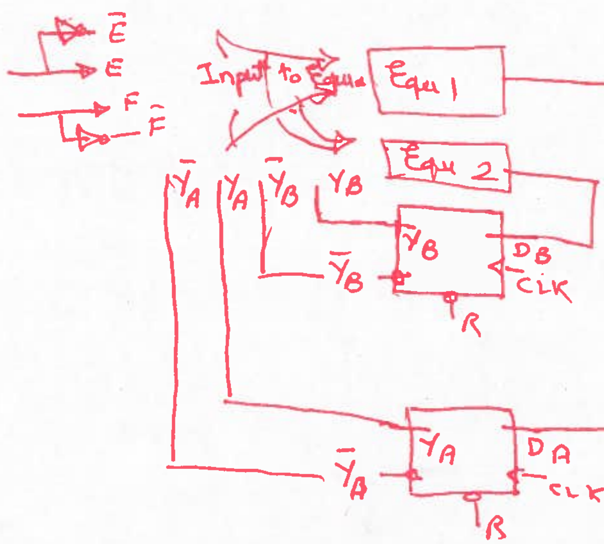
Y_AY_B \ EF	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

Y_B

$Y_A = \bar{E} Y_A + F Y_A \bar{B} + \bar{F} Y_A Y_B$ $\quad Y_B = \bar{E} Y_B + E \bar{Y}_A$
$+ E\bar{F} \bar{Y}_A \bar{Y}_B$
$+ E\bar{F} Y_A Y_B$

$D_A = Y_A = \bar{E} Y_A + F Y_A \bar{Y}_B + \bar{F} Y_A Y_B + E\bar{F}(Y_A \odot Y_B)$ Eq 1 Excitation FFA

$D_B = Y_B = \bar{E} Y_B + E \bar{Y}_A$ Equ 2 Excitation for FF B



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Q6

a)

From Diagram

$T_A = Q_A + Q_B$ & $T_B = \bar{Q}_A + Q_B$ Excitation Equations

for T flip flop $Q^+ = T\bar{Q} + \bar{T}Q$

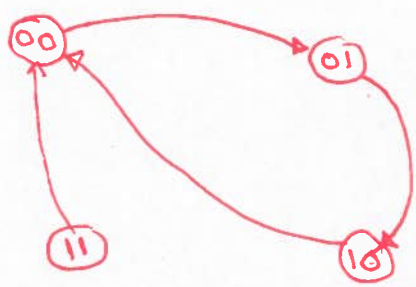
$\therefore$

$$Q^+_A = (Q_A + Q_B)\bar{Q}_A + \overline{Q_A + Q_B}\, Q_A = \bar{Q}_A Q_B \quad \text{Equ 1}$$

$$Q^+_B = (\bar{Q}_A + Q_B)\bar{Q}_B + \overline{(\bar{Q}_A + Q_B)}\, Q_B = \bar{Q}_A \bar{Q}_B \quad \text{Equ 2}$$

Next state Equations

Present state Q_A	Present state Q_B	Next state Q_A^+	Next state Q_B^+
0	0	0	1
0	1	1	0
1	0	0	0
1	1	0	0



b) The function of this circuit is a counter 00 → 01 → 10 → 00 with state 11 is not used. The provision in case the counter jumps to 11, then it will go to state 00.