

PRACTICAL 3A: COMBINATIONAL CIRCUITS

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Signature

02-05-2018

Date

Solutions

a) Truth Table for 1-bit Half Adder

A	B	S	C _{OUT}
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

$$b) S = (A \cdot \bar{B}) + (\bar{A} \cdot B)$$

$$S = A \oplus B$$

$$C_{OUT} = A \cdot B$$

c) Truth Table for 1-bit Full Adder

C _{IN}	A	B	S	C _{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

d)

$$S = (\bar{A} \cdot B \cdot \overline{C_{IN}}) + (A \cdot \bar{B} \cdot \overline{C_{IN}}) + (\bar{A} \cdot \bar{B} \cdot C_{IN}) + (A \cdot B \cdot C_{IN})$$

$$S = \overline{C_{IN}}((\bar{A} \cdot B) + (A \cdot \bar{B})) + C_{IN}((\bar{A} \cdot \bar{B}) + (A \cdot B))$$

$$\text{Let } X = (\bar{A} \cdot B) + (A \cdot \bar{B}) = A \oplus B$$

$$\text{Then, } \bar{X} = (\bar{A} \cdot \bar{B}) + (A \cdot B)$$

$$\text{Thus, } S = \overline{C_{IN}}(X) + C_{IN}(\bar{X}) = C_{IN} \oplus X$$

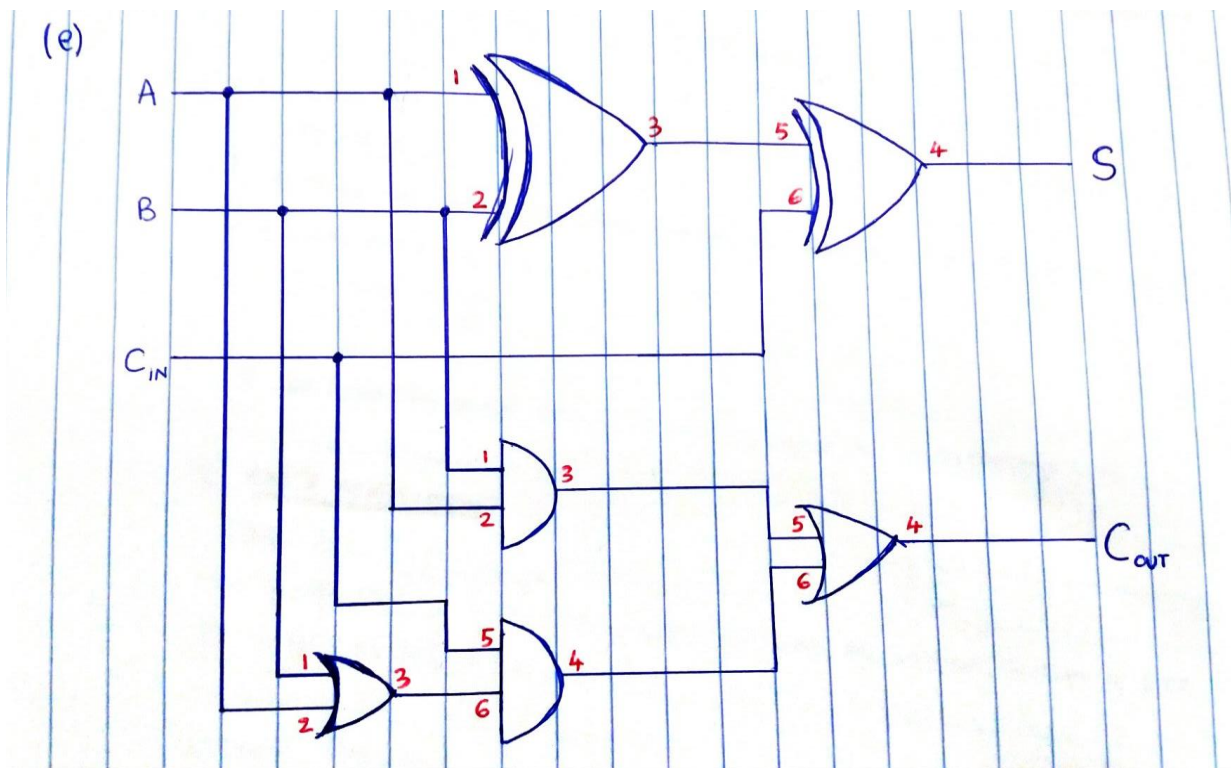
$$S = C_{IN} \oplus A \oplus B$$

C_{in}	AB				C_{out}
	00	01	11	10	
0			1		
1		1	1	1	

$$C_{OUT} = (C_{IN} \cdot B) + (C_{IN} \cdot A) + (A \cdot B)$$

$$C_{OUT} = C_{IN}(A+B) + (A \cdot B)$$

e)



f) Truth Table for 1-bit Full Subtractor

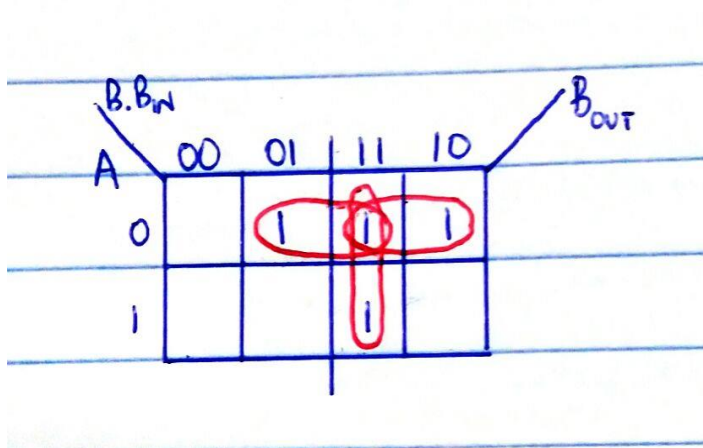
A	B	B _{IN}	D	B _{OUT}
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

g)

$$D = (\bar{A} \cdot \bar{B} \cdot B_{in}) + (\bar{A} \cdot B \cdot \bar{B}_{in}) + (A \cdot \bar{B} \cdot \bar{B}_{in}) + (A \cdot B \cdot B_{in})$$

$$D = \bar{A} ((\bar{B} \cdot B_{in}) + (B \cdot \bar{B}_{in})) + A((\bar{B} \cdot \bar{B}_{in}) + (B \cdot B_{in}))$$

$$D = A \oplus B \oplus B_{IN}$$



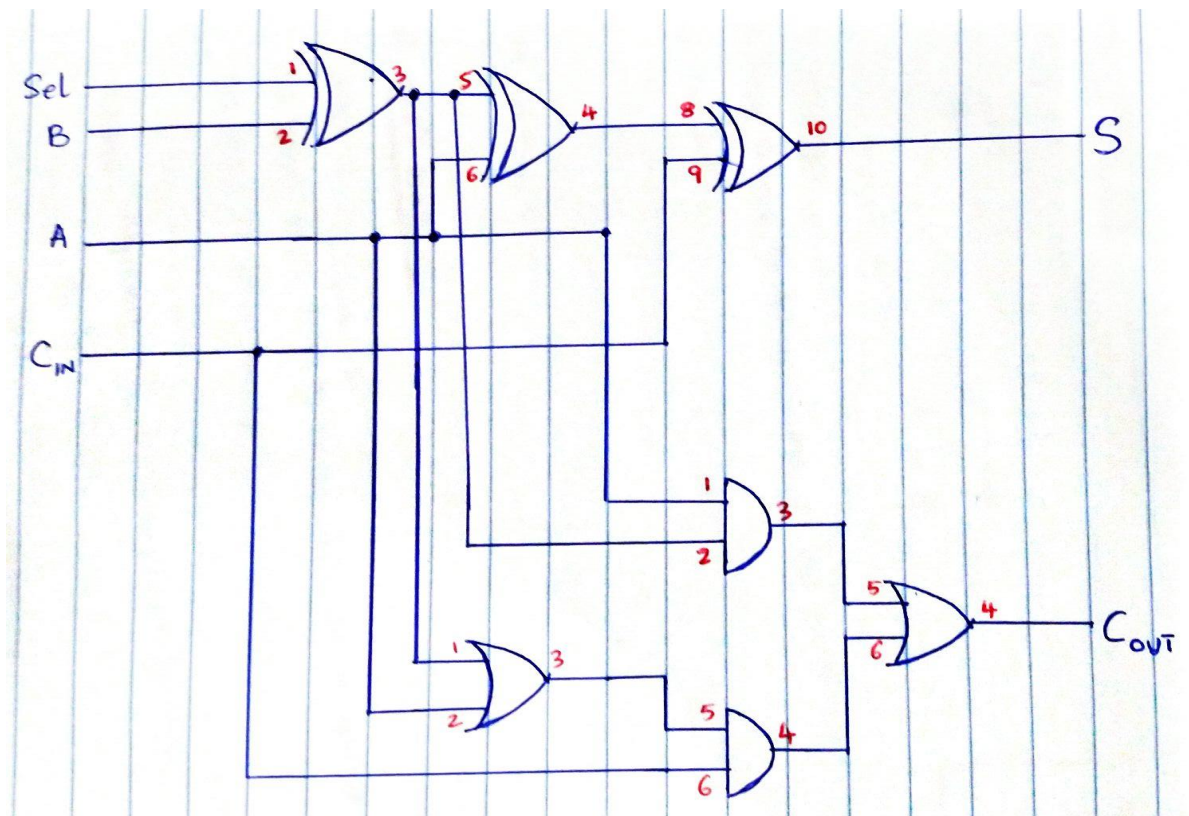
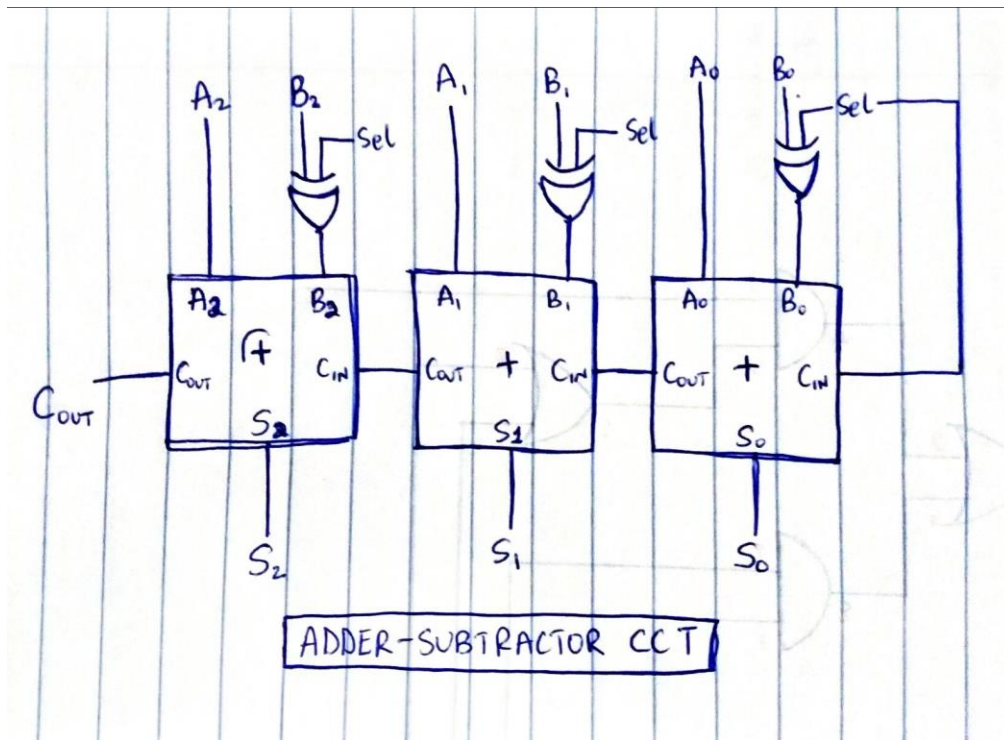
$$B_{OUT} = (B \cdot B_{IN}) + (\bar{A} \cdot B_{IN}) + (\bar{A} \cdot B)$$

$$B_{OUT} = B_{IN} (\bar{A} + B) + (\bar{A} \cdot B)$$

h)

A full Adder can be used as a Full Subtractor by connecting a NOT gate on one of the inputs and connecting the C_{IN} input to a HIGH. By connecting the NOT gate, we are converting the input to its 2's complement. We can also do this by adding an XOR gate to one of the inputs.

i)



k)

C_{IN}	A	B	Sel	S	C_{OUT}	VERIFIED the S variable
0	0	0	0	0	0	0
0	0	0	1	1	1	1
0	0	1	0	1	0	1
0	0	1	1	0	0	0
0	1	0	0	1	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	0
0	1	1	1	1	0	1
1	0	0	0	1	0	1
1	0	0	1	0	1	0
1	0	1	0	0	1	0
1	0	1	1	1	0	1
1	1	0	0	0	1	0
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	0	1	0