Question 1. (10 points)

Encircle your answers of the following questions: (1 point each)

N.O.A = None Of the Above

1- The representation of BCD code 10011001 is

a) 99 Decimal and 99 Hex (b) 99 Decimal and 63 Hex
c) 153 Decimal and 99 Hex d) 153 Decimal and 63 Hex e) N.O.A

2- XOR gate can be realized by using NAND gates.

a) F (b) T

3- The binary representation of 2.25 is

a) 10.00100101 b) 10.11001 c) 0100.0100 (d) 10.0100 e) N.O.A

4- How many combinations, can we build with 8 bits?

(a) 256 b) 255 c) 512 d) 511 e) N.O.A

5- The result of this addition, ($10001000_2 + 10001000_2$), using 8-bit calculator, is:

(a) 00010000_2 b) 00000000_2 c) 10001000_2 d) 00010001_2 e) N.O.A

6- The result of multiplication 8 bits by 8 bits is

a) 64 bits (b) 16 bits c) 8 bits d) 24 bits e) N.O.A

7- A NOR gate can be realized using AND gates.

(a) F b) T

8- If the result **F = A AND B** is equal 1010 and **B** = 1011, so **A** is equal to

a) 1100 (b) 1010 c) 1011 d) 0101 e) N.O.A

9- $(x \oplus x')\, x + x = 1$

(a) F b) T

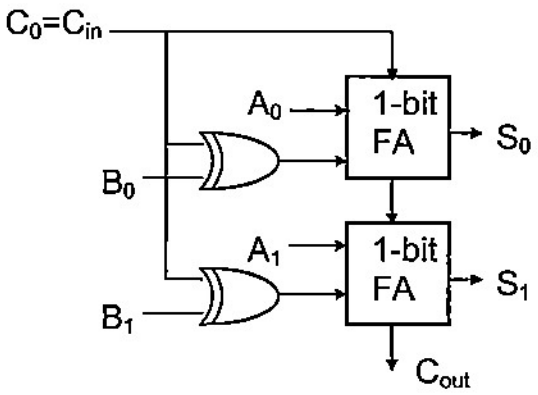
10- $A'BC + A(B'+C') = A \oplus B \oplus C$

(a) F b) T

Question 2. (10 points)

a) Complete the truth table of the following circuit:

Cin	A1	A0	B1	B0	S1	S0	Cout
0	0	0	0	0	0	0	0
0	0	0	0	1	0	1	0
0	0	0	1	0	1	0	0
0	0	0	1	1	1	1	0
0	0	1	0	0	0	1	0
0	0	1	0	1	1	0	0
0	0	1	1	0	1	1	0
0	0	1	1	1	0	0	1
0	1	0	0	0	1	0	0
0	1	0	0	1	1	1	0
0	1	0	1	0	0	0	1
0	1	0	1	1	0	1	1
0	1	1	0	0	1	1	0
0	1	1	0	1	0	0	1
0	1	1	1	0	0	1	1
0	1	1	1	1	1	0	1
1	0	0	0	0	0	0	1
1	0	0	0	1	1	1	0
1	0	0	1	0	1	0	0
1	0	0	1	1	0	1	0
1	0	1	0	0	0	1	1
1	0	1	0	1	0	0	1
1	0	1	1	0	1	1	0
1	0	1	1	1	1	0	0
1	1	0	0	0	1	0	0
1	1	0	0	1	0	1	1
1	1	0	1	0	0	0	1
1	1	0	1	1	1	1	0
1	1	1	0	0	1	1	0
1	1	1	0	1	1	0	1
1	1	1	1	0	0	1	1
1	1	1	1	1	0	0	1

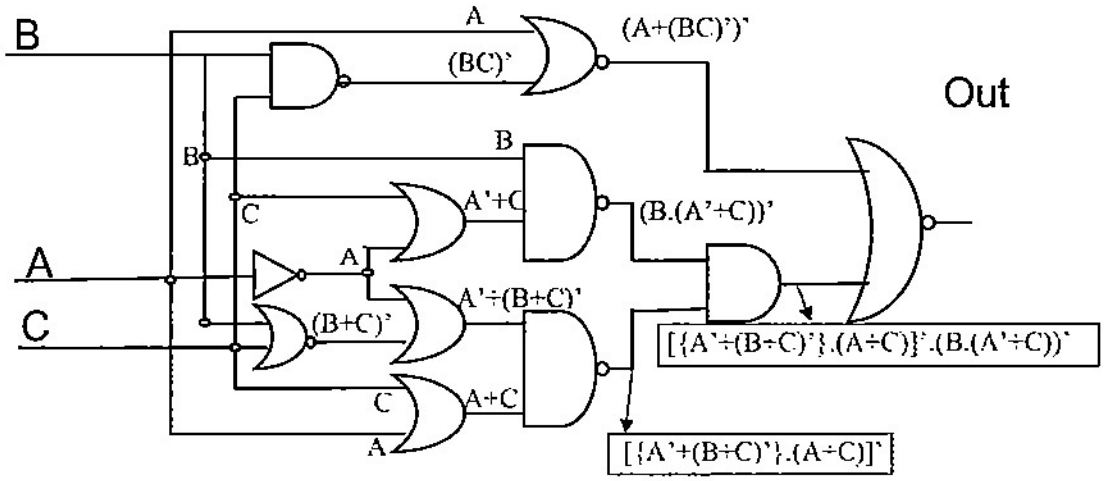


b) What this circuit does?

It adds A+B, When Cin = 0
Otherwise A-B (when Cin =1)

Question 3. (15 points)

a) Write the output expression of the following circuit: **(5 points)**



$$\text{Out} = \overline{(A + \overline{BC})} + \left\{\left[\overline{(A+(B+C))} \cdot (A + C)\right]. \left[\overline{B.(A+C)}\right]\right\}$$

b) Reduce to maximum the above circuit. **(10 points)**

$$\text{Out} = \overline{(A + \overline{BC})} \cdot \left\{\left[\overline{(A+(B+C))} \cdot (A + C)\right] + \left[\overline{B.(A+C)}\right]\right\}$$

$$= (A + \overline{BC}) \cdot \left\{\left[(\overline{A}+\overline{(B+C)}) \cdot (A + C)\right] + \left[B.\overline{(A+C)}\right]\right\}$$

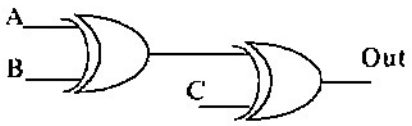
$$= (A + \overline{B}+\overline{C}) \cdot \left\{\left[(\overline{A}+ \overline{B}\,\overline{C}) \cdot (A + C)\right] + \overline{A}B+BC\right\}$$

$$= (A + \overline{B}+\overline{C}) \cdot \left\{ \overline{A}C + A\,\overline{B}\,\overline{C} + \overline{A}\,B + B\,C\right\}$$

$$= A\,\overline{B}\,\overline{C} + A\,B\,C + \overline{A}\,\overline{B}\,C + \overline{A}\,B\,\overline{C}$$

$$= A\,\overline{(B \oplus C)} + \overline{A}\,(B \oplus C)$$

$$= A \oplus B \oplus C$$



Question 4. (15 points)

Find the minimum expressions (F and F') of the following k-maps:

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

F = BD + B' D' = (B ⊕ D)'

F' = B ⊕ D

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

F = AB'+AC'+AD+BC'

F'= (A'B'D) + (BCD')

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

F= BC'D

F'= B'+C+D'

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

F = D' + AC

F' = (A'+C')D

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

F = 1

F'= 0

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

F= BC'D

F'= B'+C+D'

Simplify in maximum the following expressions (you can use K-maps):

1- X= AB'C' + A'D + D' = A' + D' + B'C

2- Y= A'C + AD + BCD = A'C + AD + CD + BCD = A'C + AD + CD = A'C + AD

Add Redundant

Remove Redundant

3- Z= AD' + BD------ NO CHANGE

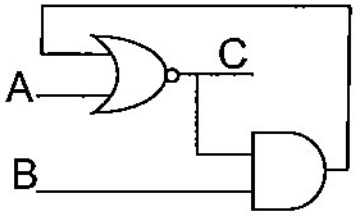
AB \ CD	00	01	11	10
00	1	1	1	1
01	1	1	0	1
11	1	1	0	0
10	1	1	1	1

AB \ CD	00	01	11	10
00				
01				
11				
10				

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

Question 5. (Bonus: **5 points**)

Complete the truth table of the following circuit:



A	B	C
0	0	1
0	1	C_p'
1	0	0
1	1	0

When A = 1 ➔ C = 0