

1. Answer The Following Questions

a) $9E36.7AH = ?_2 = ?_8$

Since the given number is Hexadecimal, we may convert it into binary by writing each digit in 4-bits binary.

$$(9E36.7A)_{16} = (1001111000110110 . 01111010)_2$$

Now, by rearranging the number in 3-bits groups, we may find its corresponding octal number:

$$(001\ 001\ 111\ 000\ 110\ 110 . 011\ 110\ 100)_2 = (117066 . 364)_8$$

- b) Decimal 3 is expressed as 0110 in a self-complementing code alphabet. Find the corresponding code for decimal 6, in the same alphabet.

The property of self-complementing codes is that, the 9's complement of a given number can be found by complementing each bit. Since the 9's complement of 3 is 6, it should be obtained by complementing each bit of 3, which is 1001.

- c) What is the smallest number that can be represented in 6-bit signed 2's complement form? Is it the same in 6-bit signed 1's complement representation? Why?

-32 (100000), is the smallest number that can be represented in 6 bit signed-2's complement form. In 1's complement form, it becomes -31 olur (100000), since one of the combinations (111111) is used for -0, which is not available in 2's complement .

- d) Find the corresponding Hamming Code for the 4-bit message 1101. Show all of your steps clearly.

Position: 1 2 3 4 5 6 7
 Received Word: p_1 p_2 **1** p_3 **1** **0** **1** (message bits are in bolds)

4,5,6,7 Parity Check: Even $\rightarrow p_3 = 0$

2,3,6,7 Parity Check: Even $\rightarrow p_2 = 0$

1,3,5,7 Parity Check: Odd $\rightarrow p_1 = 1$

Coded Word: 1010**101**

e) Given $F(x,y,z) = x'y + x'z$. Find $F'(x,y,z)$ in canonical S.O.P and P.O.S forms and express them in $\sum$ and $\prod$ standard formats.

	x y z	$F=x'(y'+z)$	F'
0	0 0 0	1	0
1	0 0 1	1	0
2	0 1 0	0	1
3	0 1 1	1	0
4	1 0 0	0	1
5	1 0 1	0	1
6	1 1 0	0	1
7	1 1 1	0	1

$F'(x,y,z) = \sum (2, 4, 5, 6, 7)$
 $= \prod (0, 1, 3)$

2 - Answer The Following Questions

- a) Given $A = (00011001)_2$ and $B = (11010010)_2$. Show how $A+B$, $A-B$, $-A-B$ and $B-A$ would be computed, using 8-bit two's complement arithmetic, step by step separately.

$$A = (25)_{10} = (00011001)_2, B = (11010010)_2, -A = 11100111, -B = 00101110,$$

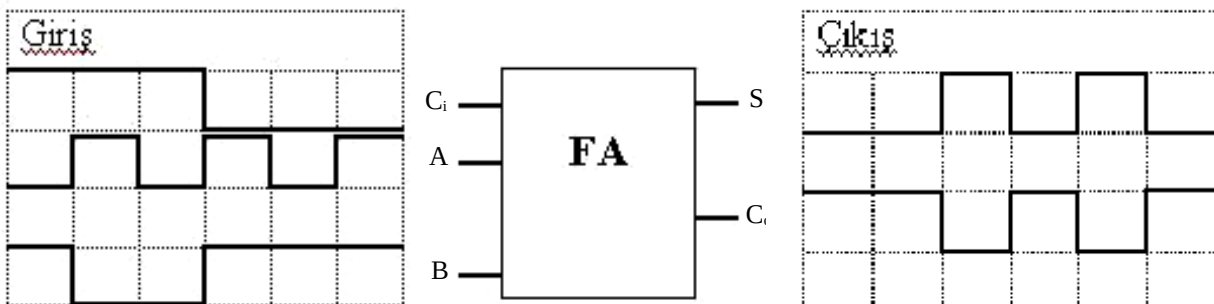
$$A+B = 11101011 = -21,$$

$$A-B = (01000111) = 71,$$

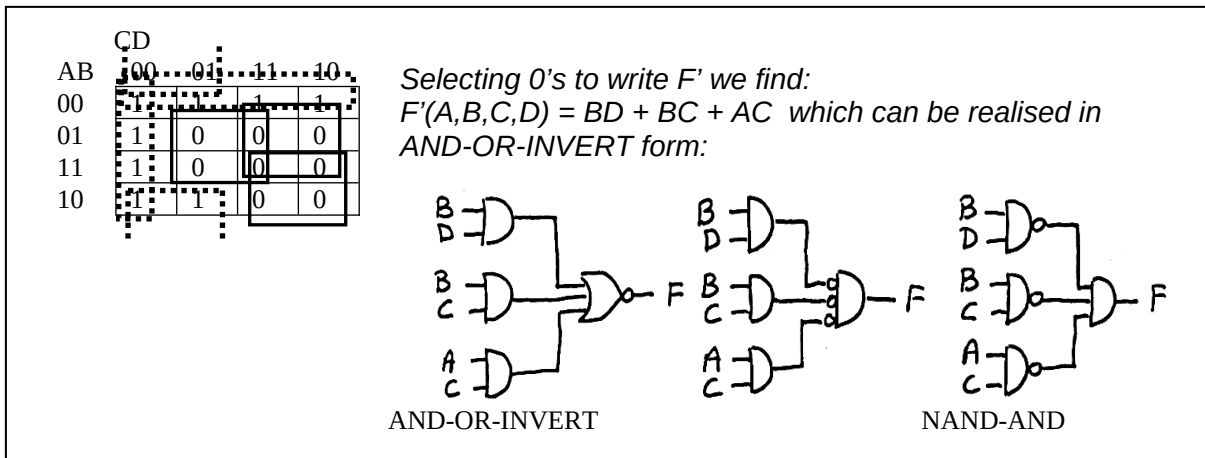
$$B-A = 10111001 = -71$$

$$-A-B = (-A)+(-B) = 00010101 = 21$$

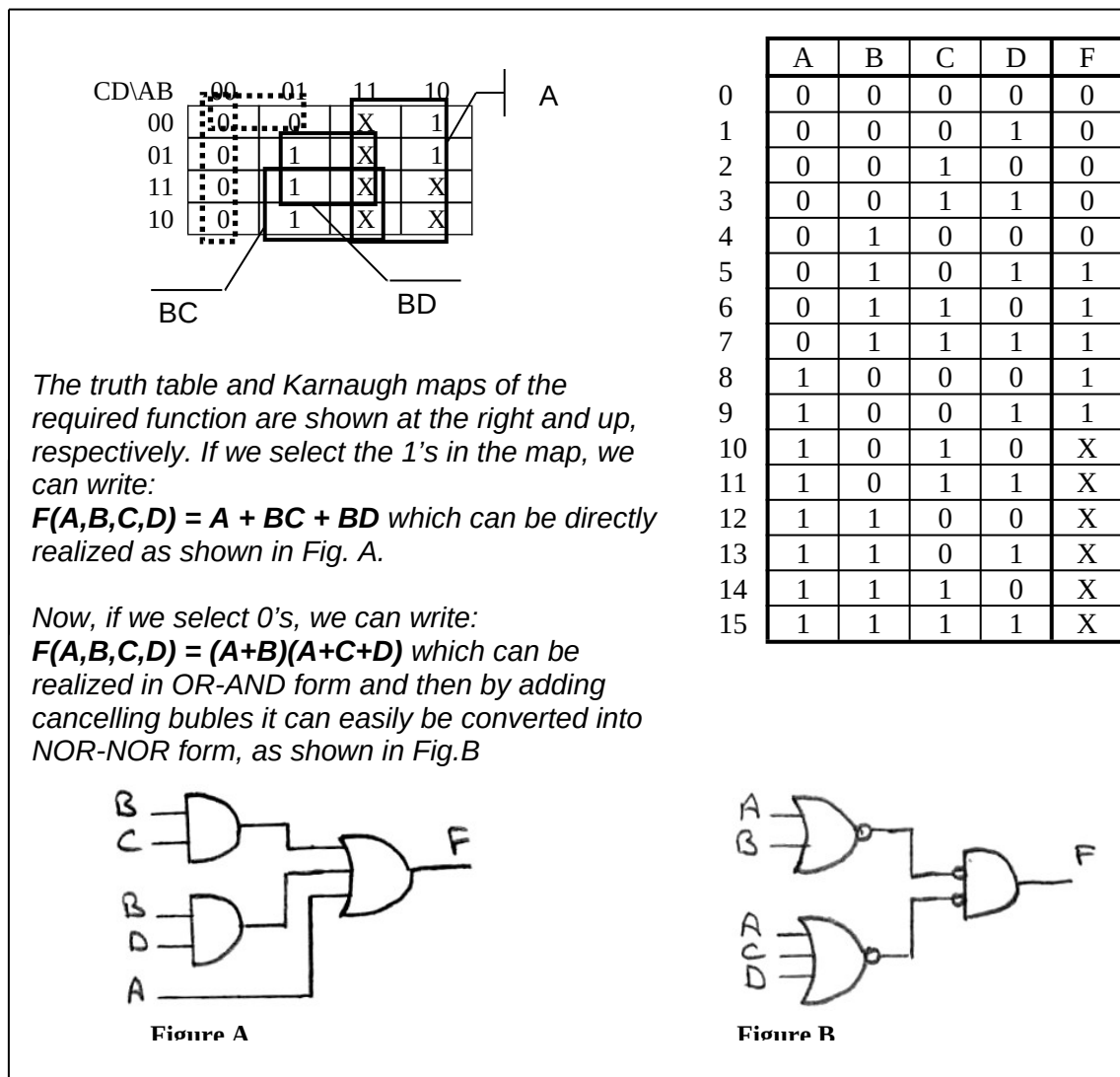
- b) Draw the output waveforms S and C (into the given spaces) of the Full Adder, that would be generated in response to the given input signals



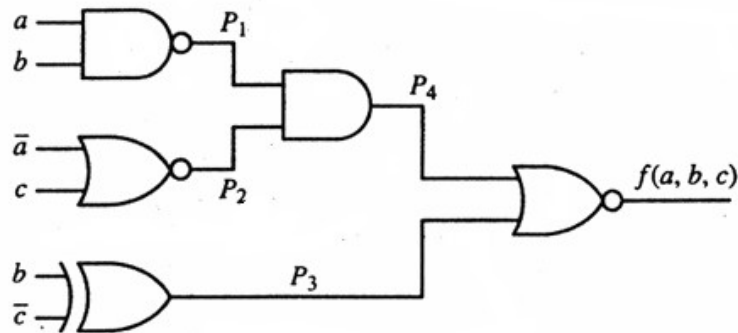
3) $F(A,B,C,D) = \Sigma (0,1,2,3,4,8,9,12)$ Implement this function using two level NAND – AND form with minimum logic gates.



4) Design a 4-input, 1-output logic circuit, that will receive BCD numbers at its input and generate an output of 1, if the received number is ≥ 5 , an output of 0 otherwise. Realize your circuit in AND – OR form, with minimum number of gates/inputs, without any inverter. Repeat your design in NOR – NOR form. NOTE: The inverted inputs are not available.



5) Find a simplified (minimized) expression and draw your new circuit, for the logic circuit below:



$$P_1 = \overline{a}b$$

$$P_2 = \overline{a} + c$$

$$P_3 = b \oplus \bar{c}$$

$$P_4 = P_1 \cdot P_2 = \overline{a}b (\bar{a} + c)$$

$$\begin{aligned} f(a, b, c) &= \overline{P_3 + P_4} \\ &= \overline{(b \oplus \bar{c}) + \overline{a}b (\bar{a} + c)} \end{aligned}$$

$$\begin{aligned} \bar{f}(a, b, c) &= (b \oplus \bar{c}) + \overline{a}b \overline{\bar{a} + c} \\ &= bc + \bar{b}\bar{c} + \overline{a}b \overline{\bar{a} + c} \\ &= bc + \bar{b}\bar{c} + (\bar{a} + b)a\bar{c} \\ &= bc + \bar{b}\bar{c} + a\bar{b}\bar{c} \\ &= bc + \bar{b}\bar{c} \end{aligned}$$

$$\begin{aligned} \bar{f}(a, b, c) &= b \odot c \\ f(a, b, c) &= \overline{b \odot c} = b \oplus c \end{aligned}$$

