

Question 1: Number System Conversion [3 points]

a. $(11001)_2 = (1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0)_{10} = (16 + 8 + 0 + 0 + 1)_{10} = 25_{10}$

0.5

b. $(3210)_4 = (3 \times 4^3 + 2 \times 4^2 + 1 \times 4^1 + 0 \times 4^0)_{10} = (192 + 32 + 4 + 0)_{10} = 228_{10}$

c. $(111000101010100001)_2 = (1 \times 2^{19} + 1 \times 2^{18} + 1 \times 2^{17} + 0 \times 2^{16} + 0 \times 2^{15} + 0 \times 2^{14} + 0 \times 2^{13} + 1 \times 2^{12} + 0 \times 2^{11} + 1 \times 2^{10} + 0 \times 2^9 + 1 \times 2^8 + 0 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0)_{10} = (524288 + 262144 + 131072 + 0 + 0 + 0 + 0 + 4096 + 0 + 1024 + 0 + 256 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 1)_{10} = 887969_{10}$

d. $(6012)_8 = (6 \times 8^3 + 0 \times 8^2 + 1 \times 8^1 + 2 \times 8^0)_{10} = (3072 + 0 + 8 + 2)_{10} = 3082_{10}$

e. $(21.25)_{10} = (21.25)_2$ [1 point]

Question 2: Subtraction and digital representation (4 points) [1 point]

(0101)₂ - (0100)₂

Ans: Find 2's complement of (0100)₂

$$\begin{array}{r} 111 \\ 01011 \\ + 10110 \\ \hline 100101 \end{array}$$

SUBTRACT

3

b. Find the 2's complement of 00110100 [1 point]

$$\begin{array}{r} 11 \\ 01100101 \\ + 11001100 \\ \hline 11001100 \end{array}$$

2's → 11001100

c. Find the 1's complement of 10000110 [1 point]

$$1's \rightarrow 01111001$$

d. Represent the value -5 in 8-bit sign magnitude [1 point]

$$\begin{array}{r} 5 | 11 \\ 2 | 0 \\ 1 | 1 \\ 0 | 11 \\ \hline \end{array}$$

-5 (0101) *
-8 (1100)

(0101) (1100)

30

Question 3: Simplifications [6 points]

a. Simplify the following function:

$$F(w, x, y, z) = \sum(1, 2, 4, 5, 6, 8, 10, 13, 15)$$

[2 points]

X

b. Simplify the following Boolean expressions to a minimum number of literals.

- I. $ABC'D + A'BD + ABCD$
- II. $A'C' + ABC + AC'$

[2 points]

X

c. Simplify the function, F represented in the following truth table.

[2 points]

	YZ	00	01	11	10
WX	00	1	0	1	1
	01	0	1	1	1
	11	X	X	X	X
	10	1	1	X	X

	w	x	y	z
A	0	0	1	0
	0	1	0	1
	1	0	1	1
	1	1	X	X
	1	0	1	X

$$F = C + A'BD + B'D$$

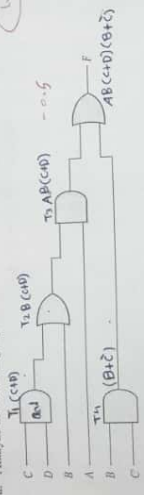
المطلوب = تحليل
المعطى = دارة

1-5

Question 4: Analysis and Design of Circuits (5 points)

[2 points]

a. Analyze the following digital circuit to know its task.



$f = AB(C+D) + (B+C)$ $T_2 = AB(C+D)$ $T_3 = (B+C)$ $T_1 = C+D$

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

b. Design a combinational circuit that detects the even number of zeros assuming that the circuit can accept input up to 7.

[3 points]

BC	00	01	10	11
A=0	0	1	1	0
A=1	1	0	0	1

A	B	C	D	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

Good Luck

yz

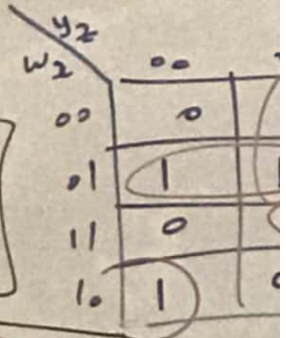
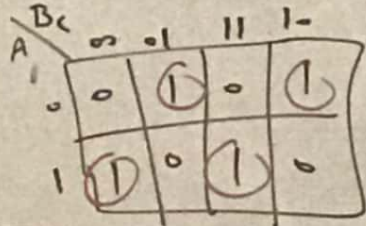
wx	00	01	11	10
00	1	0	1	1
01	0	1	1	1
11	x	x	x	y
10	1	1	x	y

even # of 3's

inputs: A, B, C
output: f

$$f(w, x, y, z) = \Sigma$$

A	B	C	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1



$$f = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

(1) $\underline{A\bar{B}\bar{C} + A\bar{B}C} + A\bar{B}$

(2) $\bar{A}\bar{C} + A\bar{B}C + A\bar{C}$
 $\bar{C}(\bar{A} + A) + A\bar{B}C = \bar{C} + A\bar{B}C$

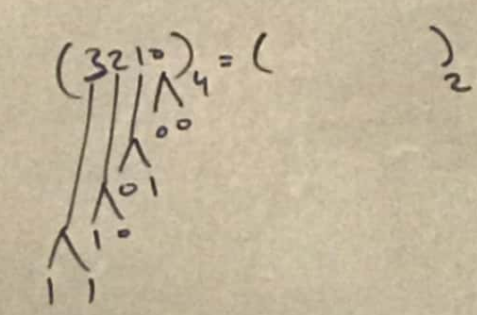
2

$$f(w, x, y, z) = \sum(1, 2, 4, 5, 6, 8, 10, 13, 15)$$

wz	00	01	11	10
00	0	1	1	1
01	1	1	0	0
11	0	1	1	0
10	1	0	0	1

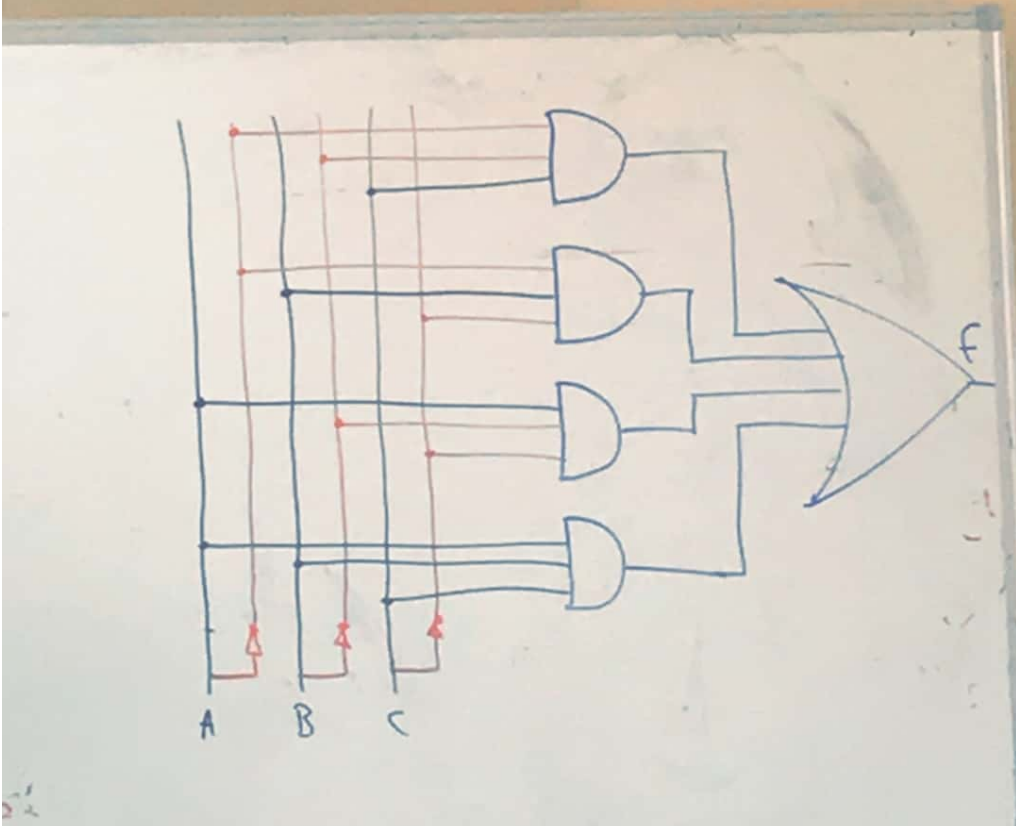
① $\underline{ABC\bar{D}} + \underline{A\bar{B}D} + \underline{ABCD} = \bar{A}BD + ABD = BD$

② $\bar{A}\bar{C} + ABC + A\bar{C}$
 $\bar{C}(\bar{A} + A) + ABC = \bar{C} + ABC = (\bar{C} + AB)(\bar{C} + C) = \bar{C} + AB$

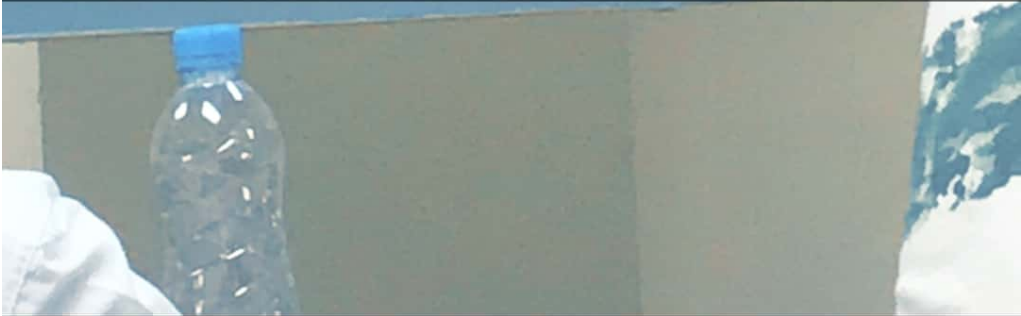


$(11100100)_2$

| -5 in 8 bits
 10000101



تصميم اخر سؤال بعد التلخيص
 $A^B^C + A^BC^ + AB^C^ + ABC$



even # of zeros

inputs

inputs: A, B, C

output:

A	B	C	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

		Bc			
		00	01	11	10
A	0	0	1	0	1
	1	1	0	1	0

$$f = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

اخر سؤال في الورقة