0907231 Digital Logic	**First Exam**	**Spring 2019**
8 Problems, 6 Pages	**75 Minutes**	**March 10th, 2:45 PM**

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Problem 1: Solve the following short questions. **(12 points)** 7.5

a) $(AB.EF2)_{16}$ is equal to (253.7362 $)_8$

b) $(43.84)_{10}$ is equal to (133.40 $)_5$

c) $(472.163)_8$ is equal to (13A.398 $)_{16}$

d) $(01100011)_{BCD}$ is equal to (110011 $)_8$

e) $(1110)_3$ is equal to (10111 $)_2$

f) If the total number of parking spots at the University of Jordan is 530. What is the ***minimum*** number of digits needed to assign each parking spot a unique code in the numbering system of base 6 (i.e. radix = 6): ……3 digits……

g) If A, B, and C are three ***consecutive*** gray codes. A= 1011 and C=1110. Which of the following codes is a valid value for B:

I. 1010 II. 1110 III. 1001 IV. 0110 V. None

h) If the value of the parity bit for the code word (1011011101111) is 1. The type of the used parity is….odd………

i) The ***Dual*** for the function $F = (A + \bar{D}).BC + \bar{A}\bar{B} + C$ is:

$((A \cdot \bar{D}) + B + C) \cdot ((\bar{A} + \bar{B}) \cdot C)$

j) Given $\bar{F}(A,B,C) = (\bar{A}C + \bar{B})(\bar{B} + \bar{C})$

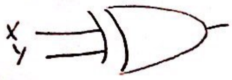
Determine $F(A,B,C) = \Sigma_m($ 2, 3, 6, 7 $)$

A	B	C	F	
0	0	0	0	m0
0	0	1	0	m1
0	1	0	1	m2
0	1	1	1	m3
1	0	0	0	m4
1	0	1	0	m5
1	1	0	1	m6
1	1	1	1	m7

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

Determine $F(A,B,C) = \Pi_M($ 1, 6, 7 $)$

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



1) Which of the following can be used to implement a 5-input *even* function?

- i) Four 2-input XOR gates
- ii) Four 2-input XNOR gates
- iii) Three 2-input XOR gates and one 2-input XNOR gate
- iv) Three 2-input XNOR gates and one 2-input XOR gate
- v) None

Problem 2. ***Using Boolean algebra*** prove that: **(3 points)** 3

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

$\overline{(A+B)} + \overline{(\bar{B}+C)} \cdot (\bar{A}C+\bar{B})$

$[\bar{A}\bar{B} + B\bar{C}](\bar{A}C+\bar{B})$

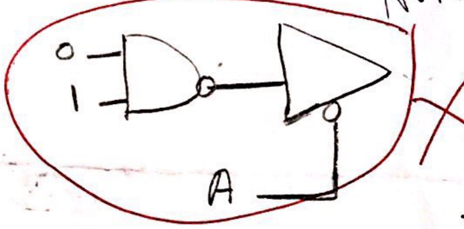
$\bar{A}\bar{B} + \bar{A}\bar{A}\bar{B}C + \bar{A}B\bar{C}C$

$\bar{A}\bar{B}C + \bar{A}\bar{B}\bar{B} + \bar{B}B\bar{C}$

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

A = 0 → B = 0 → F = C; B = 1 → F = 1

A = 1: B = 0 → F = 1 NAND; B = 1 → F = 0 NAND NOR



Problem 3. The following table is the truth table for F(A,B,C). Draw the implementation of the function using ***only*** ***two*** Tri-state buffers and ***any number*** of 2-input NAND gates.

(3 points) 0

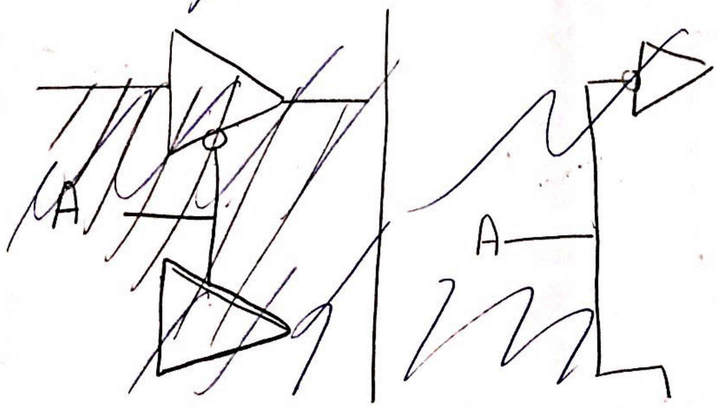
A = 0 → B = 0, F = C; → B = 1, F = 1

A = 1 → B = 0, F = 1; → B = 1, F = 0 NAND

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

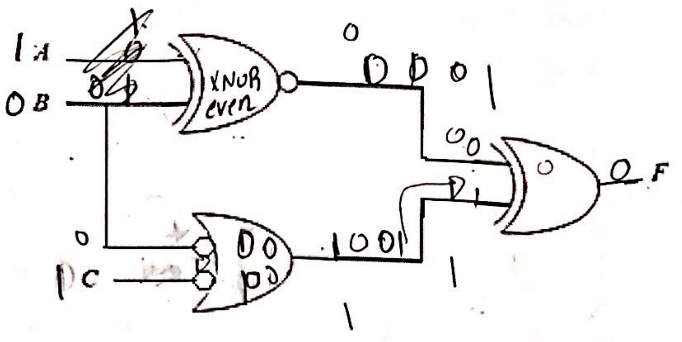
0,1 → 1

NOR → NAND



XOR

Problem 4. Complete the following truth table for the below logic circuit. **(2 points)** 2



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

Problem 5: Given the following function: **(2 points)** 1

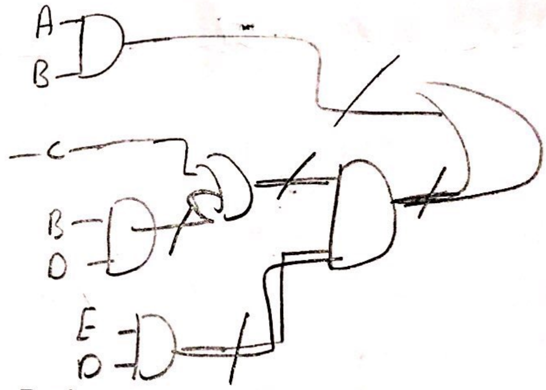
$$F(A,B,C,D,E) = A\bar{B} + (C + B\bar{D}).E\bar{D}$$

Without any simplification, what is the literal cost (L), the gate-input cost (G) and the gate-input cost with inverters counted (GN), of *F*?

L = 7 ✓

G = 12 ✗

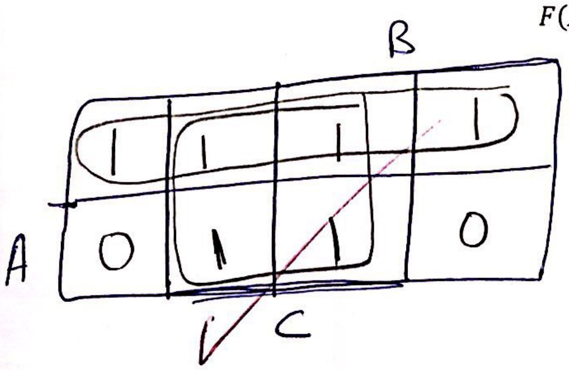
GN = 14 ✓



Problem 6: ***Fill*** the K-map of function *F* given by the following Boolean expression. ***You must label the K-map with the input variables.*** **(2 points)** 2

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

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



X	Y	Z	F	
0	0	0	1	m0
0	0	1	1	m1
0	1	0	1	m2
0	1	1	1	m3
1	0	0	0	m4
1	0	1	1	m5
1	1	0	0	m6
1	1	1	1	m7

Problem 7: Consider the following K-map for function $F(A, B, C, D)$, identify the expressions of the ***six*** prime implicants and determine which are essential. **(3 points)** 2.5

K-map (AB rows, CD columns; labels C, D, A, B):

	1	1	
1	1	1	
1		1	1
		1	

Prime Implicant Expression	Is it Essential?
CD	✓
$\bar{A}D$	✓
$\bar{A}B\bar{C}$	X
$B\bar{C}\bar{D}$	X NO
ABC	X
$AB\bar{D}$	X

Problem 8: Given the K-map of function $F(A, B, C, D)$, write the ***optimized*** Boolean expression of F as ***Product of Sums (PoS)***. **(3 points)** 2

K-map (AB rows, CD columns; labels C, D, A, B):

0	1	0	X
1	0	0	1
1	1	1	1
0	1	X	X

$\bar{F} = \bar{B}\bar{D} + \bar{B}C + ABC$

$(B+D) \cdot (B+\bar{C}) \cdot (\bar{A}+\bar{B}+\bar{C})$

$F(A, B, C, D) = (B+D) \cdot (B+\bar{C}) \cdot (\bar{A}+\bar{B}+\bar{C})$