0907231 Digital Logic	First Exam	Summer 2017
6Problems, 4 Pages	60 Minutes	August 7^{th}, 2:00 PM

الشعبة: 1	الرقم الجامعي:	الاسم :

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Problem 1: Solve the following short problems: **(11 points)**

4.5+2

a) $(350.3)_6$ is equal to (139.8 $)_{10}$

$0\times6^0 + 5\times6^1 + 3\times6^2 + 3\times6^{-1}$

$30 + 108 + 1.8 = 139.8$

b) $(384)_{10}$ is equal to (6 11 7 $)_{Excess\ 3}$

c) $(BC.FF)_{16}$ is equal to (147.3146 $)_8$

d) $(1011001)_2$ is equal to (1011001 $)_{BCD}$

e) $(35.25)_{10}$ is equal to (301.1 $)_4$

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35/4 8
8/4 2 0
2/4 0 1

$.25\times4 \to 1.0$

f) If the total number of students in the school of engineering is 12000. Then what is the ***minimum*** number of digits needed to encode the number of students in the school of engineering using system with ***base=8 (i.e. radix =8)***….3 digits

$8^n = 12000$

g) Which of the following is considered a valid gray code sequence:

1. (1100,1101,1100)
2. (1111,1110,0010)
3. (1101, 1100,0100)
4. (0000,0100,0000)

1

h) Write the following function in the standard SOM form

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

$\bar{F} = \sum_m($ ~~m1, m5, m4, m8~~ 1, 5, 4, 8 $)$

	$\bar{B}$		B	
$\bar{A}$	X 1	2	4	3
A	X 5	6	8	7
	$\bar{C}$	C		$\bar{C}$

i) If $F(A,B,C,D) = \sum_m(0,1,8,9,11)$ then $\bar{F} = \prod_M($ 0, 1, 8, 9, 11 $)$ 1

j) The dual of the Boolean expression $F = \bar{A} + \overline{BC} + 1$ is:

$F = \bar{A} \cdot (\overline{B+C}) \cdot 0$ 1

k) Fill in the K-map of F(A,B,C) given that $\bar{F}(A,B,C) = A\bar{B} + \bar{A}C$ 1

	$\bar{B}$		B	
$\bar{A}$	1	0	0	1
A	0	0	1	1
		C		

Problem 2: Given the following function F: **(2 points)**

$$F(W,X,Y,Z) = WXY + \bar{Z} + (\bar{W}Y)\cdot(X + \bar{Y})$$

What is the literal cost (L), the gate-input cost (G) and the gate-input cost with invertors counted (GN), of F?

L = 8

G = 12

GN = 13

$WXY + \bar{Z} + \bar{W}X + Y\bar{Y}$ 2

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

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AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	X	0	1
$\bar{A}B$	1	0	X	X
AB	0	0	0	1
$A\bar{B}$	0	1	0	X

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

$\bar{A}D+BD+\bar{A}\bar{B}\bar{C}+AD+A\bar{D}$

Problem 4: Consider the following K-map for function $F(A,B,C,D)$, identify the expressions of all its prime implicants and determine which are essential. **(1.5 points)**

AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1			1
$\bar{A}B$	1	1		1
AB	1	1		
$A\bar{B}$			1	

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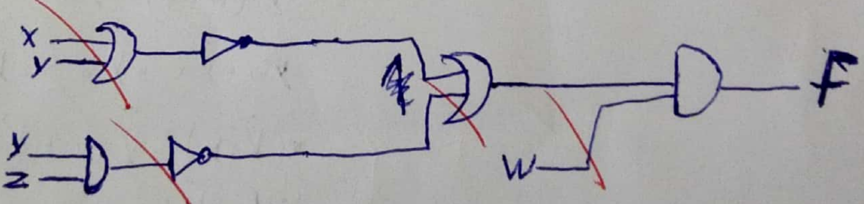
Prime Implicant Expression	Is it Essential?
$B\bar{C}$	✓
X $C\bar{D}$	X ✓
X $\bar{A}\bar{C}$	X ✓

Problem 5: Using logic gates draw the logic diagram for the following Boolean function **(2 Points)**

D and ⊙   OR D ⊕

$$F(W,X,Y,Z) = (\overline{X+Y} + \overline{YZ}).W$$

2



Problem 6: Using boolean algebra **only** prove that: **(2 Points)**

$$WX\bar{Y} + \bar{Y}(Z + X) + XY = X + \bar{Y}Z$$

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

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

$= XW + XY + \bar{Y}Z + \bar{Y}X$

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

$= X \cdot 1 + XW + \bar{Y}Z$

$= X + XW + \bar{Y}Z$

$= X(1 + W) + \bar{Y}Z$

$= X \cdot 1 + \bar{Y}Z$

$= X + \bar{Y}Z$

2