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0907231 Digital Logic	First Exam	Spring 2016
6 Problems, 4 Pages	60 Minutes	March 7th, 3:00 PM
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Problem 1. Solve the following short problems. 9 **(9 points)**

a) $(270.4)_8$ is equal to (184.5)$_{10}$

b) $(45.0625)_{10}$ is equal to (D2.1)$_{16}$

c) $(9C6.A1)_{16}$ is equal to (4706.502)$_8$

d) $(1001\ 1000\ 0101)_{BCD}$ is equal to (985)$_{10}$

e) The grading system in the University of Jordan uses the following letters: A, A-, B+, B, B-, C+, C, C-, D+, D, D-, and F. 12

- The ***minimum*** number of ***octal*** digits needed to encode the letter grades is $8^n \geq 12$ ... $\Rightarrow n = 2$
- If we want to encode the letter grades using ***3 digits*** of a number system with ***base 3 (i.e. r = 3)***. The number of unused codes will be .....15...

$12 \leq 3^3$

$27 - 12 = 15$

f) Using Boolean algebra, simplify the following expression to 3 literals:

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

$\bar{A}(B+\bar{B}) + ABC$

$\bar{A} + ABC \Rightarrow (\bar{A} + A)(\bar{A} + BC)$

$\Rightarrow = \bar{A} + BC$

g) If $F = \sum_m(0,1,3,5,7)$ then $\bar{F} = \prod_M(0,1,3,5,7)$

Problem 2. Choose the correct answer: **(3 points)**

- The dual of the Boolean expression $X + XY$ is:

a. $X(1+Y)$ b. $X(X+Y)$ c. $\bar{X}(\bar{X}+\bar{Y})$ d. None of the above

- The complement of the function $F = X(\bar{Y}\bar{Z} + YZ)$ is:

a. $\bar{X} + (Y+Z)(\bar{Y}+\bar{Z})$ b. $X + (\bar{Y}+\bar{Z})(Y+Z)$ c. $X\bar{Y}\bar{Z} + XYZ$ d. None of the above

- The equivalent expression for the Boolean function $F(A,B,C) = \sum_m(3,5,7)$ is:

a. $\bar{A}BC + A\bar{B}C + ABC$ b. $AC + BC$ c. $C(A+B)$ d. All of the above

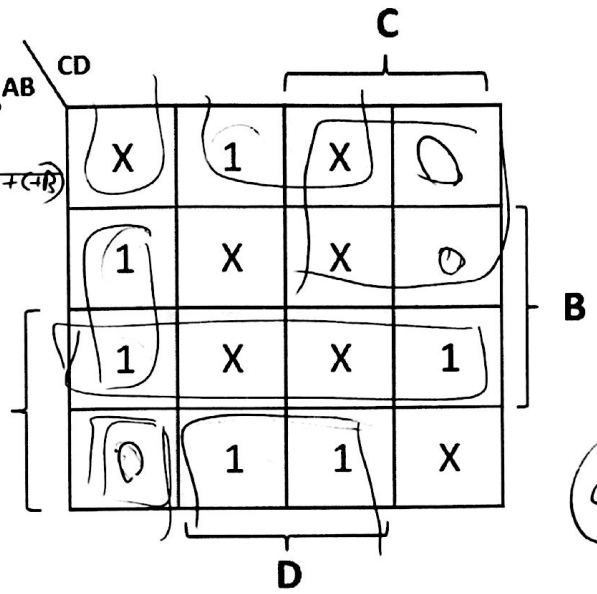
Problem 3: Given the K-map of $F(A, B, C, D)$, write the ***optimized*** Boolean expression of F as a Product of Sums (PoS). **(1 point)**

$F = D\bar{A} + AB + \bar{D}\bar{C}B$

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

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

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



0,5

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

Problem 4: Given the following function F: **(2 points)**

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

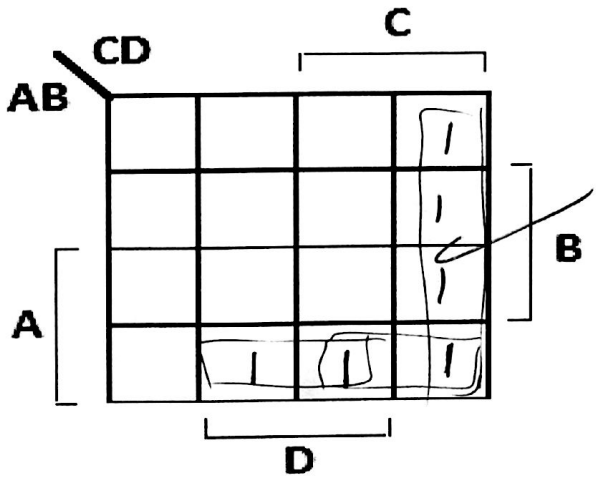
L = 8
G = 5
A = 3

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

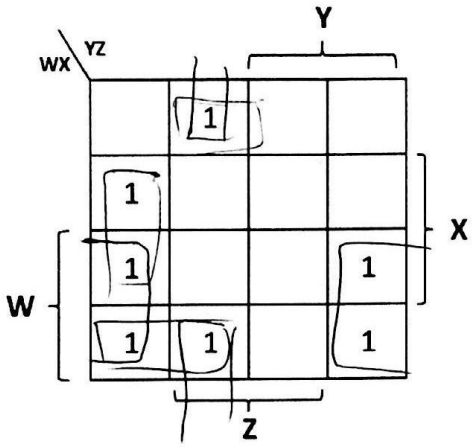
$A\bar{B}C\bar{D} + A\bar{B}D + C\bar{D} + C\bar{A}\bar{B}D$

a. What is the gate-input cost, with invertors counted (GN), of F? GN = 16

b. Fill-in the K-map of F.

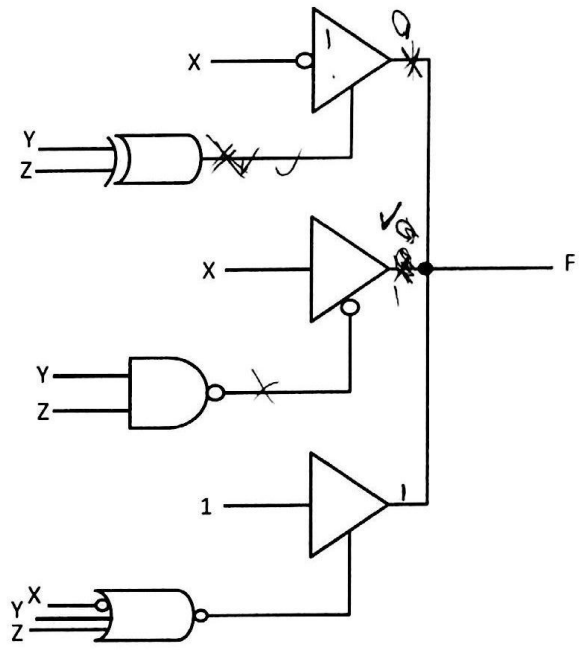


Problem 5: Consider the following K-map for the function F(W, X, Y, Z). Identify the expressions of all its prime implicants and determine which are essential. **(2 points)**



Prime Implicant Expression	Is it Essential?
$W\bar{Z}$	✓
$W\bar{X}\bar{Y}$	X
$X\bar{Y}\bar{Z}$	✓
$Z\bar{Y}\bar{X}$	✓
~~$\bar{X}\bar{Y}Z$~~	~~✗~~
~~$\bar{W}X\bar{Y}\bar{Z}$~~	~~✗~~
$W\bar{Y}\bar{Z}$	X
$Y\bar{Z}W$	X

Problem 6. Fill-in the truth table for the following circuit. **(4 points)**



X	Y	Z	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