King Fahd University of Petroleum and Minerals

College of Computer Science and Engineering

Computer Engineering Department

COE 202: Digital Logic Design (3-0-3)
Term 161 (Fall 2016)
Major Exam 1
Saturday, Oct. 22, 2016

Time: 90 minutes, Total Pages: 7

Name:_____ ID:_____ Section: _____

Notes:
Do not open the exam book until instructed
Calculators are not allowed (*basic, advanced, cell phones, etc.*)
Answer all questions
All steps must be shown
Any assumptions made must be clearly stated

Question	Maximum Points	Your Points
1	**13**	
2	**6**	
3	**6**	
4	**10**	
5	**3**	
6	**4**	
7	**8**	
Total	**50**	

Question 1: <u>Fill in the Spaces</u>: (Show all work needed to obtain your answer) (13 points)

a. To represent the decimal number 65 in binary we need _____ (how many) bits. (1 point)

b. $(1324)_5$ = (_____)$_{10}$ (2 points)

c. A communication system uses a 1-bit parity scheme for error detection. The receiver receives a byte represented in hexadecimal as **D3** without error. The parity scheme used is _____ (even/odd) parity.

(1 Point)

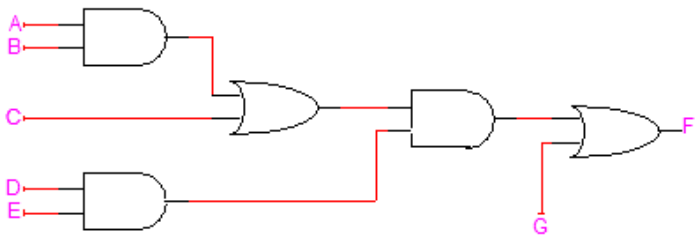
d. For 5 variables (A, B, C, D, E), m_{13} = _____ (algebraic expression), while the algebraic expression $(\overline{A}+B+\overline{C}+\overline{D}+E)$ represents the maxterm M? _____. (2 points)

e. The canonical form (sum of minterms or product of maxterms) represents the most simplified form of a logic function _____(True/False). (1 point)

f. The number of minterms and maxterms in the function $F(A,B,C) = A + B + \overline{C}$ is _____ minterms and _____ maxterms. (2 Points)

g. Given the identity: $AB + \overline{A}C + BC = AB + \overline{A}C$, using the duality principle $(A+B)(\overline{A}+C)(B+C) =$_____. The property/theorem is known as _____ theorem. (2 Points)

h. For the logic circuit shown below, assuming that all gates have the same propagation delay of **2 ns**, then the circuit takes _____ ns to produce the correct output. (2 points)



Question 2: Perform the following conversions: **[6 points]**

i. $(110100.011)_2$ to Decimal. **[1 point]**

ii. $(59.7)_{10}$ to Binary (use up to 4 fractional bits accuracy). **[3 points]**

iii. $(651.13)_8$ to hexadecimal. **[2 points]**

Question 3: Without converting to other bases, find the result of the following arithmetic operations:

i. $(57.6)_{16} + (4E.7)_{16}$ **[2 points]**

ii. $(111)_2 \times (110)_2$ **[2 points]**

iii. $(110100)_2 - (100101)_2$ **[2 points]**

Question 4:

a) List all the Minterms and Maxterms of the following Boolean function (using the ∑ and ∏ notations):

$$f(x, y, z) = xy + (x' + z)(y + z')$$ **[4 points]**

b) Given the following Boolean functions f and g: **[6 points]**

$$f(x, y, z) = \sum(1, 3, 6)$$
$$g(x, y, z) = \sum(0, 2, 4, 6, 7)$$

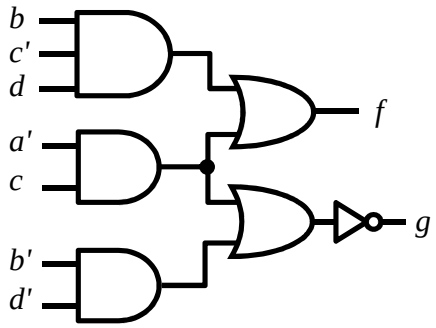
i) Write an **algebraic** expression for f as a sum-of-minterms **[2 points]**

ii) Write an algebraic expression for $(f' \cdot g)$ as a product-of-maxterms **[4 points]**

Question 5: Consider the following circuit with two outputs ***f*** and ***g***.

a) Write an expression for the output ***f*** as a **sum-of-products** **[1 points]**

b) Write an expression for the output ***g*** as a **product-of-sums**. **[2 points]**



Question 6: Find the complement of each of the function below as they are (i.e., do not change or simplify them first): **[4 Points]**

a) [2 points] $F = (X \cdot Y + Z) \cdot \overline{W} \cdot (E + \overline{D})$

b) [2 points] $G = A + D + B \cdot C \cdot \overline{E}$

Question 7: Using Boolean Algebra and showing all steps of your work: **[8 points]**

i. Prove that: $\overline{X(\overline{Y} + Z)} = \overline{X}\,\overline{Z} + \overline{X}\,\overline{Y} + XY\overline{Z} + \overline{X}YZ$ **[4 points]**

ii. Simplify the following function to minimum number of literals in SOP form:

$F(A,B,C,D) = \sum m(8,10,12,14)$ **[4 points]**