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 132 (Spring 2013-2014)
Major Exam 1
Saturday March 1, 2014

Time: 90 minutes, Total Pages: 11

Name:_____ ID:_____ Section: _____

Notes:

- Do not open the exam book until instructed
- **No Calculators are 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	12	
3	15	
4	15	
5	10	
Total	65	

Question 1. **(13 points)**

Perform the following number base conversion with fraction precision of 3-digit where needed. Show your work in the "Work/ Scratch Area"

Required Conversion	**Work / Scratch Area**
a. (i) $(0.339)_{10}$ = ( )$_2$. (ii) Convert the above obtained binary result back to decimal. = ( )$_{10}$ (iii) What is the conversion loss in accuracy?	
b. $(80.125)_{10}$=( )$_2$	

c. $(10)_{13}=(\quad)_{10}$	
d. $(F319)_{16} = (\quad)_{2}$.	
e. $(F319)_{16} = (\quad)_{8}$.	
f. $(9403)_{10} = (\quad)$ BCD 8421 code.	

Question 2. **(12 points)**

I. Compute the following arithmetic operations in the indicated bases **(9 Points)**

a. $(A69C - 3F)_{16}$	**b.** $(255 + 127)_8$
c. $(1101\ 1000 - 1001\ 1111)_2$	**d.** $(1101\ 1000 * 101)_2$

II. What is the radix r of the number system for which $(24 + 17 = 40)_r$. **(3 Points)**

Question 3. **(15 points)**

Use Boolean algebra to solve the following questions. Show clearly all your steps.

a. Give the simplest form of $F = Y(X + Y) + \overline{(X + Y)}Z + YZ$ (4 points)

b. Given that $C = A\,\overline{B} + \overline{A}\,B$ show that $A\,\overline{C} + \overline{A}\,C = B$ (5 Points)

c. Find the values of the 4 Boolean variables A, B, C, and D by solving the following set of simultaneous Boolean equations: (3 Points)

i. $\bar{A} + B = 0$

ii. $A\,B = A\,C$

iii. $A\,B + A\,\bar{C} + C\,D = \bar{C}\,D$

d. **Without simplification**, write out the **complement** and **dual** forms of the following expression:

$(x + \overline{y}\,\overline{z})(w\,\overline{x}\,z + \overline{w}\,y\,\overline{z})$: (3 Points)

Question 4. **(15 points)**

I. The truth table of a digital circuit which has two inputs (A, B) and two outputs (Y, Z) is shown: **(4 points)**

A	B	Y	Z
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

a. Write the Boolean expressions of the circuit outputs (Y , Z).

b. Draw the logic diagram of this circuit (i.e., its gate-level implementation).

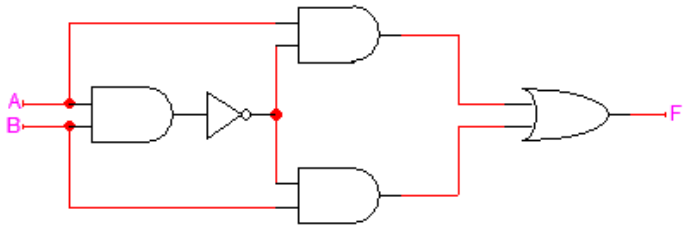
II. Given the Boolean function $F(X,Y,Z) = (X+Y)(X+Z)(\bar{X}+\bar{Z})$: **(4 points)**

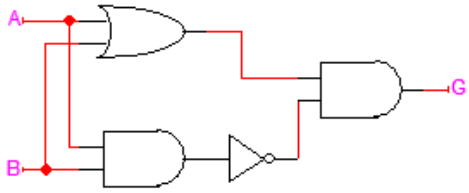
a. Express F as a **sum-of-minterms**, $F = \sum m$.

b. Find the ***algebraic*** **product-of-Maxterms** expression for *F*.

III. Given $F(A,B,C) = \sum m\,(0,3,5,7)$ and $G(A,B,C) = \prod M\,(1,2,4,7)$, express the function $F + \bar{G}$ as a sum-of-minterms. **(3 points)**

IV. Given the following two circuits representing the functions F and G. Determine whether the two functions F and G are equivalent or not. Justify your answer. **(4 points)**



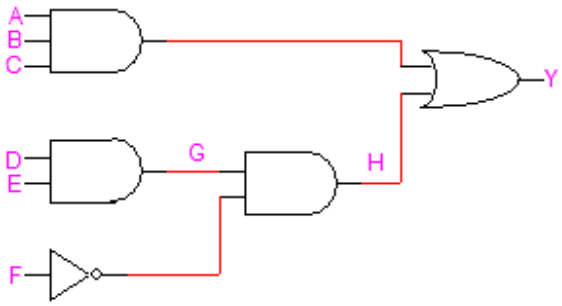


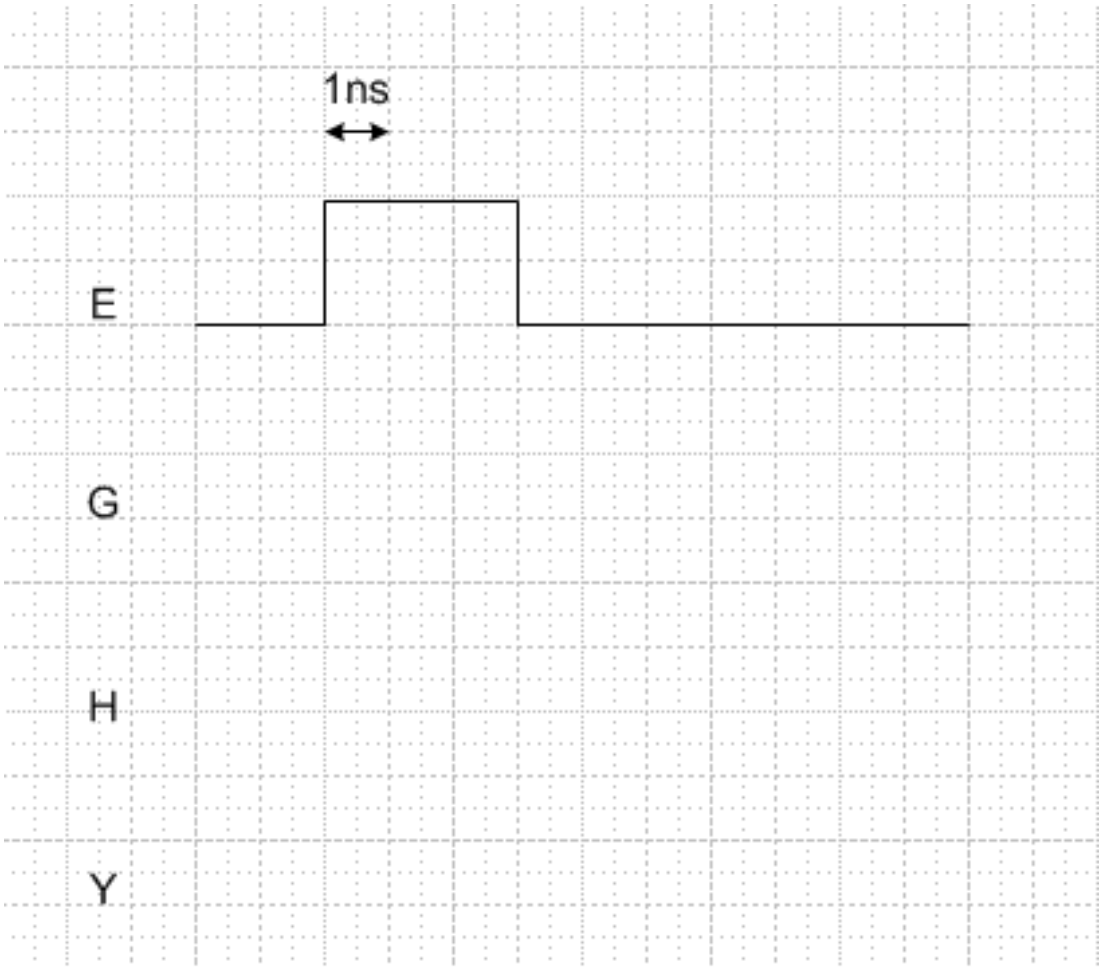
Question 5. **(10 points)**

I. Assume that the propagation delay of a gate depends only on its number of inputs. Thus, the propagation delay of an Inverter is 1 ns, of a 2-input gate (AND or OR) is 2 ns, and of a 3-input gate is 3 ns. For the circuit shown below;

a. What is the longest propagation delay from an input to the output? **(2 point)**

b. If **A=0**, **B=1**, **C=1**, **D=1**, and **F=0**, draw the signal waveforms at points **G, H**, and **Y** due to the shown applied signal at **E** by completing the timing diagram given below. **(3 points)**





II. Given an inverter with the following parameters V_{OH}=5v V_{OL}=0v, V_{IH}=2.8v, V_{IL}=1.6, the noise margins NM_H=_____ and NM_L= _____. **(2 points)**

III. The Boolean function implemented by the circuit given below expressed as a sum-of-products is

F = _____. **(3 points)**