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 142 (Spring 2014-2015)
Major Exam 1
Saturday February 28, 2015

Time: 90 minutes, Total Pages: 7

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	25	
2	20	
3	10	
Total	55	

Question 1. (**25** points)

(I) Convert the following numbers from the given base to the other uncrossed bases listed in the table (if needed, express fractions up to 3 digits only). (**12 points**)

Decimal	Binary	Octal	HEX	EXCESS-3 BCD
109.39			✕	
	10101101.101	✕		✕
	✕		E7.48	✕

(II) Perform the following arithmetic operations in the specified number system.   (**8 points**)

Octal Subtraction	Hexadecimal Addition	Binary Subtraction	Binary Addition
4 5 1 2 - 2 5 3 7 _____	F E A 3 + A F 9 D _____	1 1 1 0 0 0 1 0 - 1 0 1 1 1 1 1 1 _____	1 1 0 1 1 0 1 1 + 0 1 1 1 0 1 1 1 _____

(III) Two number system with radixes r_1 *and* r_2, have the following two relations:

        a. $(69)_{r_2} = (100)_{r_1}$, *and*

        b. $(17)_{r_2} = (21)_{r_1}$

      What are the values of r_1 *and* r_2 ?   (**5 points**)

Question 2.   (**20** points)

Use Boolean algebra to solve the following questions. <u>Show clearly all your steps</u>.

(I)   Simplify each of the following Boolean functions to the specified number of literals in <u>sum-of-products (SOP) representation</u>:

  a. $F1 = x + \overline{x}\, y$ (**2 literals**)   (**1 point**)

  b. $F2 = x\, y + \overline{x}\, z + y\, \overline{z}$ (**3 literals**)   (**4 points**)

  c. $F3 = x\, \overline{w}\, \overline{z} + x\, \overline{w}\, \overline{y} + x\, w + x\, y\, z$ (**1 literal**)   (**4 points**)

  d. $F4 = \overline{(x + \overline{y})}\; \overline{(x\, y + \overline{x}\, z)}$ (**3 literals**)   (**4 points**)

(II) Given the Boolean function $F(X,Y,Z) = (Y + \bar{Z})(\bar{X} + Y)$: **(5 points)**

    a. Express F as a **product-of-maxterms**, $F = \prod M$.

    b. Find the ***algebraic*** **sum-of-minterms** expression for F.

(III) Given the following Boolean function expressed using sum-of-products representation. $F(X,Y,Z) = X\,Y + \bar{X}\,Z$, express F as a product-of-sums (<u>NOT as product-of-maxterms</u>) representation. **(2 points)**

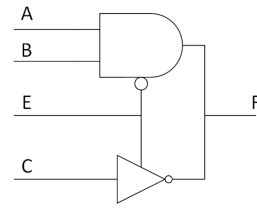**Question 3.**   (**10** points)

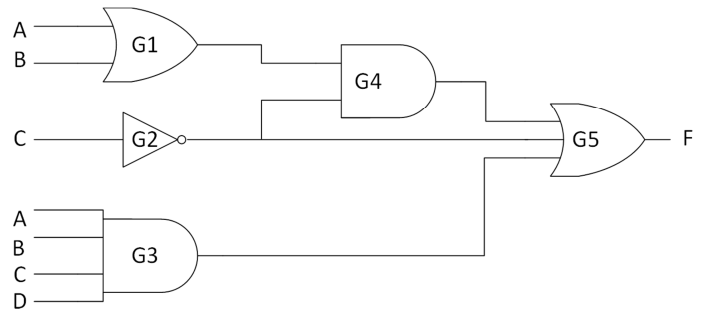I.   Without simplification, write the Boolean algebra equation that represents F: (**2 points**)

II.

a. Fill the table based on the Logic diagram   (**3 points**)

Gate	Delay (*ns*)	Fan$_{in}$	Driving Load
G1	2		
G2	1		
G3	3		
G4	2		
G5	2		

b. What is the worst-case delay?   (**1 point**)

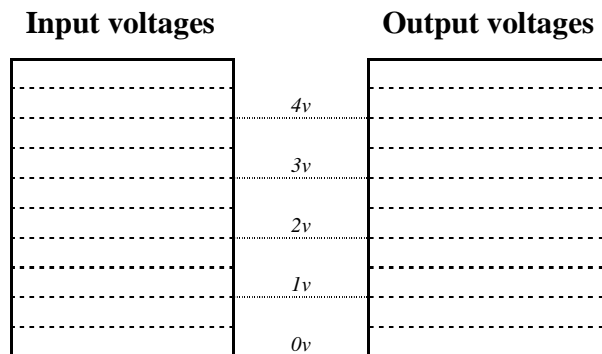c. What is the worst-case delay path?   (**1 point**)

III.

a.   You are required to mark the V_{IL}, V_{IH}, V_{OL}, V_{OH} parameters on the following diagram given that the values of these parameters are _selected_ from the set **{0.5v , 1.0v , 3.5v , 4.2v}**[*].   (**2 points**)

[*](*Voltage values are given in ascending order, i.e. not necessarily in the same order of the V_{IL}, V_{IH}, V_{OL}, V_{OH} parameters*)

Input voltages   **Output voltages**

b.   Calculate the Noise Margin for logic 1 (NM$_1$)?   (**1 point**)

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