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 171 (Fall 2017)
Major Exam 1
Saturday, October 22nd, 2017

Time: 90 minutes, Total Pages: 6

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	**12**	
2	**6**	
3	**6**	
4	**6**	
5	**20**	
Total	**50**	

Question 1: <u>Fill in the Spaces</u>: **[12 points]**

1. The number of bits required to provide distinct binary codes for 60 different colors is equal to _____ bits. If the number of colors in (i.e. 60 colors) is doubled four times (i.e. multiplied by 16), then the number of required bits will be equal to _____ bits. **(2 points)**

2. Counting the number of hours in one day in BCD requires a minimum of _____ (how many) **<u>bits</u>**. **(2 points)**

3. The number $(B3D.C6)_{16}$ converted to binary is equal to _____ while if converted to octal it will be _____. **(4 points)**

4. The largest decimal value of an unsigned 3-bit binary fraction number is _____ while the smallest decimal value of an unsigned 3-bit binary fraction number would be _____. **(2 points)**

5. The ASCII code 100 0001 corresponds to the "A" character. An even parity bit is appended at the end of the code and the result is transmitted. The transmitted code is _____. The following code 1000 0001 is received by the receiver, would it detect an error _____ (Yes/No?). **(2 points)**

Question 2. **(6 Points)**

The binary number 1001 0100 is stored in a computer. What is the decimal value represented if the stored number is:

a) BCD 5421 **(2 points)**

b) Excess 3 BCD number **(2 points)**

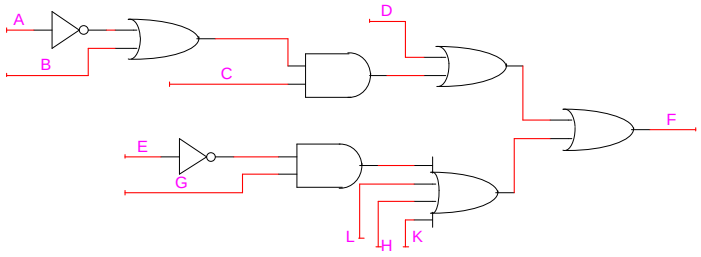
c) Unsigned binary number **(2 points)**

Question 3. Perform the following arithmetic operations in the specified number system. **(6 Points)**
Show the details of all your work (carries, borrows …etc.)

Hexadecimal Addition	Binary Subtraction	Binary Multiplication
13A + E9 ---	110 001 - 100 111 ---	1101 × 110 ---

Question 4. **(6 Points)**

1. For the Logic Diagram Below:



a) Write the Boolean expression for the output F =

(as in the logic diagram without any re-arrangement) **(3 Point)**

b) This circuit has _____ number of logic levels (Fill in the space) **(1 Point)**

c) For the gates delays shown in the Table below, the worst case delay (i.e. critical path delay) of this circuit is = _____ **(2 Point)**

Gate	Delay (in Nano seconds)
NOT	**1 ns**
2-IP AND	**2 ns**
2-IP OR	**3 ns**
4-IP OR	**5 ns**

Question 5. **(21 Points)**

1) Given the function **F(a,b,c) = a (b' + c)**,

(a) Express **F** as a product of Maxterms (use the mathematical notation ***F* = ∏ …)** **(2 points)**

(b) Express **F** as an algebraic sum of Minterms (i.e. write F as a Boolean expression) **(2 points)**

2) Given the function **G(a,b,c) = ∏M (0, 1, 2**), Express **F' + G** as Product of Maxterms **(3 points)**

3) **<u>Using DeMorgan's theorem</u>**, find the complement of the following two functions: **(6 points)**

a) $f = a\,b\,d' + b'\,c' + a'\,c\,d$

b) $g = (a + b)\,(b' + c) + d'\,(a' + b\,c)$

4) Given that: ***a b c′ + a b′ c + a′ b c + a b c = a b + a c + b c***, then use the **Duality Principle** to find out (a + b + c') (a + b' + c) (a' + b + c) (a + b + c) = ??? **(i.e. use duality to find the right hand side expression) (1 points)**

5) Using the properties of Boolean algebra, minimize the following functions to the stated number of literals (Show your steps and the properties that you used): **(6 points)**

(a) F = a b' c' + a' b' c + a b' c + b c **(minimize to three literals)**

(b) G= (x' + z) (x + y' + z) (x + y + z) **(minimize to one literals)**