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 181 (Fall 2018)
Major Exam 1
Saturday, October 6th, 2018
10 am

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	15	
2	18	
3	12	
4	15	
Total	60	

Question 1 (15 Points): Fill in the spaces for parts (1) to (7), **1 point each**.

1) Counting the number of days in a year in BCD requires (how many) ____________ bits.

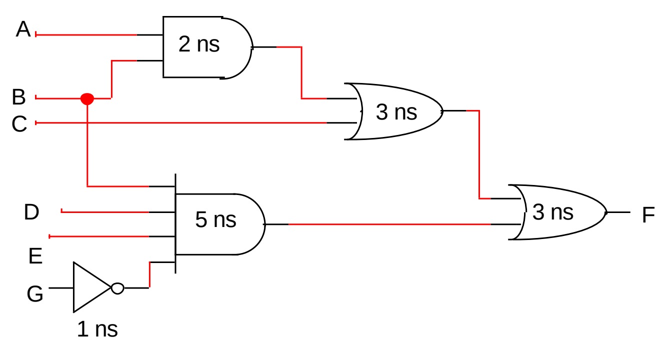
2) The largest **2-digit** number in hexadecimal is __________, which is equal to ________ in decimal.

3) If the number **(31)r** in radix **r** is equal to **16** in decimal, then the radix **r** = _____________.

4) If 10 bits are used to code only 1000 decimal values then the number of unused binary codes will be ___________________.

5) If a computer uses 3 bits for red colors, 3 bits for green, and 3 bits for blue, then the total number of colors that represent all combinations of red, green, and blue is _______________.

6) For the Logic Diagram Shown:
The gate delays are shown on the gates



a) The logic function F = (without any re-arrangement)

b) This circuit has _________ number of logic levels (Fill in the space)

c) The longest path's (i.e. critical path) delay = _________

7) Convert between different number systems. Fill-in the empty slots in the table below. **(6 points)**

Decimal	**Binary**	**Hexadecimal**
123		
	11011.101	
0.3125		

<u>Question 2 (18 points):</u>

a) For the questions below, fill in the spaces:

1. The ASCII code **101 0001** is transmitted using an **odd** parity bit that is appended at the **end** of the code. The code that should be transmitted is ______________. If the receiver receives the following code word **1110 0011**, it will _____ (Yes/NO?) detect an error. **(2 points)**

2. A machine uses the following unsigned binary number representation $(XXXX.XXX)_2$, where 4 digits are used for the integer part and 3 digits are used for the fraction part. For this machine, the smallest nonzero fraction is equal to ________(in decimal value), while the largest number is equal to _____________(in decimal value). **(2 points)**

3. The minimum number of binary digits required to assign unique binary codes for the 100 students in an academic department is equal to ________ (how many?). When the number of students increases by a factor of 16 over the next two years, the minimum number of bits required will be _________(how many?). **(2 points)**

b) The decimal number 603 is to be stored in a computer's memory. Specify how the number is represented for each of the following codes: **(3 points)**

a) BCD 5421:

b) BCD Excess-3:

c) Perform the following arithmetic operations in the respective numbering system. Specify the carry-in and borrow digits at every stage. **(9 points)**

$(32A)_{16}$ $+\ (2E8)_{16}$	$(1011\ 0110)_2$ $\times\ (110)_2$
$(1100\ 1000)_2$ $-\ (1001\ 1111)_2$	

<u>Question 3 (12 Points):</u>

1. Find the complement of F : $F = [(\bar{A} + B)CD + EG]$ **(3 points)**

2. Given F = C’D’ + AB’CD’+ ABC’D’ + A’C’D + AB’C Simplify F to minimum number of literals in Sum-of-Product format (SOP) **(4 points)**

3. Given F (A,B,C) = ∑m(0,4,5) Simplify F to minimum number of literals in **Product-of-Sum format** (POS) **(5 points)**

<u>Question 4 (15 points):</u> In this question, we denote Minterm number i by m_i and Maxterm number i by M_i.

1. Complete the following truth table where A, B, and C are the inputs. If you believe that any of the minterms or maxterms cannot be evaluated, **explain why** and leave it blank. **(2 Points)**

A	B	C	m_2	M_2	m_6	M_8
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

2. What is the value of $M_i m_i$? Explain your answer. **(2 Points)**

3. Let $F(A,B,C) = \overline{A}B + A\overline{C}$. Express $F(A,B,C)$ as a sum of minterms using the $\sum$ notation. **(2 Point)**

4. Let $$G(a,b,c) = \left(\sum m(2,6)\right) + \left(\prod M(1,2,3,4,5,7)\right)$$

   Express $G(a,b,c)$ **<u>algebraically</u>** as a sum of minterms. **(3 Points)**

5. Let $F(w,x,y,z) = wz + \overline{x}\,\overline{z} + x\overline{y}$. Express $F(w,x,y,z)$ **algebraically** as a product of maxterms. **(3 Points)**

6. Let $G = AB + \overline{C}D$. Express G in a product of sums standard form. **(3 Points)**