mid-**EXAM**ple

Obs. In order to try to address all your requests, suggestions, and comments, I have taken example questions from other exams, trying to cover as much material as I can. These are only examples of what you could see in the midterm. It is obviously much longer than the midterm, so that you can practice.

Here's a deal for the students who have not gotten to 100 in their homework: if you work through all these 16 problems, and come show me that you did them yourself (I may ask you questions at that point), I will give you 100 for all first 6 homeworks. **Constraints: this must be shown to me by October 11th, 2007, BEFORE 5pm.**

1) *(10 pts)* Convert the following numbers in each row from the given base to the remaining three bases listed in the table (i.e., fill-in the open cells in each row). Place your final results directly into the open cells in the table. Express your result in positional notation, i.e., a plus or minus sign (plus sign is optional), followed by the integer portion, followed by a radix point, followed by the fractional portion (**3 digits maximum**). The radix point and fractional portion are only required if the fractional part is non-zero.

Decimal	Binary	Octal	Hexadecimal
–31.75			
			AB.C

2) *(5 pts)* Perform the following computations directly in the base given:

Base 16:

```
  49C
+ AE1
```

Base 2:

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101110
 x 101
```

3) You are driving home after a tiring ECE331 class ☺ and all of a sudden you see this blinking purple fairy-tale-like UFO. As it approaches your car, the light is so bright you stop, and close your eyes. Something or somebody writes this equation on your windshield, along with the result for x:

5x+3=32 ; x=4.

How many fingers do these particular ETs have? (Show how you got to the conclusion.)

4) Consider a=01100110011 and b=0101. What is a*b and a/b ? Show your work in binary.

5)

1. (15) Enter the **first and last** digits of your social security number in the blank spaces of N1 (If your two digits are 00, use 83) and consider them as a two-digit decimal number labeled N1. Use 13 total places for binary arithmetic with **four of the places to the right of the radix point.** Insure that **every** blank space is filled in with an appropriate symbol.

$(N1)_{10}$	= 0 __ __.	= N1	First and last digits of your SSN
$(N1)_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N2	2's comp. representation of (N1)
$((-101.375)_{10})_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N3	2's comp. rep. of $(-101.375)_{10}$
$(N2 + N3)_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N4	Sum of N2 and N3
$(N4/8)_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N5	(N2 + N3)/8
$(N5 * 4)_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N6	4 * N5
$(\mid N6 \mid)_{2C}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N7	binary magnitude of N6
$(N7)_{16}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N8	Hexadecimal Representation of N7
$(N8 / 16)_{16}$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N9	Divide N8 by 16
$(N9)_8$	= _ _ _ _ _ _ _ _ _ . _ _ _ _	= N10	N9 in octal notation

3) *(5 pts)* Write "Engineer" in ASCII (the full ASCII code is appended to the exam), using an 8-bit ***binary*** code word in which the leftmost bit is selected to produce **odd parity**. Arrange your solution in the box below:

Letter	ASCII Code (in Binary Form) with Odd Parity
E	
n	
g	
i	
n	
e	
e	
r	

4) *(10 pts)* Fill in the Truth Table below to represent: $F_{W,X,Y,Z} = \overline{W} \cdot \overline{X} \cdot \overline{Y} \cdot Z + \overline{W} \cdot X \cdot Z + W \cdot \overline{X} \cdot \overline{Y}$.

W	X	Y	Z	F
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

5) *(15 pts)* Use Boolean algebra to determine if the following Boolean statement is true or false. State the identities/properties used in ***each*** step. (The table below is provided for convenience — use only as many steps as you need.)

$$\overline{\overline{\overline{a}\cdot b}+c\cdot\overline{d}\cdot e} \stackrel{?}{=} \overline{a}\cdot b\cdot\overline{c}+\overline{a}\cdot b\cdot d+\overline{a}\cdot b\cdot\overline{e}$$

Step	Boolean Expression	Identities/ Properties Used
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

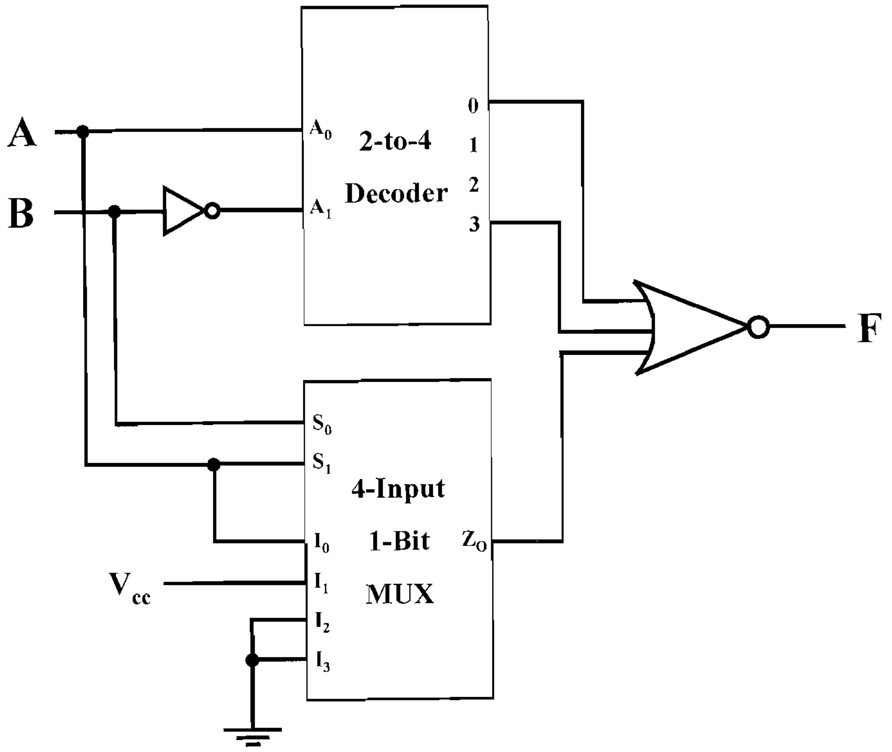
6) *(10 pts)* Use the Karnaugh Map provided to minimize the following function in **POS** form: $F_{X,Y,Z}=\sum(0,2,5,7)$.

7) *(10 pts)* Use the Karnaugh Map provided to minimize the following function in **SOP** form: $F_{W,X,Y,Z}=\sum(0,1,9-11)+d(2,4,5,8)$.

8) *(25 pts)* Let b_0, b_1, b_2 and b_3 form a BCD number (b_0 is the LSB). Design and implement a ***minimum SOP*** combinational logic circuit to detect when the coded digit is greater than 3. Show the four-step design process of: Step 1 = define inputs and outputs; Step 2 = Truth Table; Step 3 = K-map minimizations (SOP form *only*; do not count inversions of input bits towards the minimum gate count); Step 4 = circuit implementation. Assume that unused input combinations *never* occur. Use generic AND, OR and NOT (inverter) logic gates *(maximum of 4 inputs per gate)* for your implementation.

9) *(10 pts)* Determine the Truth Table for the logic function implemented in the circuit below, placing your result in the Truth Table below. A_0 is the LSB for the Decoder. S_0 and I_0 are the LSBs for the MUX.

A	B	F
0	0	
0	1	
1	0	
1	1	



10) *(10 pts)* For the pair of decimal values A and B in the table below, (*i*) express each number in the 1's complement system in columns 3 and 4, respectively, **using 8 bits** (*ii*) express each number in the 2's complement system in columns 5 and 6, respectively, **using 8 bits** and (*iii*) express their sum and difference in the 2's complement system in columns 7 and 8, respectively, **using 8 bits.**

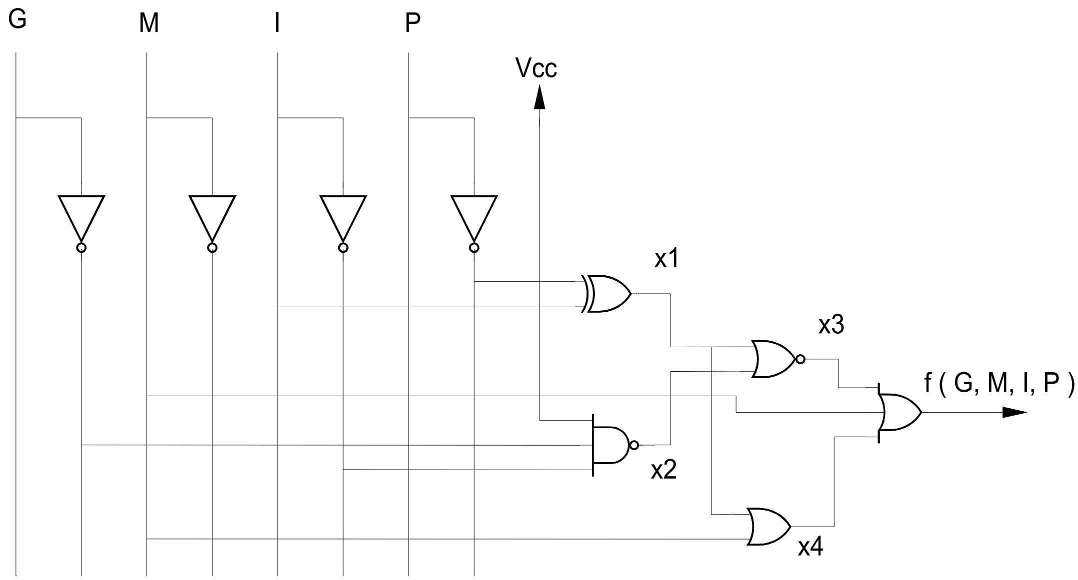
In all cases, write a result as "OVERFLOW" if it cannot be contained in the 8-bit representation.

Decimal Value:		**1's Comp. Number System (8 Bits)**		**2's Comp. Number System (8 Bits)**			
A	**B**	**A**	**B**	**A**	**B**	**A + B**	**A – B**
-97	30						

11) *(15 pts)* Use basic logic gates (AND, OR, NOT — any number of inputs) to **design** a **minimum SOP** combinational logic circuit to add a **two-bit** unsigned binary number (e.g. $00_2 \rightarrow 0_{10}$, $01_2 \rightarrow 1_{10}$, $10_2 \rightarrow 2_{10}$ and $11_2 \rightarrow 3_{10}$) to a **one-bit** unsigned binary number, with sufficient output bit length to contain any result.

Your **design** should be a three-input (two bits for the two-bit unsigned integer and one bit for the one-bit unsigned integer), three-output (for the three-bit unsigned integer sum) combinational logic circuit. (Note that overflow is not possible.)

Show your truth table, method of logic function minimization, and final logic equations for your outputs. To save time, you need **not** draw the resultant logic circuit.



2. (10) With reference to the circuit diagram above, write algebraic expressions for the following Boolean variables using only the variables G, M, I, P, and/or their complements:

x1 (G, M, I, P)= ______________________________

x2 (G, M, I, P)= ______________________________

x3 (G, M, I, P)= ______________________________

x4 (G, M, I, P)= ______________________________

f (G, M, I, P) = ______________________________

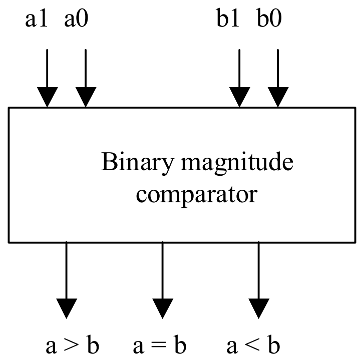
3. (10) Find the particular value for

x1 (1, 0, 0, 1)= ______________________________

x2 (1, 1, 1, 1)= ______________________________

f (1, 1, 0, 0) = ______________________________

Design a combinational circuit which compares two, 2-bit numbers which are in binary magnitude form. TRUE outputs are asserted as '1'.



4. (20) Completely fill in the truth table below.

	Decimal Inputs		Operand A		Operand B		Outputs		
(MT)$_H$	$(a)_{10}$	$(b)_{10}$	a_1	a_0	b_1	b_0	a > b	a = b	a < b
			0	0	0	0			
			0	1	0	0			
			1	0	0	0			
			1	1	0	0			
			0	0	0	1			
			0	1	0	1			
			1	0	0	1			
			1	1	0	1			
			0	0	1	0			
			0	1	1	0			
			1	0	1	0			
			1	1	1	0			
			0	0	1	1			
			0	1	1	1			
			1	0	1	1			
			1	1	1	1			