Name _____ CM _____ Section _____

ME430 - Mechatronics
Examination I
September 18, 2012

Problem	Score
1	/ 15
2	/ 8
3	/ 12
4	/ 6
5	/ 9
6	/ 10
Total	/ 60

For the written portion of the exam, you may use only:

- Any paper notes (such as notes on the videos) you brought to the exam, so long as those notes were written by you or your lab partner.
- A pencil/pen.
- A calculator (optional).

For the computer portion of the exam, you may use only:

- Your computer
- Any paper notes (such as notes on the videos) you brought to the exam, so long as those notes were written by you or your lab partner.
- Any electronic notes or code residing on your local (C:) hard drive, so long as those notes/code were written by you or your lab partner.
- The course website. (This is the only approved use of the internet for this exam.)
- A calculator (optional).
- ANGEL for code submission.

Anything not specifically allowed is prohibited. In particular, you may not use notes or code written by someone outside your lab group.

Problem 1 – Number systems:

(a) A variable that is 4 bits is called a nibble.

I. If you had a nibble with the value 6, what bits would be stored in memory? (Show leading zeros as appropriate to show the entire nibble in memory.)

II. Assuming a nibble uses the standard two's complement convention for negative numbers show the bits stored in memory for the value -3. (Show leading zeros as appropriate to show the entire nibble in memory.)

III. What is the largest positive number that a signed nibble can store? (Give this answer as a decimal value.)

IV. What is the most negative number that a nibble can store? (Give this answer as a decimal value.)

(b) What is the minimum number of bits needed to store the decimal value 300 in a signed variable?

Problem 2 – Operators:

Assume you have a variable called `eggs` which is a char. You want to determine how many dozen eggs you have, and how many remaining eggs you have. Write a line of C code that calculates the number of `dozen_eggs` and another line of code to determine the `remaining_eggs`. For example, if eggs was 15 then `dozen_eggs` should become 1, and `remaining_eggs` should become 3.

```
char eggs = 75;

char dozen_eggs = _____________________________________________  ;


char remaining_eggs = _____________________________________________ ;
```

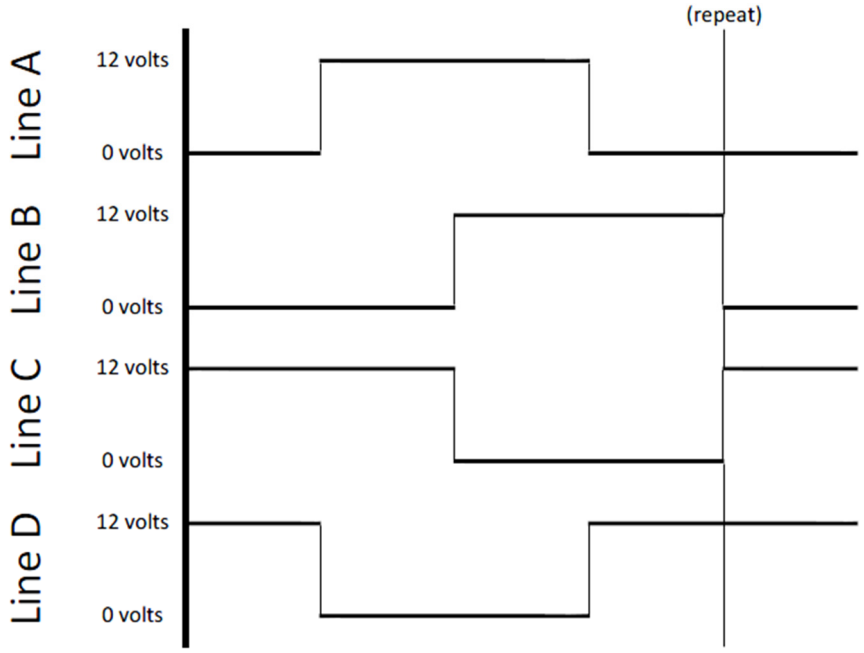
Problem 3 – Variables and operators:

True is defined as any **non-zero** value. **False** is defined as **zero**. Determine if each statement is true or false.

	Circle one
15 >> 4	T or F
(7 ^ 5) – 2	T or F
30 % 10	T or F
(2 - 2) || (2 + 2)	T or F
7 && 0 && 15	T or F
(6 | 2) – 6	T or F

Problem 4 – Wiring a stepper motor:

You are taking over a circuit where someone was connecting to a 12 volt stepper motor. You find the four wires that were going to the motor and monitor them on an oscilloscope. They look like this:



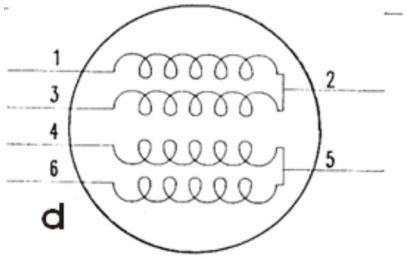
Draw connections to the stepper motor for these lines for full step drive.

A _____

B _____

C _____

D _____



Problem 5 – Special function registers:

Give the commands to make all of PORT A and PORT C digital outputs and all of PORT B and PORT D digital inputs.

Problem 6 – Instruction cycles:

Write the line(s) of code necessary to perform the specified tasks.

Write the code that sets up the PIC to use the external 4MHz crystal.

Write the code to delay for 25 milliseconds, still using the 4MHz crystal. Show your calculations for the delay time and give the command itself.