CSE 466 Exam 1 Winter, 2010

Name _____

This take-home exam has 100 points and is due at the beginning of class on Friday, Feb. 13. (!!!)

Please submit printed output if possible. Otherwise, write legibly. Both the Word document and the PDF are posted. Points will be awarded to the extent that we understand an answer or how a design works.

Problem	Points	Score
1.	20	
2.	20	
3.	20	
4.	20	
5.	20	
Total	100	

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1. Hardware: (short specific answer—no more than two sentences)

a. What is the purpose of a **current limiting resistor** in a circuit, and why is it needed?

b. Why do we need to use **pull-up resistors**? What is an example where you would need to use one?

c. Why would you want to add **bypass capacitors** to your circuit?

d. Is the ATmega16 an example of "Princeton architecture" or "Harvard architecture?"

What is the main difference between these two architectures?

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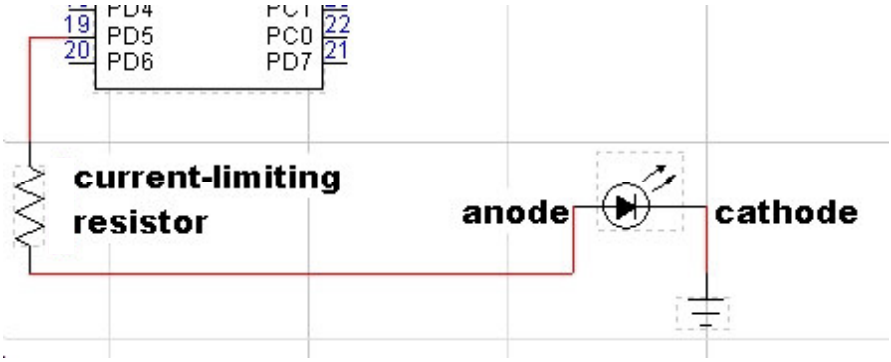
e. Calculate the current through the LED given the following:



- LED Forward Voltage = 2V
- LED Capacitance = 35 pf
- Battery Voltage = 5V
- Resistor Value = 330 ohms
- CPU Leakage Current = 1 micro amps

Current:_____

f. Describe the sequence of events when an interrupt occurs on the ATmega16. Indicate what elements of the interrupt sequence are managed by the hardware and what elements must be managed by the software/programmer.

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2a. Explain three modes of serial communication from serial devices with one example of each:

'synchronous':

'iso-synchronous' :

'asynchronous' :

2b. How do the following protocols indicate start and end of a byte or data frame?

(a) UART

(b)SPI

(c) I2C/TWI

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3. The LIS3L02DQ (datasheet) http://www.cs.washington.edu/education/courses/466/10wi/pdfs/accel.pdf is a three axis digital output linear accelerometer. Your job is to connect this part using the I2C (TWI) interface to an ATmega16 microcontroller. (The SPI interface is taken by another peripheral in this design).

a. List pins on the ATmega16 that connect to pins on the LIS3L02DQ. In addition, show any other pin connections that need to be made on the LIS3L02DQ to ensure proper operation of the I2C interface. The LIS3L02DQ is the only peripheral on this I2C bus. You do **not** need to show power and ground connections.

ATmega16 pins	LIS3L02DQ pins	Function

b. Write a driver to **initialize** the LIS3L02DQ, and to **acquire data** from it. **Hand in a print-out** of your driver, properly commented so that we can understand how it works.

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4. In Labs 3 and 4 you built a one-dimensional electric field sensor that was able to sense the distance to your hand or other grounded objects. **Describe how** you would re-design this with a single receiving antenna and multiple transmitting antennas to capture movement in the X, Y, and Z axes. Use additional sheets if necessary.

Be certain that you answer the following:

a. What hardware changes are required? What is the arrangement of the antennas?

b. What software changes are required?

c. Estimate the speed of operation of this new controller. How fast can you obtain readings in three axes, compared to the operation of your single-axis sensor in labs 3 and 4?

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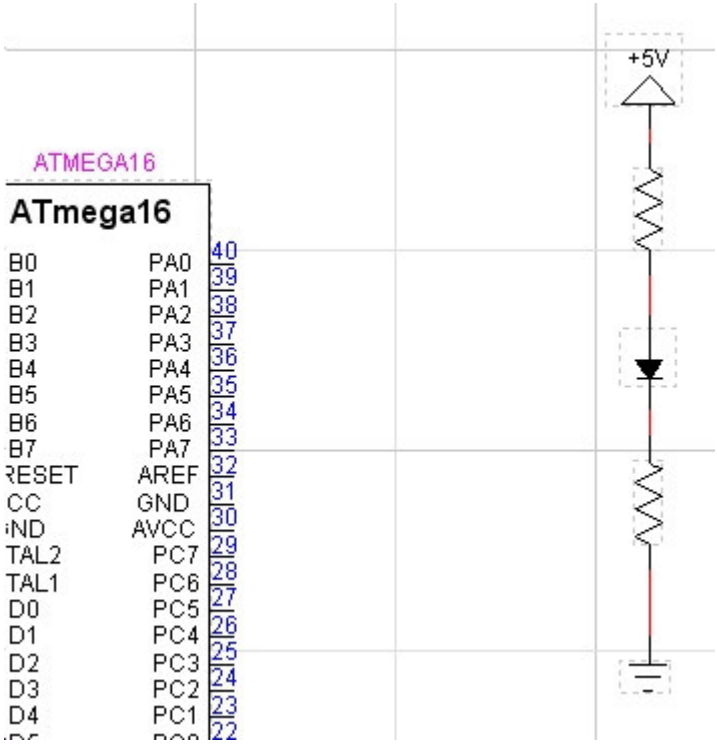
5. A temperature monitor is being designed around a germanium diode. The diode's forward voltage drop is a strong function of temperature. Therefore, a direct voltage measurement across the diode must be made to determine the temperature. Design an ADC interface using the AVR that will accomplish this, **subject to the requirements below**:

-Only port A I/O pins may be used.
-The reference voltage will be Vdd for the chip (AREF).
-No additional parts may be used.
-AVR CPU clock 8MHz
-**Convert as fast as possible**
-LSB of result will be in bit 0 of ADCL.
-The ADC configuration must maximize the sensitivity to the diode's voltage variations.
-The forward voltage drop of the diode ranges from 0.28V to 0.38V over the temperature of interest.

a. Finish the schematic below:



b. Show the values for the following registers. Bits that do not affect ADC operation may be left blank:

ADMUX

7	6	5	4	3	2	1	0

ADCSRA

7	6	5	4	3	2	1	0