CSCE 436/836: Embedded Systems
Homework 1

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Due: March 3, 2011

Instructions: This homework is an individual assignment, collaboration is not allowed. If you discuss any problems with others, please note this on the assignment as described in the syllabus. Also note any materials outside of lecture notes, course textbooks, and datasheets that you used. Answer all questions with complete sentences and describe your reasoning where appropriate. This homework is due on the date listed above before the start of class. Email submissions are preferred, however, paper copies in class will be accepted.

Name:

Problem 1. *Resistors*

a) (5pts). *In the schematic above, what is the voltage at points A, B, and C?*

b) (5pts). *How much current is flowing through each of the resistors?*

Problem 2. *Hoverboard Schematic: There are two voltage regulators, U1 and U3, in on the hoverboard. Refer to the hoverboard schematic and related datasheets for this question.*

a) (5pts). *What is the voltage U1 outputs and how much current can it supply?*

b) (5pts). *What is the voltage U3 outputs and how much current can it supply?*

c) (5pts). *If U3 is drawing 0.5 Amps, what is the maximum that U1 can supply to the rest of the circuitry?*

Problem 3. *Atmega1284p Datasheet*

a) (5pts). *Which assembly instructions take the most clock cycles to complete? How many clock cycles do they take?*

b) (5pts). *Give the values for the registers you need to set if you wanted to use the Analog Comparator to compare AIN0 to ADC2. Where do you read the result of the comparison?*

c) (5pts). *What is the starting memory address for the Internal SRAM on the Atmel?*

Problem 4. *Embedded C Programming*

a) (5pts). *Write the code to clear the 4th and 5th bits of the register UPM0 and set it to the lower two bits stored in the variable* `mode`*. Explain.*

b) (5pts). *Write code to read from and write to the memory address 0x7BD. Explain.*

c) (5pts). *What is the value of* `output` *after the following code has been executed?*

```
uint8_t output = 0;
uint16_t counter = 0xCDCD;
output += counter;
while(counter > 0){
  counter = counter >> 1;
  output++;
}
```

Problem 5. *SPI Communication*

CLK
MOSI
$\overline{\text{CS}}$
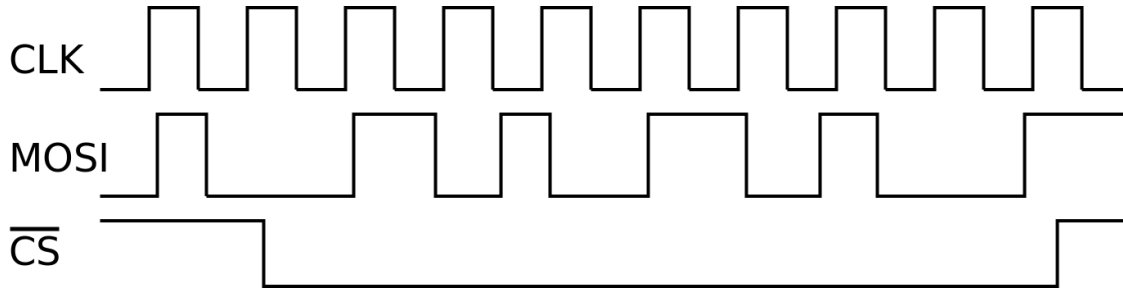
a) (10pts). *In the above signal, what is the data stream (bit values) processed by the slave device if it is configured for data to be valid on the rising edge? What about for falling edge? Note that the not CS line means the device is active low.*

b) (5pts). *How does SPI support multiple masters?*

Problem 6. *UART Communication*

a) (5pts). *On an Atmega1284p, with a clock of 7MHz, what value does the serial port UBRR register need to be set to in order to communicate with a baud rate of 19200 when in normal speed mode? What is the error associated with this setting?*

b) (5pts). *What is the maximum UART baud rate that can be used on an Atmega1284p, with a clock of 7MHz?*

Problem 7. I^2C *Communication*

a) (5pts). *In the I^2C protocol, if two masters send to different slaves at the same time, which master wins bus arbitration?*

b) (5pts). *Describe how two masters can send at the same time without causing damage to the pins controlling the I^2C lines (for example, when one master is sending a zero and the other a one)?*

c) (5pts). *Describe how arbitration works when there are multiple masters?*

Problem 8 (5pts). *Approximately how much time did this assignment take?*