CSCE 236 Embedded Systems, Spring 2012
Quiz/Test 1

Thursday, February 16, 2012

Instructions: You will have the full class period to complete this test. **Make sure to show your work to ensure you receive partial credit if your final answer is incorrect.** This is a closed book quiz, no computers, textbooks, notes, etc. are allowed.

Name:

Problem 1. *Hex and bit operations (all references to bit locations are zero referenced). For each bit operation subproblem write a single line of* `C` *code to achieve the desired result.*

a) (5 pts.)**.** *What is the value of* `((3<<2) | (1<<6))` *in hex?*

b) (5 pts.)**.** *What is the value of* `(((7<<4) & (1<<5)) + 6)` *in hex?*

c) (5 pts.)**.** *Set bit 4 in the variable* `var` *to 1.*

d) (5 pts.)**.** *Clear bit 5 in the variable* `var`*.*

e) (5 pts.)**.** *Set bits 2-4 (inclusive) in the variable* `var` *to the top three bits in the 8-bit variable* `config`*.*

Problem 2. *Memory operations. Refer to the following code example for this question:*

```
uint8_t globalVar = 0x10;
uint8_t *globalPtr;
uint8_t data[] = {0,1,2,3,4,5,6,7};

int8_t main(void){
  uint16_t var = 0x1FF;
  uint8_t *p1 = data + 2;
  //Draw Memory Map Here

  p1[0] = 9;
  *(p1+3) = 2;
  globalVar += var;
  var = (p1++)[1];
  data[3] = p1[2];

  return 1;
}
```

a) (10 pts.)**.** *Fill in the below memory map for the above code after execution has reached the statement* `Draw Memory Map Here`*. Assume the compiler allocates the memory in the order the statements appear.*

Address	**Variable**	**Value**
0x14		
0x13		
0x12		
0x11		
0x10		
0xF		
0xE		
0xD		
0xC		
0xB		
0xA		
0x9		
0x8		
0x7		
0x6		
0x5		
0x4		
0x3		
0x2		
0x1		
0x0		

b) (5 pts.)**.** *What are the values of all the variables and arrays once the code reaches the* `return` *statement?*

c) (5 pts.). *Where does* `malloc` *allocate memory? Describe why you should avoid using* `malloc` *on an embedded system.*

d) (5 pts.). *What is Harvard memory architecture? What are two advantages of using a Harvard architecture over von Neumann?*

Problem 3. *Circuits.*

a) (5 pts.). *If a LED connected to the Arduino drops 2.0 volts, what resistor would be required to limit the current going through the LED to 10mA?*

b) (5 pts.). *For the following circuit, what is the voltage at points A and B? Also, what is the current running through each of the resistors? You can answer in fractions.*

Problem 4. *Debugging.*

a) (5 pts.)**.** *What is one advantage and one disadvantage of debugging by printing over the serial port?*

b) (5 pts.)**.** *What are two other methods to debug embedded systems besides using the serial port? Explain briefly how to use these methods.*

c) (5 pts.)**.** *What are two ways to time the execution of a function that takes 5μS to execute? Which is more precise and why?*

d) (5 pts.)**.** *How many clock cycles does a function that executes in 5μS take on our Arduino?*

Problem 5. *Digital I/O*

a) (5 pts.)**.** *Write the* `C` *code to set Arduino pin* `A4` *to low.*

b) (5 pts.)**.** *Write the* `C` *code to set pin* `PB1` *to an input pin with the internal pullup resistor enabled by directly writing to the processor registers (recall the I/O registers have the general names* `DDRx`*,* `PORTx`*,* `PINx`*).*

c) (5 pts.)**.** *What does it mean when a button is described as bouncing? What problem could occur if a button bounces?*

d) (5 pts.)**.** *Describe two different approaches to debouncing a button? Which approach is better and why?*