Embedded Real-Time Systems (AME 3623)
Homework 3

April 18, 2012

This homework assignment is due on Tuesday, April 24th at 5:00pm. Your work may be handed in electronically (use the **Homework 3** digital dropbox on D2L) or in hardcopy form (in person or to my office).

This assignment must be done individually: do not share/discuss your answers with others or look at the answers of others.

Question 1

Assume: timer 4 and a prescaler of 256.

1. (5 pts) What is the time period between counts of the timer/counter? Show your work

2. (5 pts) Assume that we have the overflow interrupt enabled. What is the frequency of the overflow interrupts?

Question 2

Assume that we are using a 16 MHz crystal for our clock.

1. (10 pts) Suppose that we want to produce an overflow interrupt period of 4.096 ms. Which timer should we use and with which prescaler?

2. (5 pts) Suppose that we want to produce an overflow interrupt frequency of approximately $976Hz$. Which timer should we use and with which prescaler?

Question 3

1. (15pts) Suppose that we want a function – called $control1()$ – to be executed at approximately 30.5 Hz, and another function – called $control2()$ – to be executed at approximately 2.77 Hz. We will use the timer1 overflow interrupt service routine to call both of these. Assume a system clock of $16MHz$. What is the timer1 prescaler configuration and the code for the interrupt routine (the code does not need to be syntactically correct)? Also - show the code in your main function that configures the timer.

Question 4

Consider the following code:

```
ISR(TIMER1_OVF_vect) {
    static uint8_t counter = 0;
    static uint8_t phase = 0;
    switch(phase) {
      case 0:
          if(counter == 35) {
             PORTC = PORTC & 0xCF | 0x20;
             counter = 0;
             phase = 1;
          }
          break;
      case 1:
          if(counter == 55) {
             PORTC = PORTC & 0xCF | 0x10;
             counter = 0;
             phase = 2;
          }
          break;
      case 2:
          if(counter == 10) {
             PORTC = PORTC & 0xCF;
             counter = 0;
             phase = 1;
          break;
        }
    }
    counter = counter + 1;
};

Somewhere in the main program:

// Initialization
timer1_config(TIMER1_PRE_256);
// Enable the timer interrupt
timer1_enable();
// Enable global interrupts
sei();

DDRC = 0x30;
PORTC = 0;
while(1){};
```

1. (15 pts) What is the timing diagram for C4 and C5?

2. (15 pts) Draw the FSM diagram that represents the ISR functionality.

Question 5

How much time did you spend on this assignment?