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 976 $Hz$. 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:

```c
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:

```c
// 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?