

CS/EE 3720  
Spring 2006  
Myers

## Midterm Exam 2

- Fill in your name:
- This exam is open book and open notes.
- The exam is 80 minutes and worth 100 points.
- Show all your work.

Question	Score
1	
2	
3	
4	
Total	

1. **Threads/Semaphores** (30 points)

In lab 6, you implemented a thread scheduler in which each thread would periodically attempt to obtain a shared resource which is protected using a semaphore.

(a) Assuming that a thread is unable to obtain the semaphore, what should it do? Briefly, how could you modify the code to do this?

(b) Explain in words how you could modify the thread scheduler to avoid rescheduling this thread until the semaphore is available.

(c) Assume that you have modified your scheduler such that threads are scheduled based upon a priority. Explain how priority coupled with spin-lock semaphores can cause a system to *deadlock* (i.e., stop making useful progress).

(d) Adding priority can cause *starvation*. What is starvation and how does adding priority cause it?

(e) How can you modify a priority scheduler to avoid starvation?

2. **Input Capture/Output Compare** (27 points)

In lab 7, you implemented a device to measure the frequency of a waveform. In this problem, you are to implement a frequency generator. Assume that the desired frequency is stored in a variable named `freq`.

(a) How could the code for generating a square wave shown in Section 6.2.4 be modified to generate a desired frequency?

(b) Using this code, what range of frequencies could be generated?

(c) Explain in words how you could design a program to generate a wider range of frequencies.

3. **Serial I/O** (16 points)

In lab 8, you implemented a simple network using SCI. Assume that you want to now implement a network using SPI instead.

- (a) Show a diagram of how you could connect four microcontrollers using SPI to form a network.

- (b) Describe in words the procedure to get a packet from one microcontroller to another.

4. **Parallel I/O** (27 points)

In lab 9, you designed a stepper motor interface in which you specified a number of steps and a period between steps. In this problem, we will consider using a DC motor instead.

(a) Why is it more difficult to use a DC motor?

(b) What do number of steps and period between steps correspond to for a DC motor?

(c) What would you need to add to your design in order to move a particular “number of steps” and to have a particular “period between steps”?