ECE/CS 5780/6780
Spring 2007
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** (24 points)
   In lab 6, you implemented a preemptive scheduler in which each thread would periodically attempt to obtain a shared resource which is protected using a semaphore.

   (a) How is a non-preemptive scheduler different? What would have been an advantage of using a non-preemptive scheduler? What is a disadvantage?

   (b) How is a priority scheduler different? What would have been an advantage of using a priority scheduler? What is a disadvantage?

(c) How is a fixed scheduler different? What would have been an advantage of using a fixed scheduler? What is a disadvantage?

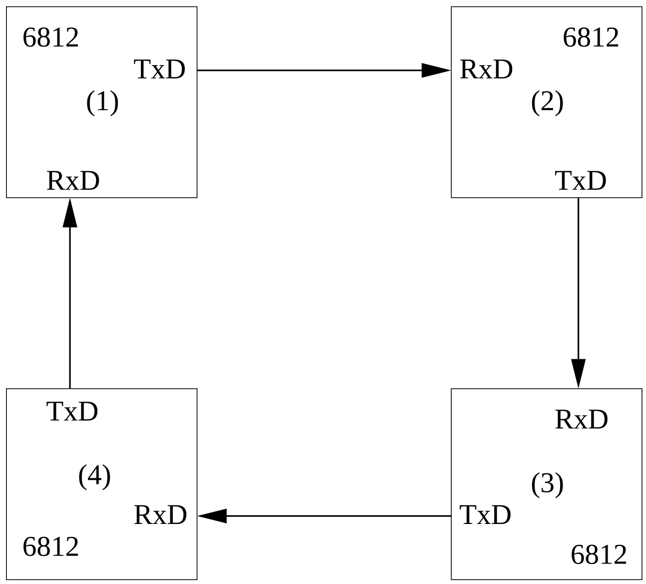
(d) If your ONLY goal is to have the CPU waste as little time as possible changing threads and executing cycles on blocked threads, which scheduler (preemptive, non-preemptive, priority, or fixed) do you think would be best and briefly explain how you would achieve this goal using this scheduler.

2. **Timing Generation and Measurements** (30 points)
In lab 7, you wrote code to measure the frequency of a waveform using an input capture to count edges and an output compare to measure the time period over which you counted edges. In this problem, you are to implement frequency measurement using the pulse accumulator to count edges and an output compare to measure the time period over which you count edges. The main code will call a ritual to start the frequency measurement which will then continue indefinitely. Your output compare handler should copy the current frequency into a global variable `freq` and setup for the next frequency measurement.

   (a) Write the code for the ritual.

   (b) Write the code for the output compare interrupt handler.

3. **Serial I/O** (21 points)
In lab 8, you implemented a simple bus network using SCI. The problem with a bus network is that collisions can occur and must be detected and avoided. A ring network as shown in the figure below eliminates the problem of collisions, but it is still possible for one bad microcontroller to completely bog down the network. For example, assume that microcontroller (1) continuously sends packets to microcontroller (4) (or even worse to itself).



(a) In this scenario, what happens if microcontroller (2) always prioritizes forwarding packets over sending out of its own packets?

(b) In this scenario, what could happens if microcontroller (2) always prioritizes sending out of its own packets and buffers incoming packets until it has nothing to send?

(c) Explain how the network above could be modified to deal with this problem? Be sure to show any new connections that are required on the figure above. Assume that you cannot add another SCI port.

4. **Parallel I/O** (25 points)
   In lab 9, you designed a stepper motor interface in which you sent a sequence of codes to move the motor. It is also possible to use a stepper moter as a shaft encoder.

   (a) Draw a schematic showing how you connect a stepper motor to your microcontroller when it is used as a shaft encoder. You may include Figure 8.91 as a component in your schematic, but you must indicate which ports you are connecting this component to.

   (b) Explain in **words** how you would design software to determine the net number of steps (clockwise steps minus counterclockwise steps) that the shaft has moved from the initial position. Be sure to mention which interrupt handlers will be implemented and what they will do.