CS 4760	**Operating Systems**	**Test 2**
Name:	Spring 2011	Max Pts: 53

Important: This is an open book test. You can use any books, notes, or paper but no electronic device. *Do not log into the computer during the test, or use any electronic or communications device. Switch off your cell phones*. Any calculations and rough work can be done on the back side of the test pages. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem. You will lose five points for not writing your name.

1. [10 pt] What is the difference between a binary semaphore and a general semaphore? How will you implement a binary semaphore with block-wakeup protocol? Give the code.

2. [6 pt] What is the advantage in having different time-quantum size at different levels in a multilevel feedback queue scheduler?

3. [10 pt] Consider three resources p_1, p_2, and p_3, executing asynchronously the following sequence of code:

p_1		p_2		p_3	
⋮		⋮		⋮	
`P(x)`		`P(y)`		`P(z)`	
⋮		⋮	←	⋮	
`P(z)`	←	`V(y)`		`P(x)`	←
⋮		⋮		⋮	
`P(z)`		`V(y)`		`P(x)`	
⋮		⋮		⋮	
`V(x)`				`V(z)`	
⋮		⋮		⋮	
`V(z)`				`V(x)`	

The arrow in each column indicates which instruction the corresponding process is currently executing. All semaphores were initially set to 1.

(a) Draw a process resource graph describing this situation where each semaphore is interpreted as a resource, and `P` and `V` operations represent *requests* and *releases* of the resources.

(b) Reduce the graph as much as possible, showing that it represents a deadlock state.

(c) If you could increase the number of units of any of the three resources, which increase (if any) would resolve the deadlock?

4. [10 pt] There are four processes p_1 through p_4 in a single-processor system. p_1 has created p_2 and p_3; it has also created two resource classes r_1 and r_2, each consisting of only one unit of that resource. The process p_3 has created the process p_4. Presently, p_1 is *running*, p_2 is *ready*, and p_3 and p_4 are both *blocked* on the resource r_1. Show the details of all process control blocks and resource descriptors and their interconnections (pointers) reflecting the system state described.

5. [15 pt] Assume you have the following jobs to execute with one processor:

Process	Burst time	Arrival time
p_0	3	0
p_1	8	0
p_2	5	2
p_3	5	2
p_4	3	6

Give the average wait time for this set of processes using the following algorithms.

(a) First in first out

(b) Shortest job next (non-preemptive)

(c) Shortest remaining time next (pre-emptive)

(d) Round robin, with a quantum of 3

(e) Round robin, with a quantum of 5 plus context switch time of 1