CS 376	**Operating Systems**	Test 2
Name:	Fall 1998	Max Pts: 50

Important: This is an open book test. You can use any books, notes, or paper. *Do not log into the computer during the test.* 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. [5 pt] Evaluate the following mutual exclusion algorithm for two processes on its ability to solve the critical section problem.

```
extern bool flag[2] = {false, false};
extern int  turn = 1;

void process ( int i )    // Code for process i; i could be 0 or 1
{
    flag[i] = true;                         // Raise my flag
    while ( ! flag[1-i] )                   // Check for other guy's flag
        if ( turn == ( 1 - i ) )
        {
            flag[i] = false;
            while ( turn == ( 1 - i ) );
            flag[i] = true;
        }

    critical_section();

    turn = 1 - i;                           // Give turn to the other guy
    flag[i] = false;                        // Lower my flag

    remainder_section();
}
```

2. [6 pt] Most round-robin schedulers use a fixed-size quantum. Give an argument in favor of a small quantum. Now give an argument in favor of a large quantum. Compare and contrast the types of systems and jobs to which the arguments apply.

3. [4pt] Suppose in a system, a new process arrives at an average of four processes per minute and each such process requires 12 seconds of service time. Estimate the fraction of time the CPU is busy in a system with a single processor.

4. [10 pt] Assume you have the following jobs to execute with one processor:

Process	Burst time	Arrival time
p_0	75	0
p_1	40	10
p_2	25	10
p_3	20	80
p_4	45	85

Give the average wait time and average turnaround time for each process using the following algorithms:

(a) First in first out

(b) Shortest job next (decision to be made when a process is finished)

(c) Shortest remaining time next

(d) Round robin, with a quantum of 15

(e) Round robin, with a quantum of 15 plus context switch time of 5

5. [5 pt] Assume a system with four resource types, $C = \langle 6, 4, 4, 2 \rangle$, and the maximum claim table shown below.

Process	R_0	R_1	R_2	R_3
p_0	3	2	1	1
p_1	1	2	0	2
p_2	1	1	2	0
p_3	3	2	1	0
p_4	2	1	0	1

The resource allocator is considering allocating resources according to the following table:

Process	R_0	R_1	R_2	R_3
p_0	2	0	1	1
p_1	1	1	0	0
p_2	1	1	0	0
p_3	1	0	1	0
p_4	0	1	0	1

Is this state safe? Why or why not?

6. [10 pt] A system is composed of four processes, $\{p_1, p_2, p_3, p_4\}$, and three types of serially reusable resources $\{R_1, R_2, R_3\}$. The number of units of resources are $\langle 3, 2, 2 \rangle$.

   - Process p_1 holds one unit of R_1 and requests 1 unit of R_2
   - p_2 holds 2 units of R_2 and requests 1 unit each of R_1 and R_3
   - p_3 holds 1 unit of R_1 and requests 1 unit of R_2
   - p_4 holds 2 unit of R_3 and requests 1 unit of R_1

   Show the process-resource graph to represent this system state. Show the reduced form of the graph. Which, if any, of the processes are deadlocked in this state?

7. [6 pt] A memory manager for a variable-sized partition strategy has a free list of blocks of size 600 bytes, 400 bytes, 1000 bytes, 2200 bytes, 1600 bytes, and 1050 bytes.

   (a) What block will be selected to honor a request for 1603 bytes using the best-fit policy?

   (b) What block will be selected to honor a request for 949 bytes using the best-fit policy?

   (c) What block will be selected to honor a request for 1603 bytes using the worst-fit policy?

   (d) What block will be selected to honor a request for 349 bytes using the worst-fit policy?

   (e) Assume the free list is ordered as the blocks are listed above. What block will be selected to honor a request for 1603 bytes using the first-fit policy?

   (f) Assume the free list is ordered as the blocks are listed above. What block will be selected to honor a request for 1603 bytes using the first-fit policy?

8. [4 pt] Suppose the page size in a computing environment is 1KB. What is the page number and the offset for the following:

   (a) 899

   (b) 23456

   (c) 0x3F244

   (d) 0x0017C