EXAM ON PROCESSES AND SCHEDULING – SPRING 2004
CSC 262 – OPERATING SYSTEMS
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1. **Vocabulary** (24 points). Describe the meaning or role of the following terms in one or two sentences.

a). Semaphore Table

b). Interrupt Controller

c). Process Table

d). Gantt Chart

e). Peterson Algorithm

f). Memory Interlock Instruction

g). Monitor (the software construct, not the hardware device!)

h). Two Generals Problem

2. **Process Management** (12 points). Write a few paragraphs explaining the differences between threads and heavyweight processes. Be sure to consider data structures, efficiency issues, and typical usage.

3. **Interrupts** (16 points) Below are a number of events that take place during the handling of an interrupt. Number them in chronological order.

a. ____ CPU signals on INTA line
b. ____ Key state registers stored in process table stack and replaced
c. ____ Interrupt code read off system bus
d. ____ Signal reaches MIC or SIC on IRQ
e. ____ Execution jumps to handler for specific interrupt type
f. ____ MIC or SIC puts interrupt code on system bus
g. ____ User programmable registers stored in process table stack
h. ____ MIC signals on INT line

4. **Race Conditions** (16 points). For each of the following programs, state the possible values for *x* and *y* if the program terminates. Also, state whether the program will always terminate, sometimes terminate, or never terminate.

You may assume that the variables are initialized as follows:

x : integer init 2
y : integer init 3
s0 : general semaphore init 0
s1 : general semaphore init 1
s2 : general semaphore init 1

a). `cobegin x := x+y; // y := x+y; coend`

b).
```
cobegin
   DOWN(s1); x := x+y; UP(s1);
//
   DOWN(s1); y := x+y; UP(s1);
coend
```

c).
```
cobegin
   DOWN(s0); x := x+y; UP(s1);
//
   DOWN(s1); y := x+y; UP(s0);
coend
```

d).
```
cobegin
   DOWN(s1); DOWN(s2); x := x+y; UP(s2); UP(s1);
//
   DOWN(s2); DOWN(s1); y := x+y; UP(s1); UP(s2);
coend
```

5. **Scheduling** (12 points). Consider the hypothetical process table shown below. For each of the scheduling policies listed, state which process would run next. Also, assuming no process blocks, terminates, or becomes unblocked, which processes would *never* run? If it matters, you may assume that process 3 has run most recently.

Process ID: 0	Process ID: 1	Process ID: 2	Process ID: 3	Process ID: 4
Priority: 15	Priority: 0	Priority: -10	Priority: 8	Priority: 8
Quanta: 2	Quanta: 5	Quanta: 0	Quanta: 8	Quanta: 8
Status: Ready	Status: Ready	Status: Ready	Status: Blocked	Status: Ready
Next: 1	Next: 2	Next: 3	Next: 4	Next: 0

a. Round robin

b. Strict priority (higher numbers = higher priority)

c. Linux `SCHED_OTHER`

6. **Semaphores** (12 points). Consider the following protocol for the *sleeping barber* problem:

```
const int chairs(5);
int waiting (0);
semaphore customers(0);
semaphore barbers(0);
semaphore mutex(1);

1     barber: process
2        while true do
3           DOWN(customers);
4           DOWN(mutex);
5           waiting := waiting-1;
6           UP(barbers);
7           UP(mutex);
8           {cut hair};
9        endwhile;
10    endprocess;

11    customer: process
12       DOWN(mutex);
13       if (waiting < chairs) then
14          waiting := waiting+1;
15          UP(customers);
16          UP(mutex);
17          DOWN(barbers);
18          {get haircut}
19       else
20          UP(mutex);
21       endif;
22    endprocess;
```

a). How would the protocol's behavior change if lines 4, 7, 12, 16, and 20 were eliminated? If there could be a change in behavior, describe a specific scenario where it would be evident.

b). How would the protocol's behavior change if lines 16 and 17 were exchanged? If there could be a change in behavior, describe a specific scenario where it would be evident.

c). How would the protocol's behavior change if line 6 were eliminated? If there could be a change in behavior, describe a specific scenario where it would be evident.

7. **Deadlock Avoidance** (8 points). A particular system has 2 Scanners, 3 Plotters, 1 Surveyor, and 2 Printers. Consider the following set of resources, current allocations, and potential needs:

	Scanners		Plotters		Surveyors		Printers	
	Current	**Max**	Current	**Max**	Current	**Max**	Current	**Max**
Process A	1	**1**	0	**1**	0	**1**	0	**1**
Process B	0	**1**	1	**1**	1	**1**	0	**0**
Process C	0	**1**	0	**0**	0	**1**	1	**1**
Process D	0	**0**	1	**3**	0	**1**	0	**1**

a. Is it safe to grant Process B access to a Scanner? Why or why not? (Give either a plan for satisfying all processes completely, or set of requests that would be impossible to satisfy.)

b. Is it safe to grant Process C access to a Scanner? Why or why not?

c. Is it safe to grant Process A access to a Printer? Why or why not?

d. Is it safe to grant Process D access to a second Plotter? Why or why not?