Dept. Computer Science	**Operating Systems**
Vrije Universiteit	**2.7.2013**

This exam consists of two pages

1 What are the advantages and disadvantages of monolithic system design (e.g., Linux) and mikrokernel-base multiserver system (e.g., MINIX)? *10pt*

2 What is a system call? *3pt*

3 In what three situations is execution transfered from a user process to the operating system kernel? *6pt*

4 Consider a system, which has a number of processes, but none of them is runnable, although there is no deadlock. Now answer the following questions:

 1. How can a system get in this state?
 2. What does the processor execute in such a situation?
 3. How can a process in the system become runnable again?

 6pt

5 Describe the mechanism of how an operating system can let two processes share memory. *6pt*

6 Given the following implementation of a ring queue in shared memory, answer the following questions:

 1. Why is this implementation safe for one producer and one consumer?
 2. How would you extend the implementation so that multiple producers can put data on the queue?

```
1   struct queue {
2           unsigned int    head;
3           unsigned int    tail;
4           int             length;
5           void *          data[];
6   };
7
8   int queue_is_empty(struct queue * q)
9   {
10          return q->head == q->tail;
11  }
12
13  int queue_is_full(struct queue * q)
14  {
15          return q->tail == (q->head - 1) % q->length;
16  }
17
18  void queue_push(struct queue * q, void * data)
19  {
20          while (queue_is_full(q));
21
22          q->data[q->tail] = data;
23          q->tail = (q->tail + 1) % q->length;
24  }
25
26  void * queue_pop(struct queue * q)
27  {
28          void * data;
29
30          while (queue_is_empty(q));
31
32          data = q->data[q->head];
33          q->head = (q->head + 1) % q->length;
34
35          return data;
36  }
```

10pt

7 Answer the following questions about priority round-robin scheduling.

1. What happens when a process runs out of its time quantum?
2. How does the scheduler pick the next process?
3. What type of processes (in terms of runtime characteristics) would you high high priority?
4. What type of processes would have low priority?

8pt

8 What is the essential difference between block and character devices? *3pt*

9 What is an orphaned process in MINIX? *3pt*

10 In what respects does accessing device registers using port IO differ from accessing devices using memory-mapped IO? *3pt*

11 What is vectored IO? What is its benefit over non-vectored IO? *6pt*

12 Describe the process of translating virtual addresses to physical addresses (both 32-bit) in a system with 4kB pages, two level pages tables and 10 bits off the addressed used as first-level offset. *10pt*

13 What is copy-on-write (COW) and how does it work? Also, give one use-case for copy-on-write. *6pt*

14 Name three possible block-level file system inconsistencies. How can they be (if possible) repaired? *10pt*