

This exam is **closed book**. You can have **one page** of notes. Be specific.

1. *Advantages and disadvantages* (5 points each).

- a) What is the main advantage of *DMA controllers*?

They move data between the main memory and the disk without any CPU intervention, thus reducing the number of context switches.

- b) What is the main advantage of *delaying writes* to the disk?

It reduces the number of disk accesses.

- c) What is the main advantage of *dual-mode CPU architectures*?

They prevent user processes from accessing directly disk drives and other peripherals, forcing them to go through the kernel.

- d) What is the main advantage of *vectorized interrupts*?

They assign different priority levels to different types of interrupts depending on their emergency level.

- e) What is the main advantage of *multithreaded servers*?

They can process several client requests in parallel.

- f) What is the main advantage of *timer interrupts*?

They notify the kernel that the running process has run for so many milliseconds, thus preventing a process from monopolizing the CPU when other processes are waiting.

2. How many lines will the following program print out? (5 points)

```
main() {
    int pid;
    if ((pid =fork()) == 0) {
        fork();
    }
    printf("Hello!\n");
}
```

The program will print out exactly three lines.

3. What is the *default action* taken by a UNIX process that receives a *signal*? (5 points)

It terminates.

What should the process do if it wants to do something else? (5 points)

It should issue beforehand a `signal()` system call to "catch" the signal..

Is this always possible? (5 points)

No, the `SIGKILL` signal cannot be caught.

4. Complete the following code fragment to ensure that (a) `stdout` is redirected to the file `output.txt` and (b) `stderr` is redirected to `errorlog.txt`? (4×5 points)

```
int fda, fdb;
fda = open("output.txt", O_WRONLY | O_CREAT, 0640);
fdb = open("errorlog.txt", O_WRONLY | O_CREAT, 0640);

close(1) _____;
dup(fda) _____;
close(2) _____;
dup(fdb) _____;
```

5. Both *microkernels* and *modular kernels* allow to extend kernel functionality without having to recompile it. What are the respective main advantages of each approach over the other? (2×5 points):

a) Microkernels are more secure than modular kernels because kernel extensions are separate server processes that cannot access the kernel address space.

b) Modular kernels are faster than microkernels because kernel extensions run in the kernel address space.

6. Give one example of

- a) A real-time process with hard deadlines? (5 points)

Any process control application \_\_\_\_\_

- b) A real-time process with soft deadlines (5 points)

Watching a DVD on your PC \_\_\_\_\_

7. Explain why a good multiprocessor operating system should :

- a) Have a symmetric organization. (5 points)

Otherwise the processor on which the kernel run could become a bottleneck.

- b) Support kernel-level threads. (5 points)

To be able to allocate several processors to a multithreaded process.