

CS-C3140 Operating systems

The exam contains five questions. The maximum points for each question are listed in the beginning of the questions. Read the questions carefully. Give clear and compact answers. Remember to write the name of the course and your own personal information on each of your answer papers. No extra appliances are allowed in the exam.

- 1 (10p) Answer *shortly* with clear definitions and descriptions. (Max. two points per subquestion.)
 - a) What is a race condition?
 - b) What is double buffering?
 - c) What is a process swap?
 - d) What is symmetric multi-processing?
 - e) What is kernel space?
- 2 (6p) Considering the *readers-writers* problem, give a solution that implements mutual exclusion without starvation by using *semaphores* for synchronization. Present your solution as a piece of pseudo code and explain it.
- 3 (6p) Explain in detail, how is the address translation from virtual addresses to physical addresses done in a modern operating system? Also, what kind of hardware is available to support such translations in modern systems?
- 4 (6p) Consider a main memory sufficient for storing four pages, which is used to implement a paged virtual memory. The main memory is initially empty, and the pages of the virtual memory are referred to in the following order: 0, 1, 2, 3, 0, 1, 4, 0, 1, and 2. How many page faults will occur, when LRU replacement is used? How many page faults will occur, when FIFO replacement is used? What is the optimal sequence of replacements? Explain and justify your results shortly.
- 5 (6p) Write an essay on device drivers that is not longer than 50 lines.