UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

COMPUTER SCIENCE THREE

OPERATING SYSTEMS

Monday 4 September 2000

14:00 to 15:30

Examiners:

Prof. K. Turner (External)

Prof. G. Brebner (Chairman)

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

1. (a) What is a *semaphore*? Define the P and V operations on a semaphore. How can P and V operations be used to ensure mutual exclusion of processes from a critical region? [*4 marks*]

   (b) What is meant by the term *busy waiting* in relation to semaphores and how can it arise? How is it avoided in operating systems? [*4 marks*]

   (c) How might user-level semaphore facilities be implemented by the kernel of an operating system? Describe the data structures that would be needed and how they would be used. [*6 marks*]

   (d) What are the necessary conditions for *deadlock* to arise? Give an example of deadlock caused by the use of semaphores in *three* processes. [*5 marks*]

   (e) How could the kernel detect the presence of deadlock arising from use of semaphores? Describe a scheme using the data structures you have suggested in part (c). [*6 marks*]

2. (a) What is a *process*? What must an operating system kernel preserve when a process is temporarily suspended? [*5 marks*]

   (b) What is a *thread*? What distinguishes threads from processes? Give an example of how threads might beneficially be employed. [*5 marks*]

   (c) Describe the difference in structure between *Microkernel* based operating systems and *Monolithic* operating systems. What benefits do each have? [*6 marks*]

   (d) Explain the difference between *preemptive* and *non-preemptive* scheduling of processes. Give an example of each and explain how it works. [*5 marks*]

   (e) Describe how the following scheduling schemes work:

      i. Round Robin

      ii. Rate Monotonic [*4 marks*]

3. (a) How are virtual addresses translated into physical addresses using *segmentation*? What are typical fields of a segment table entry? What problems associated with purely physical addressing does segmentation help to solve? [*7 marks*]

(b) How are virtual addresses translated into physical addresses in a *paging* system? What are the typical fields of a page table entry? What problems associated with purely physical addressing does paging help to solve? [*7 marks*]

(c) How can segmentation and paging be combined? [*4 marks*]

(d) Describe briefly the segmentation and paging scheme used in Intel's x86 i.e. Pentium, architecture. [*7 marks*]