**UNIVERSITY OF EDINBURGH**

**FACULTY OF SCIENCE AND ENGINEERING**

**MASTER OF SCIENCE IN COMPUTER SCIENCE**

# OPERATING SYSTEMS

**Tuesday 24 April 2001**

**14:00 to 15:30**


**Examiners:**

**I. Watson (External)**

**R.N. Ibbett (Chairman)**


**INSTRUCTIONS TO CANDIDATES**

**Answer any TWO questions.**

**All questions carry equal weight.**

1. (a) What is meant when a set of processes is said to be *deadlocked*? What are the necessary conditions for deadlock to occur? [*5 marks* ]

   (b) Show how resource requests from and allocations to processes can be modelled by a graph. How can such a graph show that deadlock has occurred? What form does the graph take when multiple resources of the same type are available and does the same deadlock criterion apply? [*5 marks* ]

   (c) What strategies might be adopted by an Operating System designer to deal with deadlocks? Briefly describe the philosophy of each approach. [*8 marks* ]

   (d) What methods might be used for deadlock detection and what would be their advantages and disadvantages? [*7 marks* ]

2. (a) What is a *process*? What must an operating system kernel preserve when a process is temporarily suspended? What costs in overall system efficiency might be incurred when processes are suspended and reactivated? [*7 marks* ]

   (b) What is a *thread*? What distinguishes threads from processes? Give examples of where threads can advantageously be employed. [*6 marks* ]

   (c) Distinguish between *preemptive* and *non-preemptive* CPU scheduling policies. Describe the following methods of CPU scheduling and discuss the circumstances in which they may typically be used.

      i. Round Robin

      ii. Multi-level Feedback [*12 marks* ]

3. (a) How are virtual addresses translated into physical addresses using a single-level *page table*? What are the typical fields of a page table entry? [*5 marks* ]

   (b) Describe the steps that can take place when a virtual page is accessed in a *demand paged* system. Include in your answer mention of the Translation Lookaside Buffer, page tables, memory caches, swap disc etc. [*8 marks* ]

   (c) What are *Multi-level Page Tables* and why are they often used? [*4 marks* ]

   (d) Explain briefly the organisation of the virtual memory segmantation and paging system of the Intel Pentium family architecture. [*8 marks* ]