

## C1 Real-Time Computing, 1996-97 resit.

Answer part (a) and then three parts from (b)-(f).

(a) Describe the main characteristics of a real-time computing system and explain the difference between a *hard* real-time computing system and a *soft* real-time computing system. Discuss whether an automatic video system using a computer controlled pan and tilt camera with variable zoom to track people as they move about, for example whilst giving a lecture, is a *hard* real-time computing system or a *soft* real-time computing system.

[7 marks]

(b) Describe how a processor farm is implemented and explain why architectures based on pipelines of processor farms are often useful in the implementation of computationally demanding real-time systems. Illustrate your answer by reference to a system that has been broken down into a three-stage pipeline with computational times of 10, 15, and 20 ms respectively.

[6 marks]

(c) In a particular real-time system, tasks may be *active*, *runnable* or *suspended*. Describe what these terms mean, and use them to explain why two tasks A and B may not, in general, be able safely to share access to the same code for a module M. Describe briefly how you would write module M so that its code can safely be shared.

[6 marks]

(d) Define what is meant when the tasks in a real-time system are said to be *schedulable* and describe what is meant by a *cyclic* scheduling strategy. Explain how the implementation of *round-robin* and *priority* scheduling strategies in a real-time system may differ from the implementation of similar strategies on a conventional computer system such as a UNIX workstation.

[6 marks]

(e) Show, by writing appropriate pseudo-code, how you would use a semaphore to ensure that two tasks A and B can only gain mutually exclusive access to a memory M. Explain what the functions you have used do and indicate briefly what problems you might expect to encounter in using a semaphore in this way.

[6 marks]

(f) Define what is meant by the reliability of a real-time computing system and explain how duplication of hardware and N-version programming can enhance the reliability of a real-time computing system. Include in your answer an explanation of why different procedures have to be adopted for hardware and software components.

[6 marks]

[END]