

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY  
FACULTY OF APPLIED SCIENCE  
**COMPUTER SCIENCE DEPARTMENT**  
MAY EXAMINATIONS 2000

**SUBJECT:** ADVANCED ARCHITECTURE AND OPERATING SYSTEMS  
**CODE:** SCS 4201

**INSTRUCTION TO CANDIDATES**

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This paper consists of two sections.  
Answer **all** questions from **Section A** and any **two** from **Section B**

**Time: 3 hours**

**SECTION A**

1. (a) The design of an operating system is better approached by developing a hierarchical layered model. What are the advantages of such a strategy? [2]
  - (b) What is a supervisor call. How is it different from general subroutine calls. [2]
  - (c) What is pre-emptive scheduling in the design of an operating system. What hardware facility aids the implementation of such a facility. [2]
  - (d) Show a scheme that is used by an operating system to protect the volatile environment of a process in a multiple process environment. [2]
  - (e) What are hardware features that aid the protection of private data space of a user process? [2]
  - (f) Show a data structure of a semaphore and draw a flowchart of one of the basic operations on this data structure. [2]
  - (g) Show a simple calculation that lends itself to parallel computation. What is the difference between applied and natural parallelism? [2]
  - (h) What is the principle of RISC architecture? [2]
  - (i) How does pipelining boost performance? Under what conditions does this system fail to meet its main objective? [2]
  - (j) Discuss the operation of content addressable storage mechanism. [2]
2. A process to enrol students in a student database runs in a multi-user environment. This process updates a running total that indicates how many students have been enrolled so far. Demonstrate how a problem of multiple update can occur if the system does not offer locking. Design a data structure of a resource that can be used for overcoming this problem. Write pseudo

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code to demonstrate how the operating system would process this data structure. Use diagrams to illustrate all the possibilities in such a system. If a registration process uses a printer, demonstrate how a deadlock could arise if another process that uses as well as access the same database runs in the same environment. [15]

3. What are the main problems associated with parallel processing? Using diagrams, discuss the operation of the following configurations.

- a) Single instruction single data stream
- b) Single instruction multiple data stream
- c) Multiple instruction single data stream
- d) Multiple instruction multiple data stream

Which of the above configurations are unsuitable for implementing parallelism? Explain why. [15]

#### SECTION B

4. (a) Discuss the structure of sectors in relation to fixed disc storage systems. Illustrate how buffering improves performance. [12]

(b) What is a File Allocation Table (FAT)? Use diagrams to illustrate your understanding. How would you recover a deleted file? Indicate all the conditions that would make the file irrecoverable. [13]

5. What is the difference between a device controller and a device driver. Using pseudo code and diagrams demonstrate how a spooled device operates. Clearly demonstrate the calling conversions and the interaction between the spooler and the device driver. [25]

6. Produce a data structure of a Process Control Block (PCB). Briefly outline the purpose of each element in the PCB. [25]

**END OF QUESTION PAPER**