UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1997

BEng Honours Degree in Computing Part I
MEng Honours Degrees in Computing Part I
BEng Honours Degree in Information Systems Engineering Part I
MEng Honours Degree in Information Systems Engineering Part I
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER 1.5 / I1.5

OPERATING SYSTEMS I

Monday, April 28th 1997, 2.00 - 3.30

Answer THREE questions

For admin. only: paper contains 4 questions

Section A

1. Buffering and I/O

a A process may use data buffers to place data that is used as input or output of the process, With the help of diagrams describe the operations of

i) Switching Buffers
ii) Circular Buffers

when placed between producer and consumer processes. Explain why a switching buffer may be preferred.

b A circular buffer C of size 2 Kbytes is being filled at a rate of 200 bytes per second and emptied at the rate of 115 bytes per second. Calculate the time that it would take for buffer C to become full (overflow) in seconds, assuming that we start at time t = 0 seconds with a totally empty buffer.

c Using assembler instructions based around the M68 processor, write a circular buffer write (BUF_WRITE) *or* circular buffer read (BUF_READ) subroutine, with suitable error handling for buffer full or buffer empty errors. Along with your code describe how information is organised in the buffer your routine is using.

The three parts carry, respectively, 30%, 20%, 50% of the marks.

2. Execution of Processes

a Describe and explain each of the following terms:

i) Process
ii) Hardware Interrupt
iii) Turnaround Time
iv) Relative Execution Time

b Explain how spooling of input/output data can contribute towards faster turnaround times for processes.

c Three processes are to be run by a computer system in sequence. Assuming that the jobs run in order I -> II ->III and using the following information, calculate the Completion Times and Relative Execution Times for each of the 3 jobs. Assume that the first job starts at time t=1.

Job	Input	Processing	Output
I	3 s	10 s	5 s
II	4 s	20 s	10 s
III	7 s	7 s	7 s

The values above relate to time taken for various part of process to complete (input, output and actual computation). All times are in seconds.

The three parts carry, respectively, 40%, 15%, 45% of the marks.

Section B (Use separate answer book for this section)

3 Process and I/O Management

a A computer system has one processor, one printer and one magnetic tape reader. Describe a scenario by which two running processes are deadlocked by trying to use these I/O resources. For each case below describe a method that does the following:

i) Detects the deadlock.
ii) Prevents the deadlock.
iii) Frees the system from the deadlock after it occured.

b Describe in detail how spooling for output would work for the system described in part a. Would it be possible to arrive at a deadlock with spooling for output introduced? Explain your answer clearly.

c The I/O devices are the same in an old and a new computer system. In the old computer system a process was allowed to do its own I/O by direct I/O instructions. There was no multi-processing, only one job ran at a time. In a new system an operating system is running all I/O; however, because of speed requirements, only one process is allowed to run at any one time. For each of the cases shown below describe the differences between the operation of the old and the new system and whether you would expect the process to run faster or slower in the new system (explain your answer).

i) The I/O device has no interrupts and handles one data item at a time.
ii) The I/O device works with interrupts one data item at a time.
iii) The I/O device works with a DMA channel and interrupts.

The three parts carry , respectively 40%, 20%, 40% of the marks

4 General Principles

a In order of priority what are the necessary attributes of a good general operating system? Discuss in detail how these attributes are achieved.

b What is the difference between the use of semaphores and a monitor? Describe in detail how a counting semaphore is used. How can a semaphore operation made safe when interrupts cannot be turned off? Why the use of monitors is more efficient than the use of semaphores?

c Describe the states of a process as it progresses from creation to termination and indicate the actions the operating system must take at each state transition.

d You are working for a computer company which just hired a young wizz kid who added demand paging to the new computer you have designed. To your horror, the processor is running half as fast now as compared to your initial design. However, you suspect immediately what the problem is and how it can be remedied in hardware. Tell me about it.

The four parts carry , respectively 30%, 30%, 20% , 20% of the marks

End of Paper ...