<table>
<thead>
<tr>
<th>Course:</th>
<th>BSc (Hons) Computing/Internet Computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode:</td>
<td>Full-Time</td>
</tr>
<tr>
<td>Level:</td>
<td>Two</td>
</tr>
<tr>
<td>Unit:</td>
<td>Operating Systems: I/O &amp; Networks CSA-2-ONS</td>
</tr>
<tr>
<td>Date:</td>
<td>8 June 2004</td>
</tr>
<tr>
<td>Time:</td>
<td>10:00 am</td>
</tr>
<tr>
<td>Time Available:</td>
<td>Two Hours</td>
</tr>
</tbody>
</table>

**Instructions to Candidates**

Answer any 3 questions.

All questions carry equal marks.

Calculators may be used provided they are noiseless, cordless, not pre-programmed by the candidate and cannot receive or transmit data remotely.
Question 1

a) A disk controller reads a block (one or more sectors) from a drive, one bit at a time. It computes a checksum to verify that no read errors have occurred. The block is transferred across a bus, one word at a time, for storage in main memory. The bus is sometimes busy on behalf of other devices.

i) Explain what storage structure needs to be provided within the controller and how it enables these requirements to be met.

ii) Explain how a processor can manage the transfer from disk to memory by means of interrupt-driven I/O.

iii) Explain how instead a processor can delegate to a DMA controller the transfer from disk to memory.  

(12 marks)

b) Which, if any, of the following statements concerning system performance are true?

i) Replacing a hard disk with a faster one will always improve the overall performance of a system.

ii) It is most important that a hard disk should have a low average seek time if it is mainly being used for random access to files all over the disk.

iii) It is most important that a hard disk should have a high transfer rate if it is mainly being used for sequential access to large files.

iv) Increasing the size of the disk cache in main memory can sometimes improve system performance.

v) Increasing the size of the disk cache in main memory can sometimes reduce system performance.

vi) The FIFO disk scheduling policy works well when many processes compete for access to a disk.

vii) Starvation can be a problem when adopting an SSTF disk scheduling policy.

viii) A system manager might consider deploying a redundant array of independent disks in order to improve performance and reliability.

(8 marks)
Question 2

a) Describe the three major methods of file-system implementation by which disk space can be allocated. In each case mention what needs to be stored in the directory entry for a file. (Do not discuss free-space management.)

(12 marks)

b) Consider a file system built upon a block-device interface that treats a disk as an array of 512-byte blocks. Each file is defined by an i-node that contains 13 addresses of 4 bytes each. The first 10 addresses point directly to data blocks; the 11th is a pointer to a single indirect block, the 12th is a pointer to a double indirect block and the 13th is a pointer to a triple indirect block.

i) Calculate the maximum size (in kilobytes) of a file that can be indexed by the first 10 addresses in its i-node.

ii) How many addresses can be stored in an indirect block?

iii) Calculate the maximum size (in kilobytes) of a file that can be indexed by the first 11 addresses in its i-node.

iv) Give an expression for the maximum size (in kilobytes) of a file that can be indexed by the first 12 addresses in its i-node.

(8 marks)

Question 3

a) Describe in some detail the sockets communication facility introduced with Unix BSD 4.3.

(14 marks)

b) Concerning IP addresses (IPv4):

i) How many bits are used to represent an address?

ii) When expressed in dotted decimal format, into how many fields is an address divided and what is the range of each decimal?

iii) What is the name of the file in which symbolic names can be looked up in order to convert them into IP addresses?

iv) What is the acronym for the Internet-based service that provides a more practical way of resolving names?

(6 marks)
Question 4

a) Explain, in the context of operating systems, the purpose and design goals of a protection mechanism. Also explain what is meant by an access matrix.

(14 marks)

b) A user of a Unix system has a data-file, appointments, that he updates by running executable-files, book and cancel. To list his appointments, he simply enters cat appointments at the command-line of a shell.

i) What should the permission-string for this data-file look like if other members of his group are only allowed to list his appointments?

ii) He decides to change the group-permissions of book to allow his colleagues to run it. Why will this not work successfully?

iii) What must he also do in order that his colleagues can book appointments with him, preferably without giving them unnecessary access rights to the data-file?

(6 marks)

END OF EXAMINATION