Question 1

Two processes, P_0 and P_1, are to be run and they update a shared variable. This update is protected by Petersons solution to the mutual exclusion problem.

a) Show Petersons algorithm and show the truth table for the part of the algorithm which dictates if a process is allowed to enter its critical region.

(10)

b) P_0, attempts to enter its critical region. Show the state of the variables that are created/updated. Will P_0 be allowed to enter its critical region? If not, why not?

(5)

c) P_1, attempts to enter its critical region. Show the state of the variables that are created/updated. Will P_1 be allowed to enter its critical region? If not, why not?

(5)

d) P_0 leaves its critical region. What effect does this have on the variables?

(2)

e) Assume no processes are running and P_0 and P_1 try to enter their critical region at ***exactly*** the same time. What will happen?

(3)

Question 2

a) With regards to I/O design principles describe the layers of the I/O system and justify this structure.

(15)

b) Consider the following C-language I/O statement:

```
count = read(fd, buffer, nbytes);
```

where fd is an integer (called the file descriptor)
buffer is a memory address pointing into the processes data memory
nbytes is an integer indicating the number of bytes to be read.

Supposing that fd refers to a file on disk with a controller which uses DMA, describe how this statement may be handled in the layers of the I/O system?

5 marks

c) How are devices represented in the UNIX operating system? How are the drivers specified? Could the file descriptor in question (b) be referring to a terminal? What would be the difference if this were so?

5 marks

Question 3

a) Describe the following scheduling algorithms

- Non Pre-Emptive, First Come, First Serve
- Round Robin
- Shortest Job First

(9)

b) Given the following processes and burst times

Process	Burst Time
P_1	13
P_2	5
P_3	23
P_4	3
P_5	31
P_6	3
P_7	14

Calculate the average wait time when each of the above scheduling algorithms is used?

Assume that a quantum of 6 is being used.

(12)

c) Which scheduling algorithm, as an operating systems designer, would you implement?

(4)

Question 4

(a) Given a disk with 200 tracks, where track requests are received in the following order

55, 58, 39, 18, 90, 160, 150, 38, 184.

The starting position for the arm is track 100. Calculate the number of tracks crossed when the following algorithms are used

- First Come First Serve
- Shortest Seek First
- The elevator algorithm starting in the direction UP.

(15)

b) Briefly explain, in which of the following cases can the algorithms in (a) augment its performance?

- A process is reading 10,000 blocks with consecutive disk addresses.
- A process is reading 10,000 blocks with random disk addresses.
- A process is creating child processes to read 10,000 blocks with random addresses.
- Processes are communicating with each other by writing and reading blocks to disk.

(8)

c) In the last case of question (b), could the algorithm influence the synchronisation between the processes?

(2)

Question 5

a) The buddy system is a memory management scheme that uses variable sized partitions.

Explain the basic principle behind the buddy system.

(5)

b) Assume a computer with a memory size of 256K, initially empty. Requests are received for blocks of memory of 17K, 6K, 63K and 9K. Show how the buddy system would deal with each request, showing the memory layout at each stage and the status of the lists at each stage.

(8)

(c) The processes terminate in the following order; 6K, 9K, 17K and 63K. Discuss what happens as each process terminates.

(4)

d) Describe and evaluate an alternative to the buddy system

(8)

Question 6

a) Every file in a filing system has a set of attributes (read only, date created etc.). Assume a filing system allows an attribute of *temporary*, meaning the creating process only uses the file during the time it is executing and has no need for the data thereafter. Assume the process is written correctly, so that it deletes the file at the end of its execution. Do you see any reason for an operating system to have *temporary* file attribute? Give your reasons.

(5)

b) An operating system supplies system calls to allow you to COPY, DELETE and RENAME a file.
Discuss the differences between using COPY/DELETE and RENAME to give a file new name?

(5)

c) There is some debate as to what will constitute a fifth generation computer. Assume such a computer is available. What do you think will differentiate it from the computers of today?
What advances do you think need to be made in order to produce a fifth generation computer?

(15)