Examination for the Ordinary degrees of Bachelor of Computer Science,
Bachelor of Engineering(Computer Systems Engineering), Bachelor of Engineering(Electrical),
Bachelor of Engineering(Information Technology and Telecommunications),
Bachelor of Economics, Bachelor of Information Science, Bachelor of Science,
Bachelor of Science(Mathematical and Computer Sciences),
Graduate Diploma of Computer Science,
Master of Engineering(Information Technology and Telecommunications)
and Master of Computer Science.

First Paper, Semester 2, November 2005

4468, 9901 COMP SCI 3004, 7064 OPERATING SYSTEMS

Official Reading Time: 10 mins

Writing Time: 120 mins

Total Duration: 130 mins

ANSWER ALL SEVEN QUESTIONS SHOWING ALL WORKING

Total marks: 120

The marks from this paper constitute 70% of
the total assessment for these courses

DO NOT COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

Question 1

(a) **Process Synchronisation**: What is an atomic operation?

[3 marks]

(b) Is the following algorithm a solution to the critical-section problem? Please, explain your answer.

```
While (turn != 0);
critical section
turn = 1;
remainder section
```

Process P0

```
While (turn != 1) ;
critical section
turn = 0;
remainder section
```

Process P1

[5 marks]

(c) Show how semaphores can be used to implement barrier synchronization to enable two processes to synchronize. Extend your answer to the case of *n* processes.

[6 marks]

[Total Marks for Question 1: 14 Marks]

Question 2

CPU Scheduling: The table below describes the CPU-I/O Burst cycles for processes P1, P2 and P3. Assume 0 is the highest priority

Process	Priority	Arrival time	CPU Burst 1	I/O Burst 1	CPU Burst 2	I/O Burst 2	CPU Burst 3
P1	1	0	10	4	12	-	-
P2	0	7	4	10	4	12	2
P3	2	4	6	2	6	-	-

(a) Draw the Gantt chart timeline, illustrating the interleaving of processes, and calculate the average waiting time for each process under

1. a pre-emptive priority scheduling algorithm

[6 marks]

2. a round robin scheduling algorithm with quantum = 6.

[6 marks]

(b) For the round robin scheduler, should you change the time quantum? Explain your answer.

[4 marks]

(c) Linux uses credits to provide dynamic priority scheduling. Explain how this is done. What type of processes does it favour? Why?

[6 marks]

[Total Marks for Question 2: 22 Marks]

Question 3

Deadlock: The banker's algorithm is used to check whether the allocation of resources requested by a process will leave the system in a safe state.

(a) What is a safe state?

[3 marks]

(b) Describe the data structures used in the safety algorithm and what they represent.

[6 marks]

(c) We have a system with four processes and three types of resources, with the Max matrix shown below. No resources have been allocated yet. Give an example of resource allocation that will put the system in an unsafe state.

	Max			**Available**		
	A	B	C	A	B	C
P_0	4	3	1	5	8	4
P_1	2	5	3			
P_2	3	2	3			
P_3	1	4	3			

[4 marks]

(d) In a system based on the banker's algorithm, is it possible to add additional resources while the processes are running? Explain your answer.

[3 marks]

(e) If you are developing a real-time operating system, which strategy is the best choice to deal with deadlock?

[4 marks]

[Total Marks for Question 3: 20 Marks]

Question 4

(a) **Disk Systems:** What is the open file table? What is it used for?

[4 Marks]

(b) Consider a file currently consisting of 30 blocks. Assume we are currently at logical block 10 (the last block accessed was block 10) and the information about the file is already in memory.

Two common methods of allocating disk space are *contiguous* and *indexed* allocation. For each allocation strategy, calculate how many disk accesses are required to:

i. read logical block 6

ii. delete logical block 15

[6 marks]

(c) What is the goal of a disk scheduling algorithm?

[2 Marks]

(d) If you are working on a new operating system, which disk scheduling algorithm would you select? Explain your answer.

[6 marks]

[Total Marks for Question 4: 18 Marks]

Question 5

(a) **Memory**: Explain how the system allocates memory to a process in a system that supports memory segmentation.

[4 marks]

(b) In a paging system the following page accesses are recorded in a page reference string:

1, 2, 4, 6, 1, 3, 7, 2, 4, 7, 8, 7, 8, 2, 4, 5, 7, 2, 4, 7, 8, 3, 7, 2, 4, 9, 7, 8, 3, 2, 4

How many page faults would occur under LRU replacement, FIFO replacement and Optimal replacement assuming the physical memory has 6 frames?

[9 marks]

(c) Describe the steps required to handle a page fault.

[4 marks]

(d) Define the following terms and the relationships between them:

working set, thrashing, frames

[7 Marks]

[Total Marks for Question 5: 24 Marks]

Question 6

(a) **Protection and Security**: What is an access right?

[2 marks]

(b) Describe how an access right can be revoked with an access list scheme.

[5 marks]

(c) You receive a message from your service provider which reads as follows:

"your password for this system has been identified as easily guessable, although we are not able to view the actual password. Can you please change your password - preferably using a combination of letters and numbers"

Your password is encrypted. How did they find out your password is not safe?

[5 marks]

[Total Marks for Question 6: 12 Marks]

Question 7

(a) **Distributed systems**: A distributed system has no shared clock. How can events in such a system be ordered?

[4 marks]

(b) Describe a distributed deadlock prevention scheme using timestamps.

[6 marks]

[Total Marks for Question 7: 10 Marks]

END OF EXAMINATION