Massey University
ALBANY CAMPUS

EXAMINATION FOR 59.305
OPERATING SYSTEMS AND CONCURRENT PROGRAMMING
Semester One − 1999

Time Allowed: THREE (3) Hours

INSTRUCTIONS

Attempt **ALL SEVEN (7)** questions.

This final examination contributes 70% to the final assessment.
Calculators are permitted.

Turn over to pg.2 ...

1. (a) Briefly explain why a CPU must have a User Mode and a Supervisor Mode to support a modern operating system.

[4 marks]

(b) What is a Device Driver?

[2 marks]

(c) Briefly explain the difference between Multiprocessing and Multiprogramming.

[2 marks]

(d) What is a distributed Operating System?

[2 marks]

2. (a) Draw a diagram to illustrate how processes move between the ready queue, the wait queue and the CPU.

[3 marks]

(b) Give three reasons for using concurrent programming.

[2 marks]

(c) Briefly explain the difference between a buffer and a cache.

[3 marks]

(d) A context switch between sibling threads will generally be faster than a context switch between processes, why is this?

[2 marks]

Turn over to pg.3 ...

3. (a) Using a simple example, briefly describe round−robin scheduling.

[3 marks]

(b) The following processes are to be scheduled

Process	Arrival Time(ms)	Burst Time(ms)
p1	0	35
p2	10	10
p3	15	20
p4	20	5

What is the response time and the average waiting time for these processes when using the following scheduling algorithms?

(i) FCFS
(ii) SJF
(iii) SRTF (preemptive SJF)

[4 marks]

(c) Describe a scheduling algorithm that would give the worst possible average waiting time. What average waiting time would your algorithm give for the example in part (b)?

[3 marks]

4. You are to design the first New Zealand space probe to the planet venus. The probe must concurrently collect data from many different sensors and send it back to earth. Choose **three** of the following topics and describe how they could be used on the probe. If the topic is not relevant, explain why.

(i) The Occam Language
(ii) Compressed File Systems
(iii) JavaOS
(iv) RAID
(v) Amoeba
(vi) ANDF
(vii) QNX
(viii) ADA
(ix) Plan 9
(x) The UNIX ’select’ system call
(xi) The Mach Microkernel
(xii) The POSIX Standard
(xiii) Pentium Memory Management
(xiv) OS Benchmarks
(xv) The OSF DCE
(xvi) The NOW Project
(xvii) NTFS

[10 marks]

Turn over to pg.4 ...

5. (a) Why is it hard to debug a concurrent program that contains a race condition?

[2 marks]

(b) The following is a solution to the readers−writers problem. Briefly explain the problem and how this solution works.

```
semaphore mutex=1, wrt=1;
int readcount=0;

Write() {
  wait(wrt);
   perform writing
  signal(wrt);
}

Read() {
  wait(mutex);
  readcount = readcount + 1;
  if (readcount == 1) wait(wrt);
  signal(mutex);
    perform reading
  wait(&mutex);
  readcount = readcount − 1;
  if (readcount == 0) signal(wrt);
  signal(mutex);
}
```

[4 marks]

(c) What would happen if a programmer initialised a mutual exclusion semaphore to zero instead of one?

[2 marks]

(d) How does paging allow memory to be shared between processes?

[2 marks]

6. Give definitions of the following OS and Concurrency terms.

(i) Monitors
(ii) The bankers algorithm
(iii) Indexed file allocation
(iv) Multilevel Paging
(v) Disk Scheduling

[10 marks]

Turn over to pg.5 ...

7. (a) A Machine has a physical memory of four frames and a virtual memory of eight pages.
A Program generates the following page requests:
0,4,7,6,5,4,3,6,2,1,4,5,3,2
How many page faults does this sequence generate when using the following Page Replacement Algorithms?

(i) FIFO
(ii) LRU

Comment on these results.

[4 marks]

(b) Briefly explain the difference between deadlock avoidance and deadlock detection.

[2 marks]

(c) The dining philosophers problem has solutions that can cause deadlock. Show such a solution and draw a resource allocation graph to illustrate the deadlock state with four philosophers.

[4 marks]

+ + + + + + + + + + +