

**MASSEY UNIVERSITY
ALBANY CAMPUS**

**EXAMINATION FOR
159.335 Operating Systems and
Concurrent Programming**

Semester Two - November 2007

Time allowed: **THREE (3)** hours

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

This examination contributes 70% to the final assessment.

Questions are of equal value

Calculators are permitted - no restrictions

1. (a) What is a System Call? *[2 marks]*
- (b) What are User Mode and Supervisor Mode and how are these modes used. *[3 marks]*
- (c) Give three reasons for using concurrent programming. *[3 marks]*
- (d) Briefly describe the sequence of events that occurs after a key is pressed on the keyboard generating an interrupt? *[2 marks]*

2. (a) What is DMA? *[3marks]*
- (b) What could the following code print when run under a UNIX OS?

```
int main() {  
    int i,j,k;  
  
    i=fork();  
    j=fork();  
    k=fork();  
  
    printf("%d %d %d\n",i,j,k);  
  
}
```

Assume the PID of this process is 100.

- (c) A process has 4 threads and a semaphore used as a mutex by the threads is initialised to 1. The mutex protects a single critical section. At some point during the execution of the process, the semaphore has a value of -2. What does this imply about the state of the process? *[3 marks]*

3. (a) What is “busy waiting” and why should it be avoided?

[3 marks]

(b) The following processes are to be scheduled

<i>Process</i>	<i>Arrival Time(ms)</i>	<i>Burst Time(ms)</i>
P ₀	0	30
P ₁	10	10
P ₂	20	30
P ₃	30	10

Draw scheduling diagrams and calculate the average waiting time and response time for these processes when using the following algorithms.

- (i) FCFS
- (ii) SJF
- (iii) SRTF
- (iv) RR with $q=20$

Comment on your results.

[5 marks]

(c) What is priority scheduling? What problem do priority scheduling algorithms suffer from that non-priority algorithms do not?

[2 marks]

4. (a) Briefly describe how the 'testandset' instruction can be used to protect a critical section. *[3 marks]*
- (b) What could happen if a semaphore that is used for mutual exclusion is initialised to two instead of one. *[2 marks]*
- (c) Briefly describe how a semaphore can be used as a “lock” to protect a global variable when passing information from one thread to another. *[3 marks]*
- (d) What synchronisation mechanisms does Java support? *[2 marks]*
5. (a) A Restaurant has four frying pans and three saucepans. Four chefs are cooking.
Chef 1 needs to use two frying pans and two saucepans.
Chef 2 needs to use two frying pans and one saucepan.
Chef 3 needs to use one frying pans and two saucepans.
Chef 4 needs to use three frying pans and three saucepans.
- At a certain point in time
Chef 1 is using a saucepan.
Chef 2 is using a frying pan.
Chef 3 is using a saucepan.
Chef 4 is using two frying pans.
- i) Draw a Resource Allocation Graph for this system. *[2 marks]*
- ii) Is this system in a safe state? Prove using the safety algorithm. *[3 marks]*
- iii) Chef 1 wants to use another saucepan. Should he be allowed to do this? Why? *[3 marks]*
- (b) What action should be taken to recover from deadlock if is detected. *[2 marks]*

6. (a) What is a page fault? What does an operating system do when a page fault occurs? *[2 marks]*
- (b) The following sequence of requests for pages is made,
1,2,3,3,2,1,4,3,2,1,5,4,3,2,1
There are three frames.
How many page faults occur when using the following page replacement algorithms?
- i) First In First Out.
 - ii) Least Recently Used.
 - iii) Optimal. *[3 marks]*
- (c) What is dynamic linking and when can it happen? *[2 marks]*
- (d) Draw a diagram to show a Memory Management Unit with one level paging and a Translation Lookaside Buffer? *[3 marks]*
7. (a) A machine uses 6 disks in a RAID 5 array. Each disk holds 500GB and can transfer data at 70MB/s. What is the capacity of the array and its peak read performance. *[2 marks]*
- (b) RAID 5 performs badly for a workload of many small random writes, why is this? *[2 marks]*
- (c) A file system uses the UNIX method of combined indexing. It has a block size of 4KB and block numbers are 32 bits. An inode contains 10 direct blocks, one single indirect block and one double indirect block.
- i) How many blocks (including index blocks) would a 20MB file use? *[2 marks]*
 - ii) What is the maximum possible size for a file? *[2 marks]*
- (d) What is a distributed file system? *[2 marks]*

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