

**MASSEY UNIVERSITY
ALBANY CAMPUS**

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

Semester Two – November 2009

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 Process Management? *[2 marks]*
- (b) What is a distributed Operating System? *[2 marks]*
- (c) Give three reasons for using concurrent programming. *[2 marks]*
- (d) What is the difference between logical memory and physical memory? *[2 marks]*
- (e) What is an interrupt handler? *[2 marks]*
-
2. (a) What is DMA? *[2 marks]*
- (b) What could the following code print when run under a UNIX OS?
- ```
for (i=0; i<3; i++) {
 j=fork()
 if (j==0)
 printf("%x", i);
 else
 printf(".");
 fflush(stdout);
}
```
- Would the output always be the same, why? *[4 marks]*
- (c) Briefly explain how a timer is used for process preemption. *[2 marks]*
- (d) One process is waiting on a semaphore and another process is signaling the same semaphore, what states are the two processes in? *[2 marks]*

3. (a) Draw a diagram to illustrate the expected distribution of burst times for a typical set of processes.

[2 marks]

(b) The following processes are to be scheduled

| <i>Process</i> | <i>Arrival Time(ms)</i> | <i>Burst Time(ms)</i> |
|----------------|-------------------------|-----------------------|
| P <sub>1</sub> | 0                       | 30                    |
| P <sub>2</sub> | 10                      | 20                    |
| P <sub>3</sub> | 20                      | 5                     |
| P <sub>4</sub> | 20                      | 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  $q=10$

Comment on your results.

[6 marks]

(c) Describe an algorithm that would give the worst possible average waiting time.

[2 marks]

4. (a) Give entry and exit code that could be used to protect a critical section using the **testandset** instruction.

[2 marks]

(b) What may happen if a semaphore that is used as a mutex is initialised to two instead of one?

[2 marks]

(c) What is "busy waiting" and why should it be avoided?

[2 marks]

(d) What is the 'load' of a system, how is it calculated?

[2 marks]

(e) What can Peterson's algorithm be used for?

[2 marks]

5. (a) An Italian restaurant employs three chefs, they share 1 frying pan, 3 saucepans and 1 knife.

Chef 1 needs to use 1 knife, and 1 frying pan.

Chef 2 needs to use 1 frying pan, and 2 saucepans.

Chef 3 needs to use 1 knife, 1 frying pan and 2 saucepans.

At a certain point in time:

Chef 1 is using 1 knife.

Chef 2 is using 1 saucepan.

Chef 3 is using 1 frying pan and 1 saucepan.

- i) Draw a resource allocation graph to illustrate the state of the system. (show future claims as dashed lines)
- ii) Draw a table to illustrate maximum, used, needed, and available resources in the system.
- iii) Use the bankers algorithm to find out if this system is in a safe state.
- iv) If it is in a safe state, give a safe sequence, if not, identify the resources involved in the resulting deadlock.

**[6 marks]**

- (b) What are monitors and what limitations of semaphores are they designed to remove?

Draw a diagram to illustrate what happens when a thread inside a monitor signals a waiting thread (also inside the monitor). State any assumptions you make.

**[4 marks]**

6. (a) Briefly explain the difference between static and dynamic linking.

*[3 marks]*

(b) The following sequence of requests for pages is made,

0,1,2,1,5,2,3,4,1,0,5,3,4,2,0,1,4

There are four 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) Draw diagram to illustrate a two level paging scheme.

*[2 marks]*

(d) What is the difference between internal and external fragmentation?

*[2 marks]*

7. (a) A machine uses 5 disks in a RAID 5 array. Each disk holds 750GB and can transfer data at 100MB/s. What is the capacity of the array and its peak read performance? *[2 marks]*
- (b) Describe a workload for which a RAID 5 array will perform badly. *[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 12 direct blocks, one single indirect block, one double indirect block and one triple indirect block.
- i) How many blocks (including index blocks) would a 100MB file use? *[2 marks]*
- ii) What is the maximum possible size for a file? *[2 marks]*
- (d) What main advantage does a logging file system have over a non-logging filesystem? *[2 marks]*

+ + + + + + + +