Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

GX 1508

Semester II Examinations, 2003/2004

Exam Code(s)	2BP
Exam(s)	Second Year Electronic and Computer Engineering
Module Code(s)	CT223
Module(s)	Operating Systems
Paper No.	1
Repeat Paper	
External Examiner(s)	Professor Paddy Nixon
Internal Examiner(s)	Professor G. Lyons
	Mr. P. Bigioi

Instructions:

Answer any 3 questions.
All questions will be marked equally.

Duration	2 hrs
No. of Answer Books	1
No. of Pages	3
Department(s)	Information Technology

Question 1

a) What are the possible states of a process? Draw the transition diagram and explain in detail the states and transitions.

10 MARKS

b) Describe the process scheduler organization and operation. Describe the cooperative and pre-emptive schedulers.

10 MARKS

c) Describe the process scheduling algorithms. Give a practical example for time slice (round robin) algorithm for a number of four processes and a time slice size of 500us. The switching time is 50 us. The processes have the following service times: $\tau(p1) = 2.2ms$, $\tau(p2) = 5ms$, $\tau(p3) = 1ms$, $\tau(p4) = 3.2ms$. Compute the average turn around time and average wait time.

15 MARKS

Question 2

a) Describe the typical operating system organization and describe each of the subsystems.

10 MARKS

b) Consider four processes (A, B, C and D) that are stored on disk and are about to be loaded in the main memory, in the following order: C, D, B and A. Process A has five pages, process B has three pages, process C has five pages and process D has five pages. Assume that the main memory has a size of 16 physical frames (numbered 0 through 15, see Figure 1), all the frames are available and that the operating system will swap out the smallest process to make more room in the main memory.

- ➢ Show how the main memory will look after each process is loaded into the main memory.
- ➢ Show each process page table after the process A has been loaded into the memory.

10 MARKS

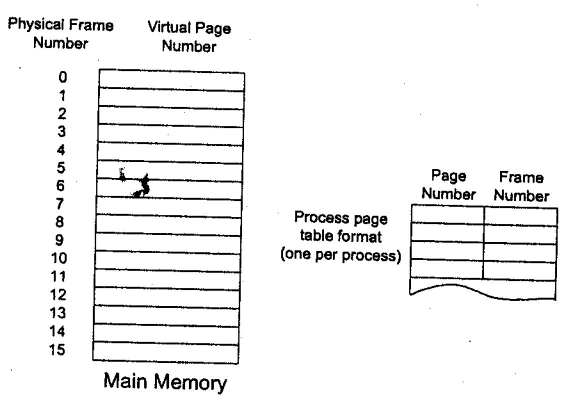

Figure 1: Initial Memory State and Process Page Table Format

c) Describe the I/O subsystem organization. Describe how direct I/O with polling is typically implemented. What is the main disadvantage of this approach? Explain why interrupt driven I/O is any better?

15 MARKS

Question 3

a) What is a critical section? Give examples of typical critical sections and describe briefly the methods to deal with critical sections.

10 MARKS

b) What are messages? What are the operating systems primitives to manipulate Messages? Describe the following design issues related to messages: synchronization, addressing and queuing discipline.

10 MARKS

c) Consider the code in Figure 2. What is the output of this program, under normal execution conditions (no errors)? Explain the output.

15 MARKS

```
#include <stdio.h>

main()
{
  int pid;
  int var = 1;

  pid = fork();

  if (pid < 0) { /* error occurred */
        fprintf(stderr, "Fork failed!\n");
        exit(-1);
  }
  else if (pid == 0) {
       /* child process */
       printf("Child: variable value is %d\n",var);
       var = 2;
       printf("I am the child, pid=%d\n", getpid());
       printf("Child: variable value is %d\n",var);
  }
  else {
       /* parent process */
       printf("I am the parent, pid=%d\n", getpid() );
       printf("Parent: variable value is %d\n",var);
       exit(0);
  }
}
```

Figure 2: Linux Program

Question 4

a) Describe how semaphores and messages could be used to solve the mutual exclusion problem.

10 MARKS

b) In the context of device management, describe interrupt driven I/O architecture.

10 MARKS

c) Describe briefly the segmented virtual memory and paged virtual memory, highlighting the advantages and disadvantages of each of them. In the context of virtual memory, describe briefly the fetch, placement and replacement policies.

15 MARKS