THE UNIVERSITY OF ADELAIDE
AUSTRALIA

Examination for the Degrees of

Bachelor of Computer Science, Master of Computer Science, Master of Software Engineering and Master of Computing and Innovation

The University of Adelaide

2nd Semester, 2011

Exam, November 2011

OPERATING SYSTEMS
COMP SCI 3004/7064

Official Reading Time:	10 mins
Writing Time:	120 mins
Total Duration:	130 mins

Questions	Time	Marks
Answer all **5** questions	120 mins	100 marks
		100 Total

Instructions

- Begin each answer on a new page
- Examination material must not be removed from the examination room
- Simple, Non-programmable Calculators Allowed

Materials

- 1 Blue book

DO NOT COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

QUESTION 1 (20 Marks)

Fill in all spaces after the bracketed numbers to complete the following statements. (1 mark for each space)

a. An operating system manages each type of resources in the computer system by performing the following three tasks:
(1) ,
allocating that resource, and
(2) .
Two primary goals of an operating system are to provide
(3) for the user, and
(4) of the computer system.
An important type of operating systems, (5)
operating system, provides (6)
that allows many users to use a computer system interactively at the same time.

b. A process is a program in (7) . A process may be in one of the following five states, defined in part by its current activity:
(8) , (9) , (10) ,
(11) , (12) .

c. Various resources (*objects*) in a computer system need to be protected from misuse. A general model of protection is (13) whose rows represent *domains*, columns represent (14) , and entries define (15) . A common method of protecting information transmitted over unreliable communication networks is (16) .

d. A computer has six identical tape drives, with n (> 1) processes competing for them. Each process may need two drives. The system is deadlock free when the values of n are
(17) ,
(18) ,
(19) .
When $n = 5$ the system is (20) .

QUESTION 2 (20 Marks)

Consider the following sets of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P_1	9	4
P_2	3	4
P_3	5	1
P_4	1	2
P_5	2	3

The process are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5, all at time 0. For each of the following scheduling algorithms, determine the *average turnaround time* and *average waiting time* respectively.

(1) First-Come-First-Served scheduling. (5 marks)

(2) Shortest-Job-First scheduling. (5 marks)

(3) Priority scheduling (a smaller priority number implies a higher priority). (5 marks)

(4) Round-Robin (quantum=1) scheduling. (5 marks)

QUESTION 3 (20 Marks)

Consider the following page reference string:

$$1, 2, 3, 2, 1, 4, 5, 3, 2, 1, 2, 3, 6, 7, 5, 6, 3, 2, 1, 2, 3, 6.$$

How many page faults would occur for each of the following replacement algorithms, assuming two, four, six, or seven frames available respectively. Note that all frames are initially empty, so your first unique pages will all cost one fault each.

a. FIFO replacement. (5 marks)

b. LRU replacement. (5 marks)

c. Second-chance replacement. (5 marks)

d. Optimal replacement. (5 marks)

QUESTION 4 **(20 Marks)**

An effective method to avoid deadlock is to ensure that any resource allocation will leave the system in a *safe* state, i.e., the circular waiting condition can never exist under the allocation. Briefly describe how this is achieved for the following systems:

a. systems with each resource type containing only one instance;
   (8 marks)

b. systems with at least one resource type containing multiple instances.
   (12 marks)

Note: You only need to give the general idea or steps, not a detailed algorithm.

QUESTION 5 (20 Marks)

The Barbershop Problem: A barber shop has three barbers, three barber chairs, and n chairs for waiting customers, if any, to sit in. If there are no customers present, a barber sits down in his barber chair and falls asleep. When a customer arrives, he has to wake up a barber. If additional customers arrive while all barbers are busy (cutting customer's hair), they either sit down (if there are empty chairs) or leave the shop (if all chairs are full). Write a program (pseudo code) to coordinate the barbers and customers.

[Hint: Use four semaphores — *customers* to count waiting customers, $barber[i]$ to indicate the status of the ith barber (0 for busy and 1 for idle), $0 \leq i \leq 2$. You may use as many *mutex* semephores as necessary for mutual exclusion, and variable *waiting* to record the number of waiting customers.]

End of exam