TEMASEK POLYTECHNIC

SCHOOL OF ENGINEERING

AY2013/2014 SEMESTRAL EXAMINATION

(Apr Semester)

COMPUTER ARCHITECTURE AND OPERATING SYSTEMS (ESE3009)
SUBJECT LEVEL : 3

TIME ALLOWED : 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. This paper consists of <u>4</u> pages (excluding the cover page).

2. This paper contains <u>4</u> questions, each worth 25 marks.

3. Answer <u>**ALL**</u> questions in the answer booklet.

4. Write your admission number on your answer booklet and any other separate sheets that you attach to your answer booklet.

SECTION A: Answer **ALL** questions in this section.

A1. a. In demand-paging, not all the pages of a process are loaded into the main memory.

    With the aid of a well-labeled diagram, list the sequence of events that will be triggered when the process attempts to access a page that has not been loaded into the main memory. [8 marks]

  b. Consider the following page-reference string:

    0, 4, 8, 2, 4, 5, 3, 1, 8, 3, 0, 1, 6, 3, 6

    Show how many page faults would occur for **FIFO** and **LRU** page replacement algorithms. Assume that four page frames are available. [10 marks]

  c. Consider a system using demand-paged memory with the following parameters:

- Memory access time = 100 ns
- Time taken to service a page fault if an empty frame is available or the replaced page is not modified = 8 ms
- Time taken to service a page fault if there is no empty frame or the replaced page is modified = 20 ms

    Assume that the page to be replaced is modified 70% of the time.

    Determine the worst-case page fault rate for an effective access time of no more than 200 ns. Show the complete working. [7 marks]

A2. a. Consider the following set of processes in **Table A2**.

Process	Arrival Time (ms)	Burst Time (ms)	Memory Request (MB)
P0	4	5	135
P1	5	1	150
P2	1	2	90
P3	7	2	40
P4	11	1	25
Assume that the context switch time is zero.			

Table A2

The memory is partitioned according to **Figure A2**.
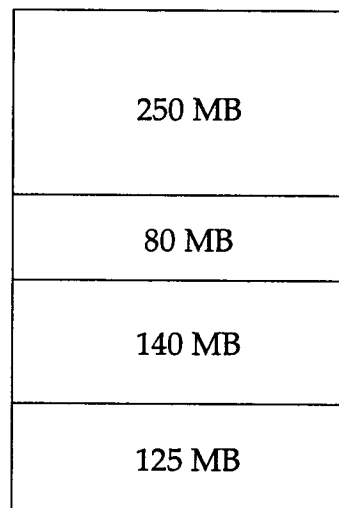

Figure A2

Using appropriate diagrams,

- show how the processes are scheduled using both **FCFS** and **Preemptive SJF** schedulers. Determine the average waiting time performance.
- Show how the processes are allocated with the memory space using **Best-Fit** algorithm. Determine the internal fragmentation and external fragmentation.

[18 marks]

b. Consider a system with three processes scheduled using the **Round-Robin** scheduler. The burst times of the three processes are 45ms, 70ms and 60ms. Assuming a time quantum of 20ms and CPU utilization rate of 80%, determine the context switch time. Show the complete working. [7 marks]

A3. a. A particular system has three processes (P_0, P_1 and P_2) and one instance of resources R_A and R_B each. Draw a possible resource allocation graph that illustrates the existence of deadlock in the system. [5 marks]

b. Consider a computer system that runs four processes ($P_0 - P_3$). The system has a total of 7 instances of resource R_0 and 8 instances of resource R_1. Assume that each process will stop processing and wait for the resource items to be allocated when the request is made. The maximum request and current allocation of the resources are shown in **Table A3-1**.

Process	Max		Allocation	
	R_0	R_1	R_0	R_1
P_0	6	4	2	3
P_1	3	3	1	2
P_2	4	1	2	0
P_3	2	2	0	1

Table A3-1

Using **Banker's algorithm**, determine if the system is able to serve the four processes successfully. Show the complete working. [15 marks]

c. Consider the following snapshot of a system shown in **Table A3-2**.

Process	Allocation				Need				Available			
	R_A	R_B	R_C	R_D	R_A	R_B	R_C	R_D	R_A	R_B	R_C	R_D
P_A	1	1	2	0	1	0	0	2	k	1	0	0
P_B	0	1	1	1	3	0	1	0				
P_C	1	1	1	1	1	1	0	0				

Table A3-2

Determine the minimum value of k such that the system is free from deadlock. Justify your answer with detailed explanation. [5 marks]

A4. a. Name the three types of scheduling queues. Explain the impact on the scheduling queues if the majority of the processes selected by the long-term scheduler are CPU-bound. [5 marks]

b. State an advantage and a disadvantage of recording the name of the creating program with the file attributes found in Macintosh OS. [4 marks]

c. With the aid of a well-labeled diagram, illustrate a **four-level tree structured directory**. With reference to a particular file in your diagram, state the absolute path and relative path of this file. [6 marks]

d. With the aid of a well-labeled diagram, explain how external fragmentation is an issue in contiguous disk allocation. [5 marks]

e. A Linux command was issued at the **caos** (located under root directory) directory and the following output was observed for the file called **temp**.

cr--r--rw-1 root 1314 2013-08-28 14:30 /proj

State the size of the file **temp**. Hence, write the command(s) to grant the file owner full access rights to the file, to allow the group of users to modify the file and to not allow other users to modify the file. [5 marks]

END OF PAPER