THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECX 5235 – OPERATING SYSTEMS

FINAL EXAMINATION – 2013 / 2014 **(CLOSE BOOK TYPE)**

Date: 22nd, August 2014 **Time: 0930-1230 hrs**

INSTRUCTIONS TO CANDIDATE:

- This paper consists of two (2) sections SECTION A and SECTION B in seven (7) pages.
- SECTION A has two (2) mandatory questions. Answer the two questions.
- SECTION B has six (6) questions, the total marks allocated to each question is equal. Answer any three (3) questions.
- Assume reasonable values or any suitable assumptions for any data not given in or if any doubt as to the interpretation of the wording of a question. Clearly state such assumptions made on the script.
- You are allowed to use scientific calculators during the exam.
- You are NOT allowed to use any study material or any other electronic resource during the examination.

SECTION A
Answer all questions in this section.

Question 1 (Marks: 30) Compulsory Question

a) What is the role of a boot loader? Name one boot loader which is used in Linux installation.

(Marks 4)

b) Graphically illustrate and briefly explain how a "Monolithic kernel" distinguishes from a "Microkernel". State at least one advantage and a disadvantage of Microkernel over Monolithic kernel.

(Marks 6)

c) What is the command that can be used to mount a USB drive detected as "/dev/sda1" under the directory "/media/usb"

(Marks 2)

d) What are the differences between a system call and an interrupt? Briefly describe how these differences become useful?

(Marks 8)

e) Explain the reasons to use the statements specified from (i) to (v) in the following C programming code snippet.

(Marks 10)

```
(i)=>   #include <dos.h>
        #include <conio.h>

        int initmouse();

(ii)=>  union REGS i, o;

        main()
        {
                int status;
                status = initmouse();

(iii)=>         if ( status == 0 )
                        printf("Mouse support not available.\n");
                else
                        printf("Mouse support available.\n");

                getch();
                return 0;
        }

        int initmouse()
        {
(iv)=>          i.x.ax = 0;
(v) =>  int86(0X33,&i,&o);
                return ( o.x.ax );
        }
```

Question 2 (Marks: 10) Compulsory Question

Write the most appropriate short answer (word / phrase) for the following questions in your answer script. It is NOT required to attach the exam paper.

1. The subsequent allocation of memory creates fragments of free memory between blocks of allocated memory. This causes a problem and it is called _____.

2. The problem of partial usage of fixed partitions and the coinciding creation of unused spaces within the partition is called _____.

3. _____ is a technique that allows the execution of processes which are not completely available in physical memory.

4. The _____ policy is a page replacement policy which chooses the page least recently accessed to be swapped out.

5. A job's _____ is the set of pages residing in memory that can be accessed directly without incurring a page fault and is used to improve the performance of demand paging schemes.

6. _____ contains the basic information about the job including what it is, where it's going, how much of its processing has been completed, where it's stored, and how much it has spent in using resources.

7. A job that requires a large number of input/output operations, resulting in much free time for the CPU is called _____ job.

8. The high-level scheduler of the processor manager that selects jobs from a queue of incoming jobs based on each job's characteristics is called _____.

9. _____ is a preemptive process scheduling policy that allocates the processor to the job closest to completion.

10. _____ is the result of conservative allocation of resources in which a single job is prevented from execution because it's kept waiting for resources that never become available.

(Marks 1 x 10)

SECTION B
Answer any three (3) questions in this section

Question 3 (Marks: 20)

a) Explain what is scheduling and why is it important? (2 marks)

b) Distinguish the tasks of a job scheduler and a process scheduler. How do they relate? (6 marks)

c) The following questions are based on the state transition of a process.

i. Draw a state transition of a process and name them. (4 marks)

ii. Explain how job scheduling and process scheduling get involved in each transition. (4 marks)

d) There are four processes A, B, C and D with execution times of 5ms, 6ms, 2ms and 4 ms respectively arrived at the same time in the order of A, B. C and D.

Calculate the **average execution time** and **average turnaround time** for each process, if the scheduling algorithm is round robin with a time quantum of 2ms. Processes will be prioritized based on the shortest remaining time and the context switching overhead is ignored. (4 marks)

Question 4 (Marks: 20)

Consider the following table where "P" indicates a process and "R" indicates a resource.

Time	Action
1	P1 requests R2, and R1 is allocated to P1
2	P2 requests R1
3	P2 requests R2
4	P3 requests R2
5	P3 requests R3, R3 and R4 are allocated to P3
6	P4 requests R3 and R4

a) Use Holt's deadlocks modeling method based resource allocation graph to analyze the above scenario. (Marks 4)

b) What are the conditions that need to be checked for identifying deadlocks? Describe them briefly. Is there a deadlock in the above system? Justify your answer. (Marks 10)

c) Describe race condition and starvation by giving appropriate examples. (Marks 6)

Question 5 (Marks: 20)

a) What is a page fault? Briefly explain the steps involved in handling a page fault.

(Marks 4)

b) Memory paging is a feature that permits extending the address space far beyond the available memory. [X] and [Y] denotes different addresses. Name the components given as [X], [Y] and [Z] in the following diagram *(Figure 1)* and describe how the extension of the address space happens.

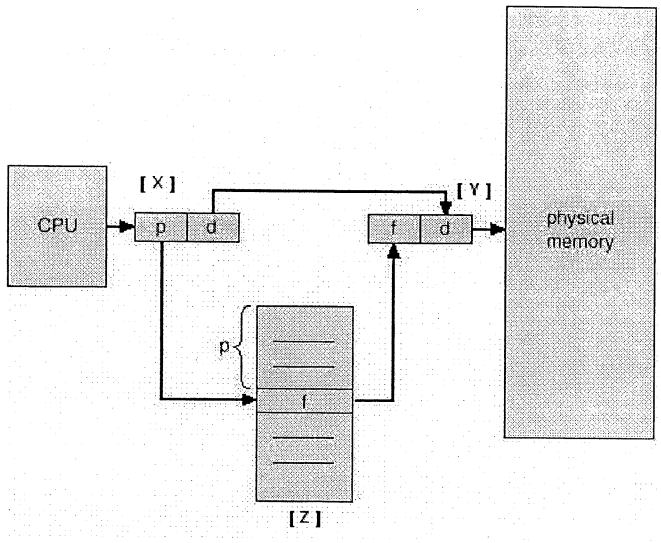

Figure 1: Memory Paging

(Marks 6)

c) Page size is one of the parameters of a virtual memory. State one advantage and one disadvantage of choosing a large page size rather than a small one.

(Marks 4)

d) The following diagram *(Figure 2)* depicts CPU utilization vs degree of multiprogramming. Focus on the regions shown by (A) and (B) and describe the reasons for such a behavior.

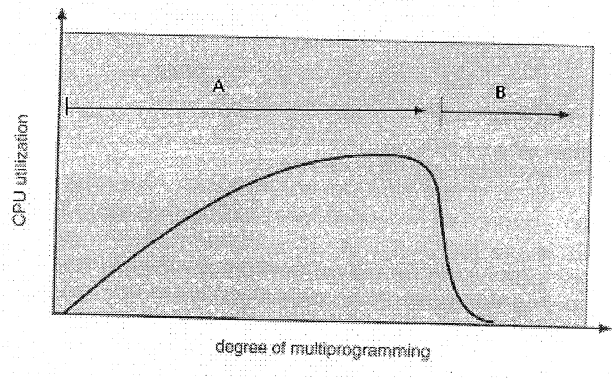

Figure 2: CPU Utilization vs Degree of multiprogramming

(Marks 6)

Question 6 (Marks: 20)

a) Explain the following;

i. Packet sniffer
ii. Packet filtering
iii. Social engineering
iv. Phishing

(Marks 4)

b) Acknowledging the need for privacy and the need for accessibility for a hospital information system, you have been asked to discuss about the possible threats and the controlling mechanisms with the hospital management. State if you make any assumptions when you answer the following questions.

i. State **four** possible threats you would encounter in the setup and explain them briefly.
ii. Briefly explain **two** possible ways to control the identified threats.

(Marks 12)

c) What is a Denial-Of-Services (DOS) attack? Explain an example of such a DOS attack.

(Marks 4)

Question 7 (Marks: 20)

BSD UNIX uses a multiple level feedback queue approach with 32 run queues. System processes use run queues 0 through 7 and processes executing in user space are placed in run queues 8 through 31. The dispatcher selects a process from the high-priority run queue whenever it allocates the CPU. Within a queue, BSD UNIX uses Round Robin scheduling. Therefore only processes in the highest priority run queue can execute. Time quantum varies among implementations, but all are less than 100 microseconds.

i. Explain what are a run queue and a multiple level feedback queue? (4 marks)

ii. Why is it important to distinguish user space and kernel space? (4 marks)

iii. What is the responsibility of a dispatcher? (2 marks)

iv. State one advantage and one disadvantage of having a short term time quantum? (4 marks)

v. "Multiple level feedback queue approach in BSD UNIX benefits interactive jobs". Do you agree on the above statement? Justify your answer. (6 marks)

Question 8 (Marks: 20)

Answer the following questions using the given memory configuration in *figure 1*. State if you make any assumptions.

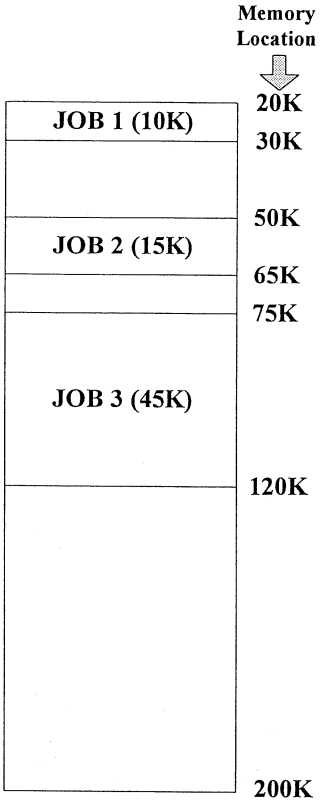

Figure 3: Memory configuration

a) At this point, JOB 4 arrives requesting a block of 100K. Can JOB4 be accommodated? Why or why not?

(Marks 2)

b) If relocation is used, what are the contents of the relocation registers for JOB 1, JOB 2 and JOB 3 after recompaction?

(Marks 6)

c) What are the contents of the relocation register for JOB 4 after it has been loaded into memory?

(Marks 4)

d) The instruction ADD A, 10 is part of JOB 1 and was originally loaded into memory location 22K. What is its new location after compaction?

(Marks 8)