The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX5335 Operating Systems**
Academic Year	: 2021/2022
Date	: 08th of March 2023
Time	: 1330 – 1630hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.

2. This question paper consists of **Eight (8)** questions on **Five (5)** pages.

3. Answer **any five (5)** questions given. All questions carry equal marks.

5. Answer for each question should commence from a new page.

6. This is a Closed Book Test (**CBT**).

7. Answers should be in clear handwriting.

8. Do not use red colour pens.

Question 1

i.) List what needs to be considered to allocate or deallocate memory in a dynamic partition memory allocation system. [06 marks]

ii.) Write an algorithm in pseudo-code to allocate and deallocate memory blocks for a dynamic partition memory allocation system considering the list you have given above. [06 marks]

iii.) Draw a flowchart to implement the working of the virtual memory with segmentation. [08 marks]

Question 2

i.) Briefly explain what makes preemptive and non-preemptive scheduling different. [04 marks]

ii.) Consider three processes, P1, P2 and P3, each arriving at time zero and taking 10, 20, and 30 units to complete as total execution time, correspondingly. Each process dedicates the first 20% of its execution time doing I/O, the next 70% to computation, and the final 10% doing I/O. The operating system schedules a new process either when the running process gets blocked on I/O or when the running process completes its computation burst using a Shortest Remaining Time First (SRTF) scheduling method. Assume that there is a maximum amount of overlap between all I/O activities.

a) Draw a Gantt chart that illustrates the execution of these processes. State all your assumptions. [04 marks]

b) Calculate the percentage of the time CPU remains idle. [04 marks]

iii.) Consider the three processes with the following arrival and burst times:

Process No.	Arrival Time	Priority	Burst Time		
			CPU Burst	I/O Burst	CPU Burst
P1	0	2	1	5	3
P2	2	3	3	3	1
P3	3	1	2	3	1

a) Draw a Gantt chart that illustrates the execution of these processes. State all your assumptions. [04 marks]

b) Calculate the average wait and turnaround times if the CPU scheduling policy is Priority Scheduling (A lower number in the priority column means higher priority). [04 marks]

Question 3

i.) A process's simplified internal layout is shown in Figure 3.1 below. Give a brief description of what each section contains. **[04 marks]**

```
┌─────────────┐
│ Stack       │
├─────────────┤
│      ↑      │
│      ↓      │
├─────────────┤
│ Heap        │
├─────────────┤
│ Data        │
├─────────────┤
│ Text        │
└─────────────┘
```
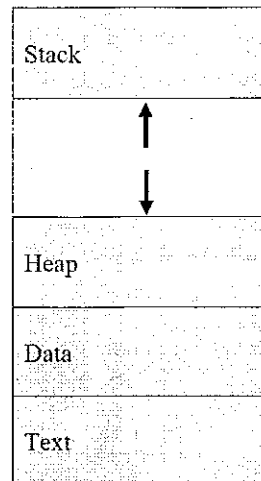
Figure 3.1: A process's simplified internal layout in main memory

ii.) Briefly describe the states of a process referring to the provided "Process state diagram" shown in Figure 3.2, **[06 marks]**
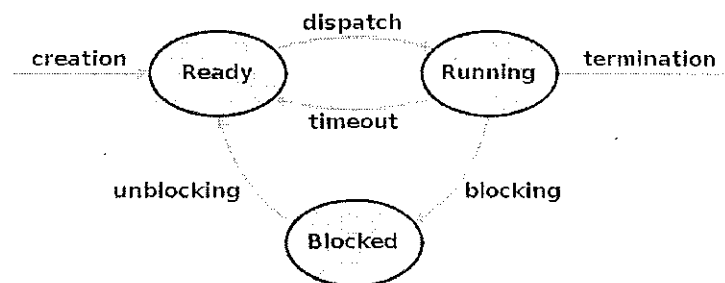

Figure 3.2: Process state diagram

iii.) Differentiate a "Thread Control Block (TCB)" from a "Process Control Block (PCB)". **[04 marks]**

iv.) Briefly explain whether the performance of a multithreaded solution with many user-level threads outperforms a single-thread solution. **[06 marks]**

Question 4

Consider the scenario in the table below, where "P" indicates a process and "R" indicates a resource.

Time	Action
1	P3 requests and is allocated R4
2	P1 requests and is allocated R2
3	P4 requests R2
4	P2 requests and is allocated R3
5	P2 requests and is allocated R1
6	P4 requests and is allocated R5
7	P3 requests R3
8	P3 releases R4
9	P2 releases R3, which is allocated to P3
10	P1 requests R5
11	P4 requests R1
12	P2 requests and is allocated R4
13	P2 releases R1 and it is allocated to P4
14	P1 releases R2 and it is allocated to P4
15	P4 releases R5 and it is allocated to P1

i.) Use Holt's deadlocks modelling method to analyze the above scenario. Indicate the types of deadlocks that have arisen in the system. How long were they effective? **[10 marks]**

ii.) Write an algorithm using a pseudo-code to implement the deadlock detection for the above system having five resources. You may assume that the number of processes allowed in this system will be at most five processes. **[10 marks]**

Question 5

i.) Explain the virtual devices briefly and give practical examples. **[06 marks]**

ii.) What is referred to as device handler seek strategies? Why are they used? Explain four of them briefly. **[14 marks]**

Question 6

i.) What is the advantage of having different time-quantum sizes on different levels of a multilevel queuing system? [04 marks]

ii.) Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O bound tasks issue an I/O operation once for every two milliseconds of CPU computing and that each I/O operation takes 20 milliseconds to complete. Also, assume that the context switching overhead is 0.1 milliseconds and that all processes are long-running tasks. Calculate the CPU utilization for a round-robin scheduler when:

    a) The time quantum is one millisecond [05 marks]

    b) The time quantum is ten milliseconds [05 marks]

iii.) Suppose that a scheduling algorithm favours the processes that have used the least processor time in the past. Why will this algorithm prefer I/O-bound programs yet not permanently starve CPU-bound programs? State all the assumptions. [06 marks]

Question 7

i.) Assume you are to write a file manager for your computer. State the requirements for your file manager. State all your assumptions clearly. [06 marks]

ii.) Assume you have been given the task of finding a data compression method for data stored in the examination division of a campus. A data entry contains the following information:

- Student's full name
- Student's registration number (similar to your registration number in OU)
- Courses followed (use the same course codes as used in OU)
- Marks obtained (in numerical form)

Suggest a suitable data compression method. Explain how the system will distinguish between compressed and direct data. Give an example of how it works. State all your assumptions clearly. [06 marks]

iii.) Write a pseudo-code program of the file manager's part that handles the one-level Indexed Storage Allocation method. Remember that it should be able to retrieve files (completely) as well as store them. Assume that the memory organization used is unblocked, fixed-length records. [08 marks]

Question 8

Figure 08 shows the memory configuration. At this point, Job 4 arrives, requesting a block of 60K.

Operating System	10K
Job 1(10K)	20K
Job 2 (15K)	35K
	50K
	60K
Job 3 (45K)	
	80K
	150K

i.) Can Job 4 be accommodated? Justify your answer. **[06 marks]**

ii.) If reallocation is used, what are the contents of the relocation registers for Job 1, Job 2, and Job 3 after compaction? **[04 marks]**

iii.) State the content of the relocation register for Job 4 after it has been loaded into memory. **[04 marks]**

iv.) The instruction MUL 4, NUMBER is part of Job 2 and was originally loaded into memory location 55K. What is its new location after compaction? **[06 marks]**

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