ZCAS University

CCS2301 - OPERATING SYSTEM CONCEPTS
END OF SEMESTER EXAMINATION

30th MAY 2024

16:30 HRS - 19:30HRS

TIME ALLOWED: **WRITING – THREE HOURS**

READING – 5 MINUTES

INSTRUCTIONS:

1. Section A: this question is **compulsory** and must be attempted.
2. Sections B: Answer **THREE (3)** questions from this section.
3. This examination paper carries a total of **100 marks**.
4. Numbering of your answers in your booklet should be the same as that in the question paper. Answers that are not numbered will **NOT be marked**.
5. Candidates must **not turn this page** until the invigilator tells them to do so.

SECTION A: Question 1 is compulsory and must be attempted.

Question 1

There are various algorithms which are used by the Operating System to schedule the processes on the processor in an efficient way. A Process Scheduler schedules different processes to be assigned to the CPU based on a particular scheduling algorithm. The following are some of the popular process scheduling algorithms:

- First-Come, First-Served (FCFS) Scheduling,
- Shortest-Job-Next (SJN) Scheduling,
- Shortest Remaining Time First (SRTF) Scheduling,
- Round Robin (RR) Scheduling.

Given the Process IDs, the Arrival Time, and the Burst Time for each of the five (5) processes, you are required to determine the Completion Time, the Turn Around Time and the Waiting Time for each process using the specified scheduling algorithm.

Note: *For each table, you simply copy each of the following four (4) tables (Table 1 to Table 4) into your answer booklet, clearly state the algorithm being used and fill in the 15 missing figures in each table. A table with figures but without a stated algorithm will NOT be marked.*

i) **a)** Use the First-Come, First-Served (FCFS) Scheduling Algorithm to determine and fill in the 15 missing figures in the table below.

Process ID	Arrival Time	Burst Time	Completion Time	Turn Around Time	Waiting Time
P1	0	4			
P2	1	2			
P3	3	7			
P4	6	1			
P5	7	3			

Table 1

b) Calculate the Average Waiting Time.

c) First-Come, First-Served (FCFS) is a non-preemptive scheduling algorithm [True / False]

(10 Marks)

ii) a) Use the Shortest-Job-Next (SJN) Scheduling Algorithm to determine and fill in the 15 missing figures in the table below.

Process ID	Arrival Time	Burst Time	Completion Time	Turn Around Time	Waiting Time
P1	0	4			
P2	1	2			
P3	3	7			
P4	6	1			
P5	7	3			

Table 2

b) Calculate the Average Waiting Time.

c) Shortest-Job-Next (SJN) is a non-preemptive scheduling algorithm [True / False]

(10 Marks)

iii) a) Use the Shortest Remaining Time First (SRTF) Scheduling Algorithm to determine and fill in the 15 missing figures in the table below.

Process ID	Arrival Time	Burst Time	Completion Time	Turn Around Time	Waiting Time
P1	0	4			
P2	1	2			
P3	3	7			
P4	6	1			
P5	7	3			

Table 3

b) Calculate the Average Waiting Time.

c) Shortest Remaining Time First (SRTF) is a non-preemptive scheduling algorithm [True / False]

(10 Marks)

iv) a) Use the Round Robin (RR) Scheduling Algorithm to determine and fill in the 15 missing figures in the table below [Time Quantum = 3 Units]

Process ID	Arrival Time	Burst Time	Completion Time	Turn Around Time	Waiting Time
P1	0	4			
P2	1	2			
P3	3	7			
P4	6	1			
P5	7	3			

Table 4

b) Calculate the Average Waiting Time.

c) Round Robin (RR) is a non-preemptive scheduling algorithm [True / False]

(10 Marks)

(Total: 40 Marks)

Question 2

Memory management is the functionality of an operating system which handles or manages primary memory. It moves processes back and forth between main memory and hard disk (HDD or SSD) during execution. This is normally referred to as "Swapping".

i) The total time taken by swapping a process includes the time it takes to move the entire process from memory to a secondary disk and then to copy the process back to memory. Let us assume that the standard hard disk where swapping will take place has a data transfer rate of around 1,024KB per second. How much time in seconds would a 8,192KB user process take to be swapped from the main memory to this standard hard disk and back to main memory? [You should clearly show your working] **(4 Marks)**

ii) Explain the concept of Internal Fragmentation in memory management and state any ONE strategy that could be used to reduce Internal Fragmentation. **(4 Marks)**

iii) Explain the concepts of External Fragmentation in memory management and state any ONE strategy that could be used to reduce External Fragmentation. **(4 Marks)**

iv) Compare and contrast Paging and Segmentation memory management techniques, highlighting their key differences in terms of implementation and memory organization. **(4 Marks)**

v) Define Demand Paging and discuss how it improves memory management efficiency in operating systems. **(4 Marks)**

(Total: 20 Marks)

Question 3

The following are some of the common Operating System Concepts and / or Terminologies that are associated with memory management. You are required to provide a brief description of each concept / terminology stated:

i) Process Control Block (PCB)
ii) Multiprogramming
iii) Symmetric Multiprocessing
iv) Asymmetric Multiprocessing
v) Multithreading
vi) Swapping
vii) Context Switching
viii) Short Term Scheduler
ix) Medium Term Scheduler
x) Long Term Scheduler

(Total: 20 Marks)

Question 4

A process is defined as an entity which represents the basic unit of work to be implemented in the system. To put it in simple terms, we write our computer programs in a text file and when we execute this program, it becomes a process which performs all the tasks mentioned in the program.

i) When a program is loaded into the memory and it becomes a process, it is usually divided into four sections — stack, heap, data and text. You are required to provide brief notes to explain each of the four (4) stated sections. **(12 Marks)**

ii) Compare and contrast the following operating system concept terminology pairs, highlighting the key differences between each pair:

a) Program Vs Process **(4 Marks)**

b) Process Vs Thread **(4 Marks)**

(Total: 20 Marks)

Question 5

The diagram below (Figure 1) is a summary of a Process Life Cycle. It indicates some common states that a process may find itself during its execution. Using the diagram or otherwise, you are required to answer the following questions:

i) Which hardware device in the computer system do you expect to find "New" processes before they convert to the "Ready" State? **(2 Marks)**

ii) Which hardware device in the computer system do you expect to find processes that are in the "Ready" State? **(2 Marks)**

iii) Which hardware device in a computer system do you expect to find processes that are in the "Running" State? **(2 Marks)**

iv) Which hardware device in a computer system do you expect to find processes that are in the "Suspend Ready" State? **(2 Marks)**

v) Which hardware device in a computer system do you expect to find processes that are in the "Waiting" State? **(2 Marks)**

vi) State the event(s) that may result in a process being moved from the "Running" State to the "Waiting" State? **(2 Marks)**

vii) State the event(s) that may result in a process being moved from the "Waiting" State to the "Suspend Wait" State? **(2 Marks)**

viii) State the event(s) that may result in a process being moved from the "Waiting" State to the "Ready" State? **(2 Marks)**

ix) State the event(s) that may result in a process being moved from the "Ready" State to the "Suspend Ready" State? **(2 Marks)**

x) State the event(s) that may result in a process being moved from the "Suspend Ready" State to the "Ready" State? **(2 Marks)**

(Total: 20 Marks)

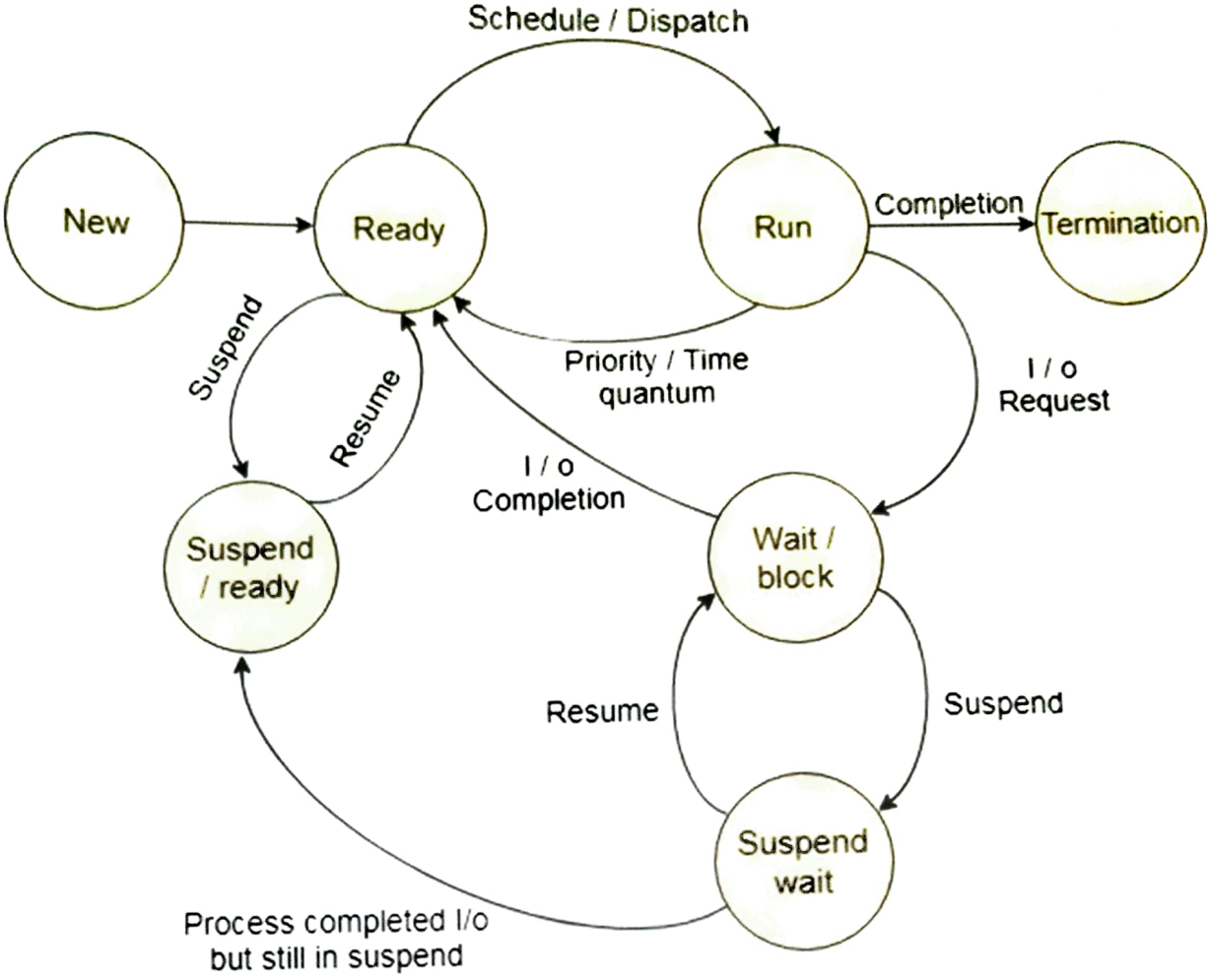

Figure 1

END OF EXAMINATION