United International University
Department of Computer Science and Engineering
CSE 4509/CSI 309: Operating System Concepts/Operating Systems
Mid-term Examination: Spring 2023
Total Marks: 30 Time: 1 hour and 45 minutes
Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Answer all of the 3 questions. Numbers to the right of the questions denote their marks.

1 (a) Look at the memory configurations in Figure-1. Two processes with lengths 5 and 2 arrive consecutively. Show the memory configuration after the arrival of each process with the following strategies: **[2+2]**

i. First fit.

ii. Best fit.

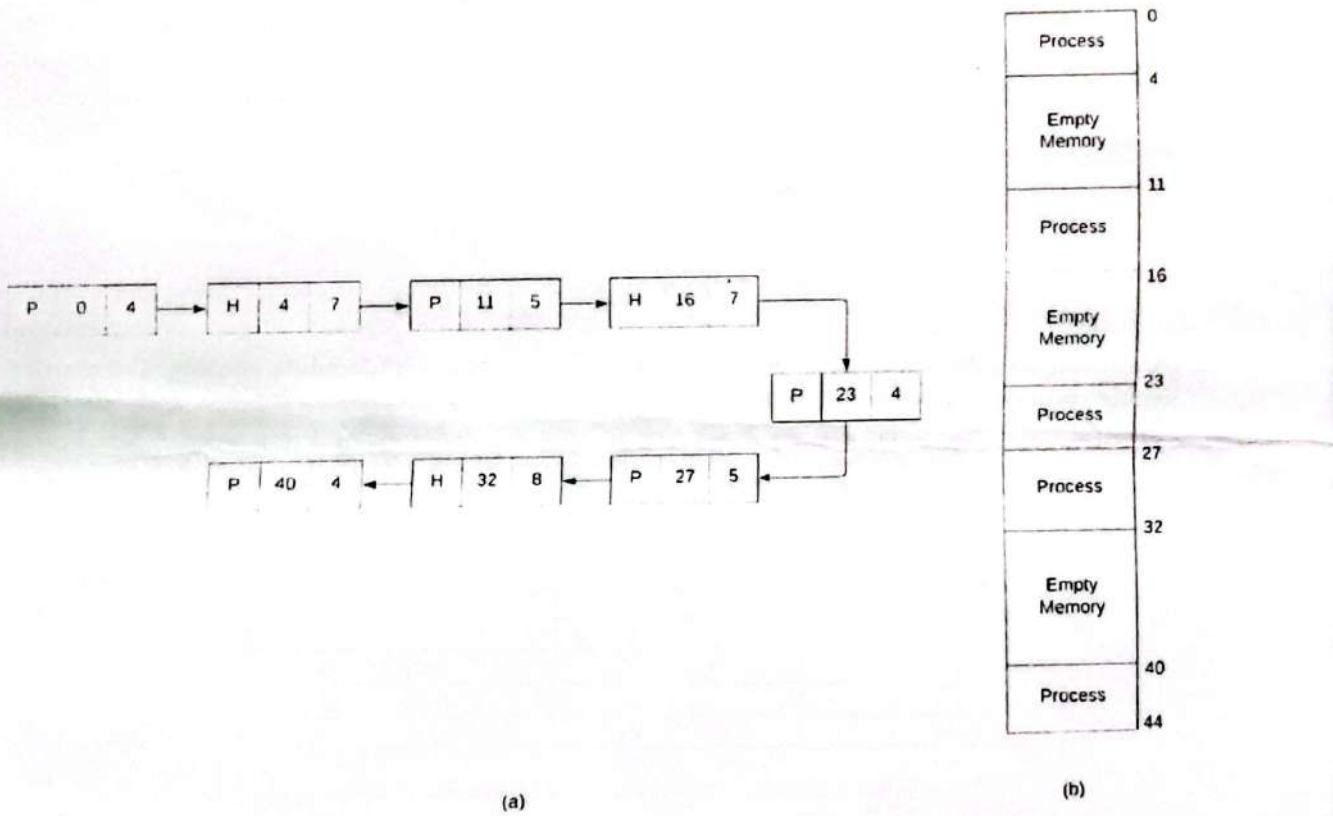


Figure 1: Memory Diagram for Question-1a

[Note that the both diagrams(a and b) in Figure-1 represent the same idea. Use whichever you are familiar with/comfortable with.]

(b) Suppose, a system has a virtual memory of size 4GB and supports pages of size 16KB. The physical address space of that system is 1GB. The system uses 3-level paging where each level has twice as many entries as the previous one **[2+1]**

i. Find the number of entries in each level.

ii. Calculate the size of the Level-1 page table.

(c) Suppose, a system uses TLB while calculating physical address from logical address. The size of virtual memory is 64KB and physical memory is 32 KB. Page size is 4KB. Find the physical address for the virtual address 0xAF50. TLB and page table for this translation is shown in figure-2. Show the translation process with a diagram. **[3]**

Page Number	Frame Number
1011	010
1001	001
0010	000
1000	100

(a) TLB

	Frame	v
15	111	1
	110	1
	100	0
	010	0
	010	1
	011	1
	001	1
	100	1
	110	0
	000	0
	001	0
	111	0
	010	0
	000	1
	010	0
0	101	1

(b) Page Table

Figure 2: Diagrams for Question-1b

[Note that you do not have to draw the entire page table or TLB while showing the process. A smaller representative version of each of the tables is enough.]

2. Consider the set of 4 processes whose arrival time and burst time are given in the table-1. CPU follows the round-robin algorithm with a time slice of 2. **[2+3+2+3]**

Process	Arrival Time	Burst Time		
		CPU Burst	I/O Burst	CPU Burst
P1	0	3	1	1
P2	1	2	0	0
P3	4	5	3	2
P4	4	1	2	1

Table 1: Process with Arrival Time and Burst Time

(a) Draw the Gantt Chart.

(b) Compute the average response time.

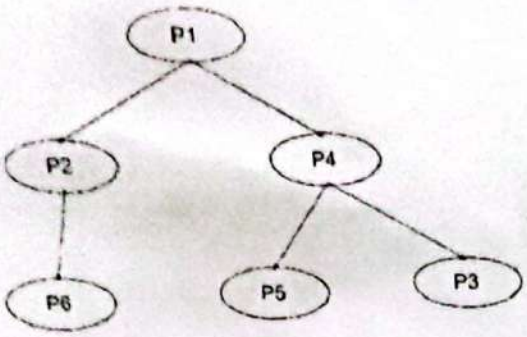
(c) If context switching takes 1.5 milliseconds, calculate the total overhead of context switching.

(d) "Shortest Remaining Time First always gives the optimal average waiting time over Round Robin" – Justify the statement.

[Note that Shortest Remaining Time First algorithm is also known as Shortest Remaining Time Next.]

3. (a) Draw an abstract view of the computer system and identify the goals of an operating system in such a computer system. **[2+1]**

(b) Figure-3a represents a typical process tree in a Linux-based operating system. Here the termination of process P4 is unknown to the system. On the contrary, process P1 is notified of process P2's termination. The table in figure-3b displays the arrival and termination times of each of the processes. Determine the zombie and orphan processes and provide proper reasoning for your answer. **[4]**



(a) A tree of processes on a typical Linux system

Process	Arrival Time	Termination Time
P1	0	7
P2	1	4
P3	2	5
P4	1	4
P5	2	6
P6	3	5

(b) entry and exit time of each process

Figure 3: Figure for Question-3b

(c) In a classical Producer-Consumer problem, we usually set a bound on the maximum size of the buffer. What will happen if we remove this bound on the maximum size? Explain. [3]