



Sri Lanka Institute of Information Technology

B.Sc. Special Honours Degree/Diploma  
in  
Information Technology

Final Examination  
Year 2, Semester I (2024)

IT2060 – Operating System and System  
Administration

Duration: 2 Hours

June 2024

Instructions to Candidates:

- ◆ This paper contains 5 pages including the cover page.
- ◆ This paper has 4 questions with a total of 100 marks.
- ◆ Students will be given 10 minutes additional reading time.
- ◆ Answer all questions in the booklet given.
- ◆ Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

## Question 1 **(25 Marks)**

- a) Briefly define what a deadlock is. (2 marks)
- b) List the three methods for deadlock handling. (3 marks)
- c) What is the graph/ algorithm used for deadlock avoidance in resources with single instances? (2 marks)
- d) Consider the Resource Allocation Graph given in figure 1 and answer the questions. (10 marks)

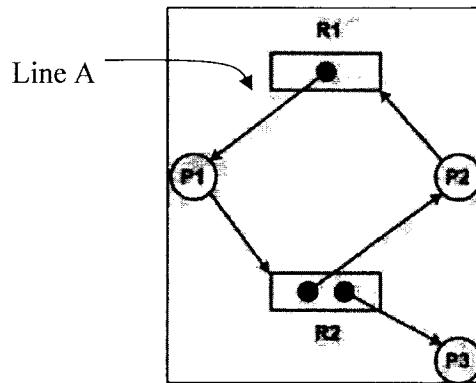


Figure 1

- i. What is the name given for Line A?
- ii. Is there any deadlock available? Justify your answer.
- iii. Draw the wait for graph based on the above figure.
- iv. Determining the availability of deadlocks in this graph if another process named P4 requests a resource from R2. *(Note: Your answer must include a picture of the new resource allocation graph and the steps of determining the deadlocks)*
- e) Consider a system comprised of four processes P1 through P4. There are 8 resource instances of the resource type R1. Answer the questions given below. (8 marks)

Table 1

Process	Allocation	Max Need	Available	Current Need
P1	1	2	2	
P2	X	4		
P3	1	3		
P4	1	2		

- i. Compute X, the number of resources allocated to P2.
- ii. Complete the current need column. *(Note: You must draw the above table in your booklet and fill the current need column)*
- iii. Is this system safe from deadlocks? *(Note: Draw the table and illustrate all the steps of your work)*

## Question 2 (25 Marks)

- a) Briefly define the term Critical section of a program. (2 marks)
- b) List the three solutions for critical section problems. (3 marks)
- c) Consider the pseudocodes of the process  $P_i$  and  $P_j$  given in figure 2 and answer the questions. (10 marks)

<b><math>P_i</math></b>	<b><math>P_j</math></b>
<b>While <math>i \geq 10</math></b> $i = i / 2$ $x = i \% 2$	<b>While <math>i \geq 10</math></b> $i = i * 2$ $y = i \% 2$

Figure 2

- i. Identify the critical sections of  $P_i$  and  $P_j$  respectively.
- ii. "Process  $P_i$  and  $P_j$  are facing the critical section problem". Briefly explain this statement.
- iii. Modify the process  $P_i$  and  $P_j$  by adding semaphore variable name 'S' to solve the critical section problem.
- d) What are spinlocks? What is the main disadvantage of spinlocks. (4 marks)
- e) Give two examples for the incorrect use of semaphore in a process. (2 marks)
- f) Consider the semaphore list given in figure 3 and the processes named P1 and P2 which are blocked in the semaphore list. Answer the following questions. (4 marks)

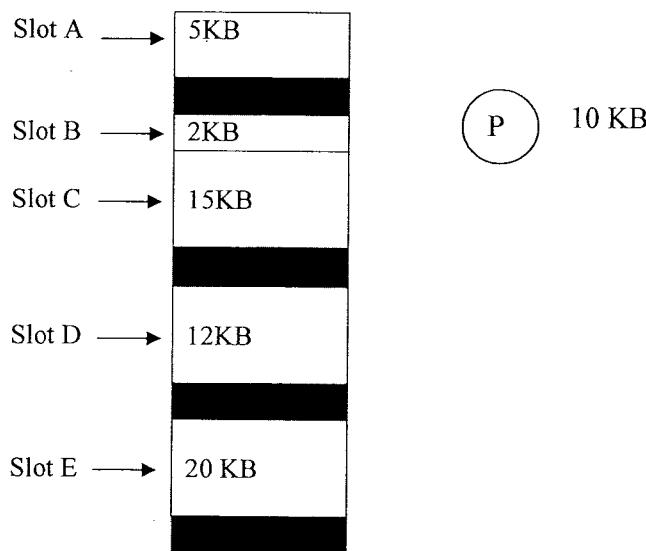
P1	P2		
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Figure 3

- i. How many processes are executing their critical sections now?
- ii. If the semaphore named *Mutex* is used in the above implementation, determine the current value of *Mutex* variable.

**Question 3****(25 Marks)**

- a) Briefly define the following. (4 marks)
- Internal fragmentation
  - External fragmentation
- b) Consider the diagram of the RAM given in figure 4. The free memory slots are indicated using their capacities. According to the figure, identify the first-fit, best-fit, and the worst-fit allocation for process P which is 10 KB in capacity. (6 marks)

*Figure 4*

- c) In a computer system the capacity of the RAM is 2 GB and the capacity of the virtual memory is 4 GB. The system uses a simple paging system, and the page size is 2 KB. (15 marks)

- Calculate the number of bits used in the physical address.
- Calculate the number of bits used in the logical address.
- Calculate the number of pages that are available in the RAM.
- Calculate the capacity of a frame.
- What is the purpose of having a page table in the system?
- Where is the page table store in the system?
- Calculate the effective memory access time for a system which a TLB is using. The time taken to access the TLB is 30ns, the percentage of entries that can be resolved is 99% and 80ns for memory access.

## Question 4 (25 Marks)

- a) Virtual memory is a technique that allows the execution of processes that are not completely in memory. Consider the memory diagram given in figure 5 and answer the following questions. (4 marks)

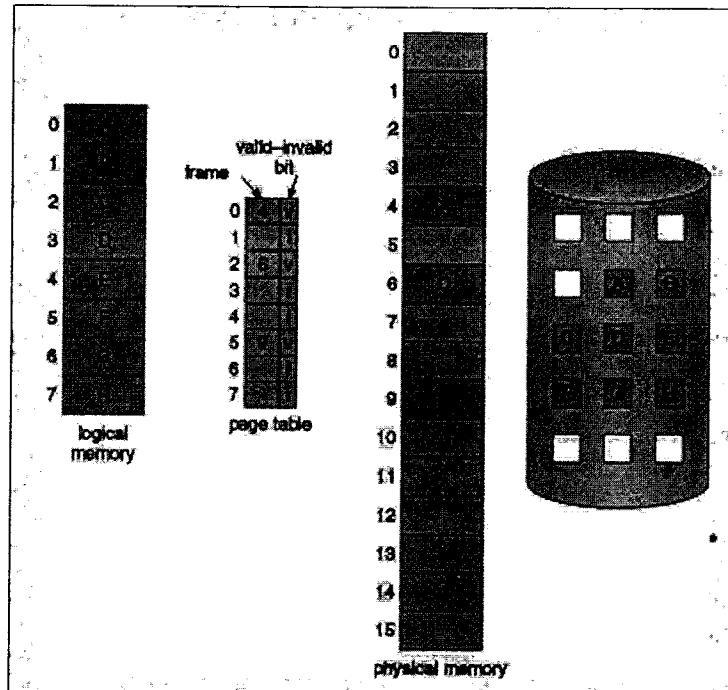


Figure 5

- i. What is the purpose of having a column for valid- invalid bit in the page table?
- ii. What is a page fault?
- b) Consider the page reference sequence given below and calculate the number of page faults occur using Least Recently Used algorithm. Assume that there are three frames available, and they are initially empty. (9 marks)

Page reference sequence: 0,3,1,4,2,0,3,0,1,4,2,3,0,3,2,4,1,2,0

- c) In a disk drive, Disk requests are generated for cylinders 12, 7, 10, 15, 18, 20, 2, and 19, in the order. It takes 10 msec for a cylinder movement. Assuming that the arm head is initially at cylinder 14 (the previous request was at cylinder 20) for a disk with 25 cylinders (1 to 25). How much seek time is needed for the following algorithms? (Note: You must draw the diagram and illustrate the calculation.)

(12 marks)

- i. SCAN
- ii. LOOK
- iii. FCFS

\*\*\* End of Paper \*\*\*