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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR FIRST YEAR, FIRST SEMESTER EXAMINATION FOR THE CERTIFICATE IN INFORMATION TECHNOLOGY <u>CIT 1004 OPERATING SYSTEMS</u>

Date: 12TH AUGUST 2024 Time: 8:30AM – 10:30AM

<u>INSTRUCTIONS TO CANDIDATES</u> <u>ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS</u> <u>QUESTION ONE (30 MARKS</u>)

TechSol is a technology company specializing in developing cutting-edge operating systems. The company's latest OS, TechSol OS, aims to provide enhanced performance, efficiency, and user experience. The development team is focused on optimizing various aspects of the operating system, including thread and process management, memory management, and process scheduling.

Background:

Threads and Processes: TechSol OS uses both processes and threads to manage tasks. Understanding the relationship between these two concepts is crucial for optimizing performance.

Waiting Time: Minimizing waiting time for processes is essential to improve overall system efficiency.

Time-Sharing OS: The development team is evaluating the benefits and drawbacks of using a time-sharing operating system.

Types of Operating Systems: It is important to distinguish between different types of operating systems to choose the most suitable one for various use cases.

Context Switching: Efficient context switching is vital for maintaining system responsiveness during process scheduling.

Multiprogramming: Implementing multiprogramming can significantly enhance the performance and resource utilization of TechSol OS.

External Fragmentation: Managing memory fragmentation is a critical aspect of memory management in the operating system.

Swapping: Swapping plays a significant role in memory management, and understanding its impact can help in optimizing system performance.

<u>Required:</u>

- a) Discuss the relationship between threads and processes in the context of TechSol OS. (4 Marks)
- **b**) Define waiting time and explain its significance in process scheduling for TechSol OS. (2 Marks)
- c) Identify and explain two advantages and two disadvantages of using a time-sharing operating system for TechSol OS. (4 Marks)
- **d**) Differentiate between the following types of operating systems as applicable to TechSol OS:

(4 Marks)

- i) Multi-user vs Single-user
- ii) Multi-tasking vs Single-tasking

e) Explain the concept of a context switch in process scheduling and its importance for TechSol OS.

(4 Marks)

- f) List and explain four advantages of implementing multiprogramming in TechSol OS. (4 Marks)
- g) Define external fragmentation and suggest a possible solution to this issue in both contiguous and non-contiguous memory allocation for TechSol OS. (4 Marks)
- h) Describe the concept of swapping in memory management and explain its role in TechSol OS. (4 Marks)

QUESTION TWO (20 MARKS)

- a) Deadlock prevention is accomplished by preventing any of the Coffman conditions from occurring.
 Briefly explain how the three conditions can be prevented. (6 Marks)
- **b**) Discuss the three requirements that a solution to a critical section problem must satisfy.(6 Marks)
- c) Discuss the four conditions necessary for a deadlock to occur. (8 Marks)

QUESTION THREE (20 MARKS)

OptiSys OS is a sophisticated operating system designed to efficiently manage system resources and ensure optimal performance. To achieve this, the development team at OptiSys is focusing on refining the scheduling mechanisms and memory management strategies. The system utilizes various schedulers and memory management techniques to handle multiple processes and tasks effectively.

Required;

- a) In the context of OptiSys OS, compare and contrast the roles and functions of the Long-Term Scheduler, Short-Term Scheduler, and Medium-Term Scheduler. (10 Marks)
- **b**) Define the following terms as they apply to OptiSys OS:

i)	Multitasking	(2 Marks)
ii)	Multiprogramming	(2 Marks)
iii)	Operating System	(2 Marks)
iv)	Paging	(2 Marks)
V)	Fragmentation in Memory	(2 Marks)

QUESTION FOUR (20 MARKS)

NovaOS is a newly developed operating system designed to cater to various computing environments, from personal desktops to large-scale networked systems. To optimize performance and user experience, the NovaOS development team is focusing on understanding the effects of different multitasking approaches and evaluating the advantages and disadvantages of various operating system types.

Multitasking: NovaOS can utilize both pre-emptive and non-pre-emptive multitasking, each impacting system performance differently from the user's perspective.

Operating System Types: The team is also exploring different types of operating systems—Batch, Time Sharing, Distributed, Network, and Real-Time—to determine the most suitable implementations for different use cases.

<u>Required;</u>

- a) In the context of NovaOS, explain the meaning of the following terms and describe their effect on the performance of the computer from the user's view:
 - i) Pre-emptive multitasking (3 M
 - ii) Non-pre-emptive multitasking

(3 Marks)

(3 Marks)

b)	Discuss the advantages and disadvantages of the following types of operating systems as they apply
	to NovaOS:

	to NovaUS:				
	i)	Batch Operating System	(3 Marks)		
	ii)	Time Sharing Operating System	(3 Marks)		
	iii)	Distributed Operating System	(3 Marks)		
	iv)	Network Operating System	(3 Marks)		
	V)	Real-Time Operating System	(2 Marks)		
QUE	ESTION	N FIVE (20 MARKS)			
a)	Defi	ne a process in the context of operating systems.	(2 Marks)		
b)	Desc	ribe the following process scheduling algorithms:	(8 Marks)		
	i)	First-Come, First-Served (FCFS)			
	ii)	Shortest Job Next (SJN)			
	iii)	Priority Scheduling			
	iv)	Round Robin (RR)			
	V)	Multilevel Queue Scheduling			
c)	Diffe	erentiate between paging and segmentation in memory management.	(6 Marks)		
d)	Explain the following methods for handling deadlocks: (4				
	i)	Deadlock Prevention			

- Deadlock Avoidance ii)
- Deadlock Detection and Recovery Combined Approach
- iii) iv)