U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

Branch: Artificial Intelligence & Machine Learning **Duration: 3 hrs.**

Course Code: 24AM4ESOPS **Max Marks: 100**

Course: Operating Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Analyze and justify the following scenarios that can be mapped to a type of operating system i. Processing salaries for thousands of employees once per month. ii. Multiple students logged in simultaneously to a central server, compiling code or running simulations. iii. weather forecasting center running climate models on multiple CPUs. iv. Detect collision and deploy airbags within milliseconds. v. Managing temperature, touch screen UI, and Wi-Fi connectivity.	*CO1*	*PO1*	**10**
	b)		Distinguish among Long term, Short term and Medium-term schedulers.	*CO1*	*PO1*	**06**
	c)		Signify the importance of user and kernel space.	*CO1*	*PO1*	**04**
			OR			
2	a)		Microsoft develops a text editor that automatically saves documents to the disk when the save button is pressed. Illustrate different system calls used in this scenario.	*CO2*	*PO2*	**07**
	b)		Model the classical process state transition diagram as a finite state machine, formally specifying all valid transitions between process states.	*CO2*	*PO2*	**06**
	c)		Compare and Contrast Threads and Process.	*CO1*	*PO1*	**07**
			UNIT - II			
3	a)		"Apple" company in Cupertino, USA owns a production line where various machines manufacture iPhone components, and multiple technicians assemble these components into finished iPhones. Illustrate how the producer-consumer problem can be used to manage synchronization in this scenario.	*CO2*	*PO2*	**10**
	b)		Consider the following set of process with length of the CPU burst time given in milliseconds:	*CO3*	*PO3*	**10**

			<table><tr><th>Process</th><th>Arrival Time</th><th>Burst Time</th></tr><tr><td>P1</td><td>0</td><td>9</td></tr><tr><td>P2</td><td>0</td><td>2</td></tr><tr><td>P3</td><td>4</td><td>1</td></tr><tr><td>P4</td><td>4</td><td>2</td></tr><tr><td>P5</td><td>8</td><td>4</td></tr><tr><td>P6</td><td>10</td><td>6</td></tr></table> i. Draw a Gantt chart illustrating the execution of these processes using First Come First Serve (FCFS) and non – preemptive Shortest Job First (SJF) CPU scheduling. ii. Calculate the average turnaround time and average wait time for the above scheduling algorithms. iii. Find the throughput for each scheduling algorithms.			
			OR			
4	a)	Consider the following set of processes with length of the CPU burst time given in milliseconds: <table><tr><th>Process</th><th>Arrival Time</th><th>Burst Time</th></tr><tr><td>P1</td><td>0</td><td>8</td></tr><tr><td>P2</td><td>1</td><td>3</td></tr><tr><td>P3</td><td>3</td><td>2</td></tr><tr><td>P4</td><td>4</td><td>3</td></tr><tr><td>P5</td><td>7</td><td>5</td></tr><tr><td>P6</td><td>9</td><td>7</td></tr></table> i. Draw a Gantt chart illustrating the execution of these processes using Round Robin scheduling with time quantum 2 milliseconds. ii. Apply Shortest Remaining Time First (SRTF) to demonstrate the execution of process. iii. Calculate the average turnaround time, average wait time and throughput for the above scheduling algorithms.	*CO3*	*PO3*	**10**
	b)	A company has a shared database where multiple users can read and write data. Describe how the readers-writers problem can be used to achieve synchronization.	*CO2*	*PO2*	**10**
		UNIT - III			
5	a)	Prove that segmentation inherently suffers from external fragmentation whereas paging produces internal fragmentation, using suitable models of memory allocation.	*CO2*	*PO2*	**06**
	b)	Critically assess the relevance of traditional demand paging techniques in non-volatile memory systems, proposing necessary architectural modifications.	*CO2*	*PO2*	**04**
	c)	Consider the following page reference string: 7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1. Assuming demand paging with three frames, calculate the number of page faults, page hits, probability of page fault and probability of page hits for each of the following page replacement algorithms. i. First in First Out (FIFO) replacement. ii. Optimal Replacement.	*CO3*	*PO3*	**10**

<table>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>Analyze how the choice of page table structure in early UNIX systems influenced subsequent Operating System’s designs.</td><td>CO2</td><td>PO2</td><td>06</td></tr>
<tr><td></td><td></td><td>b)</td><td>Justify why swapping operation is the best process in memory management.</td><td>CO2</td><td>PO2</td><td>04</td></tr>
<tr><td></td><td></td><td>c)</td><td>Consider a system using a page reference string 5, 0, 1, 0, 2, 3, 0, 2, 4, 3, 3, 2, 0, 2, 1, 2, 7, 0, 1, 1, 0 with three frames in memory. Calculate the total number of page faults and number of hits for the following algorithms:
i. FIFO (First-In-First-Out) Page Replacement
ii. LRU (Least Recently Used) Page Replacement
Which algorithm results in fewer page faults for this scenario?</td><td>CO3</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Outline the sufficient and necessary conditions that lead to deadlock situations in the context of resource sharing among processes.</td><td>CO2</td><td>PO2</td><td>04</td></tr>
<tr><td></td><td></td><td>b)</td><td>Illustrate on how the electromechanical components of a hard disk drive work synergistically to achieve data storage and retrieval.</td><td>CO2</td><td>PO2</td><td>06</td></tr>
<tr><td></td><td></td><td>c)</td><td>Consider a system with the following processes and three resources of type A, B and C. The resource allocation state at time T is as follows:
<table>
<tr><th rowspan="2">Process</th><th colspan="3">Allocation</th><th colspan="3">Max Need</th><th colspan="3">Available</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>A</th><th>B</th><th>C</th><th>A</th><th>B</th><th>C</th></tr>
<tr><td>P0</td><td>1</td><td>0</td><td>1</td><td>4</td><td>2</td><td>3</td><td>1</td><td>2</td><td>1</td></tr>
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</table>
Apply the Banker’s algorithm to answer the following questions.
i. What is the content of matrix NEED?
ii. Justify whether the system is in the safe state? If no what are the changes required in available resources to make system safe?</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Consider a system with seven processes, A though G, and six resources, R through W. The state of which resources are currently owned and which ones are currently being requested is as follows:
1. Process A holds R and wants S.
2. Process B holds nothing but wants T.
3. Process C holds nothing but wants S.
4. Process D holds U and wants S and T.
5. Process E holds T and wants V.
6. Process F holds W and wants S.</td><td>CO2</td><td>PO2</td><td>06</td></tr>
</table>

			7. Process G holds V and wants U. Draw a Resource Allocation Graph (RAG) and analyze whether a deadlock is present. Justify your conclusion.			
		b)	Describe methods for preventing deadlocks in resource allocation. How do these techniques ensure system safety?	*CO2*	*PO2*	**06**
		c)	On a disk with 200 cylinders (0-199), compute the number of tracks the disk arm must move to satisfy all the requests in the disk queue. Assume the last request was serviced at track 100 and head is moving towards track 0. The queue contains requests for the following tracks: 23, 89, 132, 42, 187, 60. Perform the computations for the following disk scheduling algorithms and draw the corresponding graph: i. Shortest Seek Time First (SSTF) ii. LOOK	*CO2*	*PO2*	**08**
			UNIT - V			
	9	a)	Outline key file operations in operating systems and assess the role of Access Control Lists in permission management. Explain each with an example.	*CO1*	*PO1*	**10**
		b)	VMware is developing a new AI-based operating system designed to support various types of file systems seamlessly. The experts have decided to implement a Virtual File System (VFS) layer. Highlight the importance of this decision and elucidate how the VFS works.	*CO1*	*PO1*	**10**
			OR			
	10	a)	Analyze the architectural considerations involved in selecting directory implementation methods for large-scale file systems, citing relevant examples from contemporary Operating System's designs.	*CO1*	*PO1*	**10**
		b)	From a system's design perspective, when would contiguous allocation be preferable to indexed allocation of disk space? Justify your answer with theoretical and practical considerations.	*CO1*	*PO1*	**10**

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