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: 22AM4PCOPS **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.

<table>
<tr><th></th><th></th><th>UNIT - I</th><th>CO</th><th>PO</th><th>Marks</th></tr>
<tr><td>1</td><td>a)</td><td>State the two main functions of an operating system. “The Operating System is resource manager.” Justify the statement.</td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td>b)</td><td>What are System Calls? Write any two process System Calls. Also give an example for each.</td><td>CO1</td><td>PO2</td><td>8</td></tr>
<tr><td></td><td>c)</td><td>Define Threads. Illustrate multithreading with an example.</td><td>CO2</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>a)</td><td>Explain the following operating system concepts:
i. The Shell
ii. Address space</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td>b)</td><td>Describe the various states a process using a state transition diagram.</td><td>CO1</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td>c)</td><td>Explain the roles and interactions between kernel and user mode in an operating system with a neat sketch.</td><td>CO2</td><td>PO1</td><td>7</td></tr>
<tr><td></td><td></td><td>UNIT - II</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>a)</td><td>Define Mutual Exclusion and Critical Region. Illustrate the Peterson’s solution for achieving mutual exclusion.</td><td>CO2</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Consider the following data about processes.
<table>
<tr><th>Process</th><th>Arrival time</th><th>Burst time</th></tr>
<tr><td>P_0</td><td>0</td><td>6</td></tr>
<tr><td>P_1</td><td>1</td><td>3</td></tr>
<tr><td>P_2</td><td>2</td><td>1</td></tr>
<tr><td>P_3</td><td>3</td><td>4</td></tr>
</table>
Draw Gantt Chart and calculate waiting time and turnaround time for the following scheduling algorithms:
i. Shortest Job First
ii. Shortest Remaining Time First</td><td>CO3</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td></td><td>4</td><td>a)</td><td>Consider the following set of 5 processes, with the length of the CPU-burst time given in milliseconds:
<table>
<tr><th>Process</th><th>Burst Time</th><th>Priority</th></tr>
<tr><td>P1</td><td>10</td><td>3</td></tr>
<tr><td>P2</td><td>1</td><td>1</td></tr>
<tr><td>P3</td><td>2</td><td>3</td></tr>
<tr><td>P4</td><td>1</td><td>4</td></tr>
<tr><td>P5</td><td>5</td><td>2</td></tr>
</table>
The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0.
i. Draw Gantt charts illustrating the execution of these processes using a priority (a smaller priority number implies a higher priority), and Round Robin (quantum= 1) scheduling algorithms.
ii. Calculate the average turnaround time and average waiting for each of the scheduling algorithms?</td><td>CO3</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>With a code snippet, illustrate the Readers and Writers problem with its solution.</td><td>CO2</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Memory abstraction provided by Operating System overcomes the drawbacks of exposing physical memory to processes. Explain briefly the notion of an address space.</td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Illustrate the concept of Paging with proper hardware support page implementation.</td><td>CO2</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Discuss the working principle of Working Set page replacement algorithm. Apply the Working Set page replacement algorithm for a given page reference string:
2,6,1,5,7,7,7,5,1,6,2,3,4,1,2,3,4,4,4 with window size(W)=5.
Calculate the number of page faults, page hits, hit ratio, and miss ratio.</td><td>CO3</td><td>PO3</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>6</td><td>a)</td><td>Consider the given reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6 with 3-page frames. Apply FIFO and LRU page replacement algorithms to find the following:
i. Total number of page faults
ii. Page hits
iii. Page fault probability
iv. Page fault percentage.</td><td>CO3</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Illustrate the mechanism of the optimal page replacement algorithm with an example.</td><td>CO3</td><td>PO3</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Describe the process of Segmentation with a neat diagram.</td><td>CO2</td><td>PO1</td><td>5</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>A disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143. The queue of pending requests in FIFO order is 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130. Starting from current head position, what is a total</td><td>CO3</td><td>PO4</td><td>10</td></tr>
</table>

			distance travelled (in cylinders) that the Disk arm to satisfy the requests using FCFS, SSTF, SCAN, LOOK and C-LOOK algorithms?			
		b)	Assume we have a hard disk with the following characteristics: i) Number of platters: 2 ii) Number of surfaces per platter: 2 (upper and lower) iii) Number of tracks per surface: 200 iv) Number of sectors per track: 50 v) Size of each sector: 512 bytes Find the disk size in terms of KB, MB, and GB?	*CO3*	*PO4*	**5**
		c)	If the blocks are allocated to the file in such a way that all the logical blocks of the file get the contiguous physical block in the hard disk. With an example, illustrate the advantages and disadvantages of contiguous allocation.	*CO1*	*PO2*	**5**
			OR			
	8	a)	In a disk with 1000 cylinders (0-999), 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 756 and head is moving towards track 0. The queue contains requests for the following tracks: 811, 348, 153, 968, 407, 500. Perform the computations for the following disk scheduling algorithms and draw the corresponding graph. i. SSTF ii. SCAN	*CO2*	*PO2*	**6**
		b)	Explain contiguous and linked disk space allocation methods with diagram.	*CO1*	*PO1*	**7**
		c)	Illustrate on different components of disk architecture and highlight the importance of disk formatting in Operating Systems.	*CO2*	*PO3*	**7**
			UNIT - V			
	9	a)	How a resource allocation graph is used to describe deadlocks? Explain with an example.	*CO3*	*PO1*	**5**
		b)	i. Define deadlock. Explain briefly the necessary conditions for the deadlock to occur. ii. Consider the system that has 5 processes P_0 through P_4; 3 resource types: *A* (10 instances), *B* (5instances), and *C* (7 instances) Snapshot at time T_0: (see table below) Calculate the content of Need Matrix. If process P1 makes a request $\boldsymbol{P_1}$ **(1,0,2)** , can it be allocated ?	*CO3*	*PO3*	**10**

Process	Allocation	Max	Available
	A B C	A B C	A B C
P_0	0 1 0	7 5 3	3 3 2
P_1	2 0 0	3 2 2	
P_2	3 0 2	9 0 2	
P_3	2 1 1	2 2 2	
P_4	0 0 2	4 3 3	

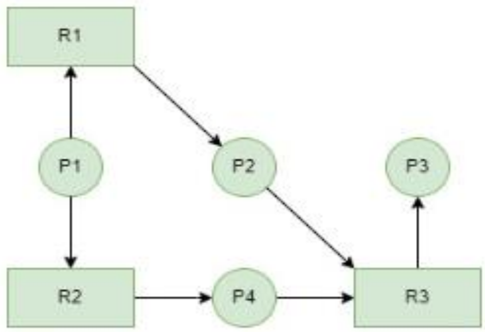
		c)	A Shared-memory multiprocessor is a computer system in which two or more CPUs share full access to a common RAM. Illustrate Master – Slave multiprocessors with an example.	*CO2*	*PO1*	**5**
			OR			
	10	a)	Consider the following snapshot of a system:	*CO3*	*PO3*	**9**

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	2	0	0	1	4	2	1	2	3	3	2	1
P1	3	1	2	1	5	2	5	2				
P2	2	1	0	3	2	3	1	6				
P3	1	3	1	2	1	4	2	4				
P4	1	4	3	2	3	6	6	5				

Apply Banker's algorithm to find the following:

i) Is the system being safe? If so, give the safe sequence.
ii) If process P2 requests (0, 1, 1, 3) resources can it be granted immediately?

		b)	i. For the given Resource Allocation Graph, write the wait-for-graph. ii. Justify whether there is any deadlock occurrence.	*CO2*	*PO2*	**5**



		c)	Illustrate any two multiprocessor operating system types.	*CO1*	*PO1*	**6**

******