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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: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 23CS4PCOPS **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)	List out the key services provided by an operating system, and how do they support both user applications and system operations?	*CO1*	*PO1*	**10**
	b)	Analyze the system calls listed below, categorize them, and specify their respective categories. load, close, execute, open, send and receive message, get device attributes, get time or date.	*CO2*	*PO2*	**5**
	c)	Analyze each of the following transitions between process states, indicate whether the transition is possible. If it is possible, give an example of one thing that would cause it. (i) Run---to---Ready (ii) Run---to---Blocked (iii) Run---to---wait (iv) Blocked---to---Run (v) Run---to---Terminated.	*CO2*	*PO2*	**5**
		OR			
2	a)	Explain the process by which an operating system transitions from user mode to kernel mode. Illustrate your explanation with a neat and well-labeled diagram.	*CO1*	*PO1*	**10**
	b)	Compare and assess various inter-process communication (IPC) techniques—such as message passing, shared memory, and pipes—with respect to their performance, scalability, and ease of implementation.	*CO2*	*PO2*	**5**
	c)	Demonstrate with a C program how the UNIX operating system uses the fork() system call to create a new process and the exec() system call to assign it the task of listing files. Include appropriate messages indicating the success or failure of child process creation and execution.	*CO2*	*PO2*	**5**

UNIT - II

3 a) *CO2* *PO2* **10**

Construct Gantt charts to illustrate the execution of the given processes using FCFS and non-preemptive SJF scheduling algorithms.
Calculate the Turnaround Time (TAT) and Waiting Time (WT) for each process in both cases.
Identify the time at which the Ready Queue contains the maximum number of processes in each scheduling method.

process	Arrival-time	Burst-time
P1	0	10
P2	0	1
P3	3	2
P4	5	1
P5	10	5

b) *CO1* *PO1* **10**

Discuss the different multithreading models used in operating systems. Highlight the pros and cons of each model, and suggest practical use cases where each model can be effectively applied.

OR

4 a) *CO3* *PO3* **10**

Consider the following set of processes with Arrival Time, Burst Time and Priority given in milliseconds. Create a Gantt Chart where a lower number indicates a higher priority. Calculate the Average Waiting Time, Turnaround Time (TAT), and Response Time (RT) for the processes. Compare these metrics using both priority preemptive and non-preemptive scheduling.

Process	**Arrival Time**	**Burst Time**	**Priority**
P1	0	3	5
P2	2	2	3
P3	3	5	2
P4	4	4	4
P5	6	1	1

b) *CO3* *PO3* **10**

Write a C program to implement the First Come First Serve (FCFS) scheduling algorithm. Calculate and display the average Turnaround Time and average Waiting Time for the given set of processes.

UNIT - III

5 a) *CO2* *PO2* **10**

Considering a system with five processes P_0 through P_4 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time t_0 following snapshot of the system has been taken:

process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	3	3	2
P1	2	0	0	3	2	2			
P2	3	0	2	9	0	2			
P3	2	1	1	2	2	2			
P4	0	0	2	4	3	3			

(i) What will be the content of the Need matrix?

(ii) Is the system in a safe state? If Yes, then what is the safe sequence?

(iii) What will happen if process P_1 requests one additional instance of resource type A and two instances of resource type C, whether the request can be immediately granted, is the system in a safe state if yes, then what is the safe sequence?

b) Write a code to demonstrate the Bounded Buffer Problem. Explain how semaphores are used to achieve synchronization between the producer and consumer processes. — *CO2* | *PO2* | **10**

OR

6 a) Apply Banker's algorithm for the following and find out whether the system is in safe state or not. — ***CO2*** | ***PO2*** | **10**

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	4	0	0	1	6	0	1	2				
P1	1	1	0	0	2	7	5	0				
P2	1	2	5	4	2	3	5	6	3	2	1	1
P3	0	6	3	3	1	6	5	3				
P4	0	2	1	2	1	6	5	6				

b) Imagine you are developing a hospital management system using multithreaded programming. The system maintains a shared digital patient record database. — ***CO1*** | ***PO1*** | **10**

Doctors (readers) frequently access patient records to review medical history or lab results.

Administrators (writers) occasionally need exclusive access to update patient information, such as adding new records or modifying existing ones.

Your task is to ensure:

- **Multiple doctors can read** the database concurrently without interference.
- **Administrators must have exclusive access** while updating records—no doctor or other administrator should access the database during this time.

Write a code snippet to demonstrate the Reader-Writer synchronization problem using semaphores.

			UNIT - IV			
	7	a)	Given memory partitions of sizes 150K, 600K, 350K, 275K, 125K, and 450K, apply the First Fit, Best Fit, and Worst Fit memory allocation strategies to allocate memory for process requests of 300K, 210K, 470K, and 160K. Compare the results and determine which allocation strategy makes the most efficient use of memory.	*CO2*	*PO2*	**10**
		b)	Analyze the role of hardware support in memory management through the use of relocation and limit registers. Using a neat diagram, demonstrate how these registers work together to ensure secure and efficient process execution.	*CO2*	*PO2*	**10**
			OR			
	8	a)	Illustrate the sequence of steps involved in handling a page fault in a demand paging system. Support your explanation with a neat and well-labeled diagram.	*CO2*	*PO2*	**10**
		b)	Given the following sequence of memory block accesses: 3, 5, 2, 8, 5, 2, 9, 1, 5, 1, 6, 3 — and assuming an associative cache with four lines — calculate the cache hit ratio using each of the following replacement policies: Least Recently Used (LRU), Least Frequently Used (LFU), and First-In First-Out (FIFO).	*CO2*	*PO2*	**10**
			UNIT - V			
	9	a)	Consider a disk with 200 cylinders numbered from 0 to 199. The current position of the read/write head is at cylinder 50, and the queue of pending requests consists of the following cylinders: 82, 170, 43, 140, 24, 16, and 190. Calculate the total distance (in cylinders) traveled by the disk arm to fulfill these requests using the following scheduling algorithms: FCFS, SSTF, LOOK, and SCAN. Illustrate the process with appropriate graphs for each algorithm.	*CO2*	*PO2*	**10**
		b)	Analyze the differences between Acyclic-Graph Directories and Tree-Structured Directories in operating system storage management. Evaluate the benefits, drawbacks, and appropriate use cases for each type of directory structure.	*CO2*	*PO2*	**10**
			OR			
	10	a)	Explain the different file allocation methods.	***CO1***	***PO1***	**10**
		b)	Explain access matrix method of system protection with domain as objects and its importance.	***CO1***	***PO1***	**10**

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