


VIT

Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BCSE303L - Operating Systems

Class NBR(s): 0589/1313/1315/1316/1318/1320/1322/

1325/1329/1332/1336/1338/1340/1345/1348/1352/

1356/1361/1364/2374

Slot: C1+TC1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
CO2	Design scheduling algorithms to compute and compare various scheduling criteria.
CO3	Apply and analyze communication between inter process and synchronization techniques
CO4	Implement page replacement algorithms, memory management problems and segmentation.
CO5	Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
Answer ALL Questions
(10 X 10 = 100 Marks)

1.
 - a) A team is developing a new operating system. Identify and explain five critical design issues they must consider. Briefly describe each issue and explain its relevance to operating system functionality. [6] CO1 BL2
 - b) Differentiate among multiprogramming, multiprocessing, and time-sharing operating systems, with emphasis on how they execute multiple tasks and utilize CPU resources. [4]

2. A university's online examination system employs multiple processes and threads to manage student logins, question delivery, and real-time monitoring. During peak usage, the system encounters performance bottlenecks and occasional instability. In this context, explain how processes and threads differ in terms of memory usage, execution context, and communication overhead. Describe the typical states a process transitions through during its lifecycle and also explain how the Process Control Block (PCB) supports this management. CO1 BL3

3.

Consider the following set of processes, with their CPU burst times given in milliseconds. Draw the Gantt chart for the execution of these processes using (i) Shortest Remaining Time First (SRTF) and (ii) Non-preemptive Priority Scheduling. For each method, calculate the average waiting time, average turnaround time, response time, and the total number of context switches.

CO2 BL3

Process no	Arrival Time	Burst Time	Priority (Lower number=High priority)
P1	0	8	5
P2	1	4	2
P3	2	2	4
P4	3	1	1
P5	4	3	2
P6	5	2	6

4.

Consider the following snapshot of the resource allocation table for processes P0 to P4 and resource types A, B, C, and D. The total number of instances available for each resource type is:

CO2 BL4

A = 10, B = 13, C = 9, D = 12.

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

Answer the following:

- Calculate the content of the Available matrix?
- Construct the Need matrix for all processes.
- Determine whether the system is currently in a safe state. If so, provide a valid safe sequence of process execution.
- If process P1 requests additional resources in the form (1, 1, 0, 1), evaluate whether this request can be safely granted. Justify your answer with appropriate reasoning and calculations.

5. a) Provide the pseudocode for the Test-and-Set (TSL) atomic hardware instruction, assuming a shared boolean lock variable initialized to false. Evaluate the protocol for synchronizing concurrent processes. Identify and justify the key conditions required to ensure safe and fair access to the critical section. If any condition is not adequately met, propose and briefly describe a suitable alternative synchronization approach. [8] CO3 BL3
- b) The following two processes P1 and P2 that share a variable C with an initial value of 3 execute concurrently? [2]

P1()	P2()
{	{
B=C-1;	D= 2*C;
C=2*B;	C=D-2;
}	}

The number of distinct values that C can possibly take after the execution? (Note: Show the execution process step by step).

6. In a hospital's Electronic Medical Records (EMR) system, doctors and nurses frequently access patient records to review medical history, lab results, and treatment plans, while medical administrators and specialists occasionally update these records with new diagnoses, prescriptions, or discharge summaries. CO3 BL3
- To ensure patient safety and data consistency, the system must allow multiple healthcare professionals to read records concurrently, while enforcing exclusive access for writers during updates. No reader should access a record while it is being modified, and no writer should update a record while another writer is active.
- Using semaphore-based design, explain a synchronization solution that enables concurrent reading, enforces mutual exclusion for writing, and prevents race conditions. Additionally, discuss how your approach handles fairness and potential starvation between readers and writers.
7. a) Consider a machine with 32 bit logical address, 4KB page size and page table entries of 4 bytes each. Find the size of the page table in bytes. Assume the memory is byte addressable. [4] CO4 BL4
- b) Analyze the various page table structures implemented in memory management. Illustrate each structure with a neat diagram and discuss their respective advantages and limitations. [6]

8. Consider the reference string: 1, 2, 3, 4, 2, 1, 5, 7, 2, 1, 2, 3, 6, 7, 3, 2, 1, 2, 3, 7. How many page faults and page fault rate occur for the FIFO, LRU and optimal page replacement algorithms, assuming four page frames? CO4 BL4

9.a) Discuss the concept of virtualization and explain its significance in modern computing environments. Compare Type 1 and Type 2 hypervisors in terms of architecture, performance, security and use case with neat diagrams. CO5 BL2

OR

9.b) Explain about free space management with example. Illustrate the functions of file and file implementation methods. CO5 BL2

10.a) Explain the concept of the Access Matrix in operating systems and its role in enforcing system protection. Illustrate your explanation with a suitable example involving users and resources in a university system. Describe two practical methods for implementing the access matrix and compare their advantages and limitations. Also discuss how access rights such as copy, owner, and control are used to manage and modify entries in the access matrix. CO5 BL4

OR

10.b) Suppose that a disk drive has 200 cylinders, numbered 0 through 199. The drive is serving a request at cylinder 53. The queue of pending requests, in FIFO order is 90, 181, 26, 132, 15, 125, 75, 65. Starting from the head position calculate the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk scheduling algorithms? FCFS, SSTF, SCAN, LOOK, C-SCAN. Assume the default direction of head movement is towards the left. CO5 BL4

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