



# VIT

Vellore Institute of Technology  
(Chartered to be a University under section 3 of the UVC Act, 1994)

## Final Assessment Test – November 2025

Course: BCSE303L

Operating Systems

Class NBR(s): 1314/1317/1319/1321/1323/1327/1331/  
1334/1337/1339/1341/1342/1346/1350/1354/1358/  
1362/1365/2375/4523

Slot: C2+TC2

Max. Marks: 100

Time: Three Hours

- 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, represent 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)

Demonstrate, how the design of an operating system for general-purpose systems balance functionality, security, and performance, and discuss the trade-offs involved in achieving this balance?

CO1

i. Compare and analyze a thread and a process by applying the following criteria:- [5] CO1

- Complexity
- Structure
- Switching overhead
- Benefits

ii. Explain the purpose of system calls in an operating system and describe the purpose and identify the type (privileged or non-privileged) of each of the following system calls:- [5]

ptrace() setuid() execve(), read(), init\_module()

3. Consider the following set of processes that arrive at different times, with their respective burst times. Using the Shortest Job First (SJF) and Round Robin (quantum-4sec) scheduling algorithms. Illustrate a complete Gantt chart and calculate the Completion Time (CT), Average Turnaround Time (TAT), and Average Waiting Time (WT) for each process.

| Process | Arrival Time(AT) | Burst Time(BT) |
|---------|------------------|----------------|
| P1      | 0                | 8              |
| P2      | 1                | 4              |
| P3      | 2                | 9              |
| P4      | 3                | 5              |

4. Analyze the information in the table and draw the resource allocation graph (RAG). Apply the Banker's algorithm to determine, whether the system as described in the table will be in a safe state or not.

| Process | Allocated |    |    |    | Maximum Demand |    |    |    | Available |    |    |    |
|---------|-----------|----|----|----|----------------|----|----|----|-----------|----|----|----|
|         | R1        | R2 | R3 | R4 | R1             | R2 | R3 | R4 | R1        | R2 | R3 | R4 |
| P0      | 2         | 0  | 0  | 1  | 4              | 3  | 2  | 2  | 4         | 3  | 2  | 2  |
| P1      | 1         | 1  | 0  | 0  | 1              | 2  | 1  | 3  |           |    |    |    |
| P2      | 1         | 0  | 1  | 0  | 4              | 3  | 4  | 3  |           |    |    |    |
| P3      | 0         | 1  | 0  | 1  | 3              | 5  | 3  | 2  |           |    |    |    |
| P4      | 2         | 2  | 1  | 1  | 3              | 4  | 3  | 4  |           |    |    |    |

5. Explain how semaphores are used to manage concurrency in operating systems, with a focus on synchronization problems such as the Producer-Consumer scenario. Compare binary and counting semaphores, and justify which type is more suitable for solving this problem. Provide a pseudocode solution to demonstrate your explanation.

6. Narrate the needs for critical region and provide relevant justifications. Give an example of a scenario where a binary semaphore would be more appropriate than a lock. Demonstrate how Peterson's Algorithm resolves process synchronization issues for any real-world problem.

7. Compare contiguous, linked and indexed file allocation in terms of space utilization, access time and fragmentation.  
For a system handling large, frequently updated files with both sequential and random access. Discuss which method is best and why? Support your choice with technical reasoning.

CO5 BL4

CO5 BL5

8. Evaluate how the following parameters influence the overall hard disk throughput.

- Seek Time
- Rotational Delay
- Actual Transfer Time

Demonstrate the working of Shortest Seek Time First (SSTF), C-LOOK, and SCAN algorithm for the given specifications:-

- Request sequence = 82, 170, 43, 140, 24, 16, 190
- Initial head position = 50
- Disk size : 0-199

CO4 BL4

9.a) Compare Paging, Segmentation and Paged Segmentation in terms of memory allocation, address translation and fragmentation.  
Then, for a system with 64 MB physical memory, a 32-bit virtual address space, and a 4 KB page size, calculate the page table size and explain how its size (smaller or larger than a page) affects memory management and the choice between the three schemes.

OR

CO4 BL4

9.b) A computer system uses paging for memory management, with system details:-  
Logical address space: 32 KB, Page size: 2 KB, Physical memory size: 16 KB and Each frame is 2 KB (same as page size).  
The page table for a process is:

| Page Number | Frame number |
|-------------|--------------|
| 0           | 3            |
| 1           | 0            |
| 2           | 2            |
| 3           | 1            |

- Calculate the number of bits in Logical address, Offset, Page number.
- Convert the following logical addresses 8165, 945, 256 into physical address.
- Will the logical address 16384 cause a page fault? Why or why not?

10.a) Consider three users: X, Y and Z and three files: file1.txt, file2.sh and file3.cfg. The access permissions (Access Control List - ACL) for each user on each file are given below:

CO5 BL1

| File      | User | Read(R) | Write(W) | Execute(EXE) |
|-----------|------|---------|----------|--------------|
| File1.txt | X    | 1       | 1        | 0            |
|           | Y    | 1       | 0        | 0            |
| File2.sh  | X    | 0       | 0        | 1            |
|           | Z    | 1       | 1        | 1            |
| File3.cfg | Y    | 1       | 1        | 0            |
|           | Z    | 1       | 0        | 0            |

- Construct the Capability List for each user based on the above ACL data.
- Identify which users have both read and write access to file3.cfg.
- Determine whether X has execute permission for file2.sh. Justify your answer.

OR

10.b) How does virtualization improve resource utilization and scalability in modern IT infrastructures, and what are the potential drawbacks or challenges associated with its implementation?

CO5 BL1