



# VIT<sup>®</sup>

Vellore Institute of Technology  
(Deemed to be University under section 3 of UGC Act, 1956)

SLOT: C1

**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**  
**CONTINUOUS ASSESSMENT TEST - II**  
**FALL SEMESTER 2025-2026**

**Programme Name & Branch** : B.Tech / BBS  
**Course Code and Course Name** : CBS1006 - Principles of Operating Systems  
**Faculty Name(s)** : Dr. Priyadharsini M  
**Class Number(s)** : VL2025260103273  
**Date of Examination** : 07.10.2025  
**Exam Duration** : 90 minutes **Maximum Marks: 50**

**General instruction(s):**

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes:  
CO4: Apply and explore the communication between inter process and synchronization techniques.  
CO5: Implement memory placement strategies, replacement algorithms related to main and virtual memory techniques.  
CO6: Differentiate the file systems for applying various file allocation and access techniques.

| Q. No | Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Module | Marks      | CO  | BL |     |           |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
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| 1.    | <p>Consider a system with <b>5 processes (P1, P2, P3, P4, P5)</b> and <b>3 resource types (A, B, C)</b>. Given Allocation and Maximum matrices, test multiple requests from processes and decide if they can be safely granted.</p> <table><tr><th></th><th colspan="3">Allocation</th><th colspan="3">Max</th><th colspan="3">Available</th></tr><tr><th></th><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>P1</td><td>0</td><td>1</td><td>0</td><td>7</td><td>5</td><td>3</td><td>10</td><td>5</td><td>7</td></tr><tr><td>P2</td><td>2</td><td>0</td><td>0</td><td>3</td><td>2</td><td>2</td><td></td><td></td><td></td></tr><tr><td>P3</td><td>3</td><td>0</td><td>2</td><td>9</td><td>0</td><td>2</td><td></td><td></td><td></td></tr><tr><td>P4</td><td>2</td><td>1</td><td>1</td><td>2</td><td>2</td><td>2</td><td></td><td></td><td></td></tr><tr><td>P5</td><td>0</td><td>0</td><td>2</td><td>4</td><td>3</td><td>3</td><td></td><td></td><td></td></tr></table> <p>Apply the Banker's Algorithm and determine the following:</p> <p>i) <b>Safety Check:</b> Check whether the system is in a safe state now. Display the sequence of processes and work vectors utilized to confirm this. (5 marks)</p> <p>ii) <b>Resource Request:</b> Let's say process P1 requests resources [2, 1,0]. Verify if such a request can be fulfilled by ensuring the request is less than or equal to the remaining requirement of the process. Ensuring the request is less than or equal to the available resources. Simulating allocation and then carrying out a safety check to confirm that the system does not enter an unsafe state. (5 marks)</p> |        | Allocation |     |    | Max |           |   | Available |  |  |  | A | B | C | A | B | C | A | B | C | P1 | 0 | 1 | 0 | 7 | 5 | 3 | 10 | 5 | 7 | P2 | 2 | 0 | 0 | 3 | 2 | 2 |  |  |  | P3 | 3 | 0 | 2 | 9 | 0 | 2 |  |  |  | P4 | 2 | 1 | 1 | 2 | 2 | 2 |  |  |  | P5 | 0 | 0 | 2 | 4 | 3 | 3 |  |  |  | 3 | 10 | 4 | 4 |
|       | Allocation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |            | Max |    |     | Available |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
|       | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B      | C          | A   | B  | C   | A         | B | C         |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
| P1    | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1      | 0          | 7   | 5  | 3   | 10        | 5 | 7         |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
| P2    | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0      | 0          | 3   | 2  | 2   |           |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
| P3    | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0      | 2          | 9   | 0  | 2   |           |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
| P4    | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1      | 1          | 2   | 2  | 2   |           |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |
| P5    | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0      | 2          | 4   | 3  | 3   |           |   |           |  |  |  |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |    |   |   |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |    |   |   |   |   |   |   |  |  |  |   |    |   |   |

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| 2. | <p>a) A system is given with <b>4</b> Page frames and the following page reference string:<br/> <b>3, 5, 2, 1, 0, 5, 2, 6, 2, 1, 0, 3, 5, 7, 6, 1, 2, 4, 1, 2</b><br/> Apply the FIFO and Optimal Page Replacement algorithms to this reference string.</p> <p>i) Show the sequence of page replacement steps clearly for each algorithm.</p> <p>ii) Calculate the total number of page faults in each case.</p> <p>iii) Compute the hit ratio and miss ratio for both algorithms.</p>                                                                                                                                                                                                                                                                 | 4 | 5  | 5 | 3 |
|    | <p>b) A program has the following logical segments:<br/> <b>code = 500 KB, data = 300 KB, stack = 200 KB.</b><br/> The operating system places them in physical memory starting at addresses <b>1000, 2000, and 3000 respectively.</b></p> <p>i) Construct the segment table showing segment number, base and limit.</p> <p>ii) A logical address of segment 1, offset 150 is generated. Find the physical address.</p>                                                                                                                                                                                                                                                                                                                                |   | 5  |   |   |
| 3. | <p>a) Consider a memory of <b>2000 KB</b>, with free partitions of sizes: <b>500 KB, 300 KB, 600 KB, 350 KB, 250 KB.</b><br/> Six processes request memory in this order: <b>P1: 275 KB, P2: 425 KB, P3: 120 KB, P4: 310 KB, P5: 95 KB</b></p> <p>i) Allocate memory using First Fit and Best Fit.</p> <p>ii) Draw the final memory block distribution for each strategy.</p> <p>iii) Which method results in the largest unused block?</p>                                                                                                                                                                                                                                                                                                            | 4 | 5  | 5 | 4 |
|    | <p>b) Consider a system with two-level paging and a <b>TLB</b>, assume that both the page tables and all pages reside in main memory. The main memory <b>access time is 50 ms</b>, and the effective memory <b>access time is 120 ms</b>. If the TLB hit ratio is <b>50%</b>, calculate the TLB access time in milliseconds.</p>                                                                                                                                                                                                                                                                                                                                                                                                                       |   | 5  |   |   |
| 4. | <p>Consider a file management system is being developed for a <b>multi-user computing environment</b>. The system must maintain a directory that stores information about all files, including their locations, ownership, and access permissions. To ensure smooth operation, the directory must support several essential operations.</p> <p>Address the following from the perspective of a user or program interacting with the directory.</p> <p>a) Explain how the most common logical directory organization schemes work. Show how files are arranged and accessed in each scheme to illustrate their structure and usage. (7 marks)</p> <p>b) List the key operations that the system must support to manage files effectively. (3 marks)</p> | 5 | 10 | 6 | 3 |
| 5. | <p>A university's file server has <b>100 disk blocks</b>. Some blocks are already occupied by system and user files, leaving the following blocks free: <b>Free blocks: 2, 3, 5, 7, 8, 10, 15, 20, 25, 30, 35, 40, 45, 50</b><br/> The system maintains free space using <b>different methods (bit vector, linked list, and counting)</b>. New files arrive sequentially with sizes <b>3, 2, 4 and 5 blocks</b>.</p> <p>a) Represent the free blocks as a bit vector, linked list, ranges. (6 marks)</p> <p>b) Which allocation method is most efficient in minimizing fragmentation? Explain briefly. (4 marks)</p>                                                                                                                                   | 5 | 10 | 6 | 4 |

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