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

**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**
**CONTINUOUS ASSESSMENT TEST - II**
**FALL SEMESTER 2024-2025**

**SLOT: B1+TB1**

**Programme Name & Branch** : B.Tech. CSE
**Course Code and Course Name** : BCSE303L – Operating Systems
**Date of Examination** : 14.10.2024
**Exam Duration** : 90 minutes **Maximum Marks: 50**

**General instruction(s):**

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level
- Course Outcomes
  - 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.

<table>
<tr><th>Q. No</th><th>Question</th><th>M</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>Consider a system with 5 processes (P0, P1, P2, P3, P4) and 4 resource types (A, B, C, D). The Allocation, Max, and Available matrices are given as follows:
<table>
<tr><th></th><th colspan="4">Allocation</th><th colspan="4">Max</th><th colspan="4">Available</th></tr>
<tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>A</th><th>B</th><th>C</th><th>D</th><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>P0</td><td>2</td><td>0</td><td>0</td><td>1</td><td>4</td><td>2</td><td>1</td><td>2</td><td>3</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>P1</td><td>3</td><td>1</td><td>2</td><td>1</td><td>5</td><td>2</td><td>5</td><td>2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>P2</td><td>2</td><td>1</td><td>0</td><td>3</td><td>2</td><td>3</td><td>1</td><td>6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>P3</td><td>1</td><td>3</td><td>1</td><td>2</td><td>1</td><td>4</td><td>2</td><td>4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>P4</td><td>1</td><td>4</td><td>3</td><td>2</td><td>3</td><td>6</td><td>6</td><td>5</td><td></td><td></td><td></td><td></td></tr>
</table>
Using the Banker's Algorithm, answer the following questions:<br>
1. Safety Check: Determine if the system is currently in a safe state. Show the sequence of processes and work vectors used to verify this.<br>
2. Resource Request: Suppose process (P1) makes a request for resources: (1, 1, 0, 0). Check if this request can be granted by:<br>
- Verifying if the request is less than or equal to the process's remaining need.<br>
- Verifying if the request is less than or equal to the available resources.<br>
- Simulating the allocation and then performing a safety check to ensure the system remains in a safe state.</td><td>10</td><td>CO2</td><td>BL3</td></tr>
<tr><td>2.</td><td>(a) A university library has a study room that can accommodate up to 20 students at a time. Students can enter the study room only if there is space available. Once inside, students can request to use a shared whiteboard for group discussions. Only one group can use the whiteboard at a time. If the whiteboard is in use, other groups must wait until it becomes available. Design a synchronization mechanism using semaphores to manage the entry of students into the study room</td><td>7</td><td>CO3</td><td>BL2</td></tr>
</table>

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| | | | | |
|---|---|---|---|---|
| | and the use of the shared whiteboard. Provide the pseudo code for your solution and explain how it ensures mutual exclusion and proper coordination. | | | |
| | b) Describe Peterson's solution for mutual exclusion. How does it ensure that only one process enters the critical section at a time? | 3 | | |
| 3 | a) In a study group, there are five scholars who need to use shared resources: pens and notebooks. Each scholar requires both a pen and a notebook to take notes. However, only one scholar can use a pen or a notebook at a time. If a scholar cannot acquire both a pen and a notebook, they must wait until both are available. The goal is to ensure that no two scholars are using the same pen or notebook simultaneously and to avoid deadlock where scholars are waiting indefinitely for resources. Design a synchronization mechanism using the principles of the Dining Philosophers problem to manage the allocation of pens and notebooks to scholars. Provide the pseudo code for your solution and explain how it ensures mutual exclusion, prevents deadlock, and allows scholars to take notes in an orderly manner. | 7 | CO3 | BL2 |
| | b) Compare shared memory and message passing in Interprocess Communication (IPC). | 3 | | |
| 4. | Consider a system with 4 page frames and the following page reference string: 3, 2, 1, 4, 2, 5, 2, 3, 4, 5, 2, 5, 4, 1, 4, 2, 1, 3, 2, 1.<br>Using the FIFO, LRU, and Optimal page replacement algorithms:<br>• Clearly show the page replacement activities for each algorithm.<br>• Calculate the number of page faults for each algorithm.<br>• Determine the hit ratio and miss ratio for each algorithm. | 10 | CO4 | BL3 |
| 5 | A computer system has a total memory capacity of 1000 KB, divided into the following free memory blocks (in KB): 200, 350, 150, 400, and 250. Eight processes require memory allocations as follows:<br>• Process A: 300 KB<br>• Process B: 210 KB<br>• Process C: 180 KB<br>• Process D: 90 KB<br>• Process E: 120 KB<br>• Process F: 130 KB<br>• Process G: 160 KB<br>• Process H: 70 KB<br>Using the First Fit, Best Fit, and Worst Fit allocation algorithms, determine how the memory will be allocated to each process. Illustrate the state of the memory blocks after each allocation for each algorithm. Analyze the efficiency of each algorithm based on the final state of the memory blocks. | 10 | CO4 | BL4 |

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