OPERATING SYSTEMS			
(Effective from the academic year 2022 -2023)			
SEMESTER – IV			
Course Code	21AM404	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:
1. Explain the concepts, principles, and services of operating system.
2. Identify fundamental operating system abstractions such as Process, Threads, Files, Semaphores, IPC abstractions and demonstrate them.
3. Assess the benefits of concurrency and synchronization and apply them to write concurrent programs.
4. Analyse basic resource management technologies in job and process scheduling. Use and compare different memory management techniques.
5. Study Linux Operating System in terms of process scheduling, Memory management, File system and I/O

Unit I	Contact Hours
INTRODUCTION TO OPERATING SYSTEMS, SYSTEM STRUCTURES: **Operating System structure**: Operating System Services, User and Operating System interface, System calls, System Services, Linkers and Loaders, Operating System design and implementation, Operating System structure. **Process Management:** Process concept; Process scheduling; Operations on processes; Inter-process communication. **Threads & Concurrency**: Multicore Programming, Multithreading Models. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple-Processor scheduling. **Process Synchronization**: The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Monitors, Classical problems of synchronization.	15
Unit II	
Deadlocks: System model; Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, avoidance, detection, and recovery from deadlock. **MEMORY MANAGEMENT:** **Main Memory**: Paging, Structure of page table, Swapping. **Virtual Memory**: Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Mass-Storage Structure:** Storage Device Management, Swap-Space Management, Storage Attachment. **Implementing File System**: File system Concepts, File System Structure, Operations and implementation, Directory implementation, Allocation methods, Free space management.	15
Unit III	

Security: The Security Problem, Program Threats, System and Network Threats, Implementing Security Defences. Protection: Goals of Protection, Principles of Protection, Protection Rings, Domain of Protection, Role-Based Access Control, Mandatory Access Control (MAC).	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recognise the structural components of operating system and describe a process, its state and process of its creation and termination.
2. Illustrate critical section problem and demonstrate the Peterson's solution. Investigate the Deadlock condition and determine the solution to avoid.
3. Summarize Main memory and Virtual Memory allocation methods and prepare a page replacement schedule to the given set of page requirement request.
4. Illustrate Storage Device management and classify file systems based on operations and implementations.
5. Identify threat and defence systems with respect to Operating Systems and associate principles of protection and access control methods to achieve goals of operating system protection.

Textbooks:

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, Peter B. Galvin,10thEdition, John Wiley & Sons, 2018, ISBN: 9781119320913.

Reference Books:

1. D. M Dhamdhere: Operating systems - A concept-based Approach, 2nd Edition, Tata McGraw- Hill,2002.
2. P. C. P. Bhatt: Operating Systems, 2nd Edition, PHI,2006.
3. Harvey M Deital: Operating systems, 3rd Edition, Addison Wesley, 1990.

<table>
<tr><th colspan="16">Table 1: Mapping Levels of COs to POs
1: Low, 2: Medium, 3: High</th></tr>
<tr><th rowspan="2">COs</th><th colspan="12">Program Objectives (POs)</th><th colspan="2">PSOs</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>1</th><th>2</th></tr>
<tr><td>CO1</td><td>3</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td>3</td><td></td></tr>
<tr><td>CO2</td><td>3</td><td>2</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td></td><td>3</td><td>1</td></tr>
<tr><td>CO3</td><td>3</td><td>2</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td>1</td><td>3</td><td>1</td></tr>
<tr><td>CO4</td><td>3</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td><td>1</td><td></td><td>1</td><td>3</td><td>1</td></tr>
<tr><td>CO5</td><td>3</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>3</td><td></td></tr>
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<table>
<tr><th colspan="4">Table 2: Mapping of COs to PIs, POs and BTL</th></tr>
<tr><th>Course outcomes</th><th>Program Outcomes</th><th>Performance Indicators</th><th>Bloom's Taxonomy Level</th></tr>
<tr><td>CO1</td><td>1,2</td><td>1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2</td><td>L2</td></tr>
<tr><td>CO2</td><td>1,2</td><td>1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.2.2, 2.2.3, 2.3.2,</td><td>L4</td></tr>
</table>

		3.4.3	
CO3	1,2	1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.2.5, 2.3.2, 2.4.3	L3
CO4	1	1.3.1, 1.4.1	L3
CO5	1,2	1.1.1, 1.1.2, 1.3.1, 2.1.1, 2.1.2, 2.2.2, 2.2.5, 2.4.3	L2