**UCS303 OPERATING SYSTEMS**

**(For the year 2020)**

**L T P Cr**

**3 0 2 4.0**

**Course Objectives:** To understand the role, responsibilities, and the algorithms involved for achieving various functionalities of an Operating System.

**Introduction and System Structures:** Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure.

**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Multi-threaded programming: Multi-core Programming, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Algorithm Evaluation.

**Deadlock:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

**Memory Management:** Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Allocating Kernel Memory.

**File Systems:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

**Disk Management:** Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure.

**Protection and Security:** Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, The Security Problem, Program Threats, System and Network Threats, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks.

**Concurrency:** The Critical-Section Problem, Peterson’s Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors.

**Laboratory work:** To explore detailed architecture and shell commands in Linux / Unix environment, and to simulate CPU scheduling, Paging, Disk-scheduling and process synchronization algorithms.

**Course learning outcomes (CLOs):**

After the completion of the course, the student will be able to:

1. Explain the basic of an operating system viz. system programs, system calls, user mode and kernel mode.

2. Select a particular CPU scheduling algorithms for specific situation, and analyze the environment leading to deadlock and its rectification.

3. Explicate memory management techniques viz. caching, paging, segmentation, virtual memory, and thrashing.

4. Understand the concepts related to file systems, disk-scheduling, and security, protection.

5. Comprehend the concepts related to concurrency.

**Text Books:**

*1. Silberschatz A., Galvin B. P. and Gagne G., Operating System Concepts, John Wiley & Sons Inc (2013) 9th ed.*

*2. Stallings W., Operating Systems Internals and Design Principles, Prentice Hall (2018) 9th ed.*

**Reference Books:**

*1. Bovet P. D., Cesati M., Understanding the Linux Kernel, O'Reilly Media (2006), 3rd ed.*

*2. Kifer M., Smolka A. S., Introduction to Operating System Design and Implementation: The OSP 2 Approach, Springer (2007).*

**PLEASE NOTE**: All the Chapters & respective Sections refer below are taken from 9**th** Edition of the book “Operating System Concepts” By Galvin. We (Course Coordinators) don’t take the responsibility for any discrepancy in Chapters & Sections, if someone is referring from any other Edition.

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| **Introduction and System Structures:** Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure. | CHAPTER -1 **Introduction**  Complete (Excluding – Sec 1.10, 1.11.7, 1.12) |
| CHAPTER -2 **System Structure**  Complete (Excluding – Sec 2.7.5, Sec 2.8, Sec 2.9) |
| **Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Multi-threaded programming: Multi-core Programming, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Algorithm Evaluation. | CHAPTER -3 **Process Concepts**  Complete (Excluding – Sec 3.5, Sec 3.6) |
| CHAPTER -4 **Multithreaded Programming**  Complete (Excluding – Sec 4.4, Sec 4.5, Sec 4.6, Sec 4.7) |
| CHAPTER -5/6 **Process Scheduling**  Complete (Excluding Sec 5.4, Sec 5.6, Sec 5.7, Sec 5.8) [Including Sec 5.5]  Please note that if you are following **e-book of 9th Edition**; then for this specific chapter please follow **CHPATER 6** (from e-book) named **CPU Scheduling** and topic numbering will go like: Complete (Excluding Sec 6.4, Sec 6.6, Sec 6.7, Sec 6.8) [Including Sec 6.5] |
| **Deadlock:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. | CHAPTER -7 **Deadlock**  (Full Chapter) |
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| **Memory Management:** Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. | CHAPTER -8 **Memory Management Strategies**  Complete (Excluding Sec 8.6.4, 8.7, 8.8) |
| **Virtual Memory Management**: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Allocating Kernel Memory. | CHAPTER-9 **Virtual Memory Management**  Complete (Excluding Sec 9.6.2, Sec 9.6.3, Sec 9.6.4, Sec 9.7, Sec 9.8, Sec 9.9, Sec 9.10) |
| **Disk Management:** Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure. | CHAPTER-10 **Mass Storage Structure**  Complete (Excluding Sec 10.7.4 to 10.7.6, 10.8, 10.9) |
| **Protection and Security:** Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, The Security Problem, Program Threats, System and Network Threats, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks. | CHAPTER-14 **Protection**  (**Include Only Sec** 14.1, 14.2, 14.3.1, 14.4, 14.5)  CHAPTER-15 **Security**  (**Include Only Sec** 15.1, 15.2) |
| **File Systems:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management. | CHAPTER-11 **File System Interface**  (**Include Only** 11.1, 11.2, 11.3, 11.5, 11.6)  CHAPTER-12 **File System Implementation**  (**Include Only** 12.1, 12.2, 12.3, 12.4, 12.7) |
| **Concurrency:** The Critical-Section Problem, Peterson’s Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors. | CHAPTER-06/05 **Process Synchronization**  (**Include Only** 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7)  Please note that if you are following **e-book of 9th Edition**; then for this specific chapter please follow **CHPATER 5** (from e-book) named **Process Synchronization**. |