

Course Title: **Operating System (3 Cr.)**

Course Code: **CACS251**

Year/Semester: **II/IV**

Class Load: **6 Hrs. / Week (Theory: 3 Hrs, Tutorial: 1, Practical: 2 Hrs.)**

### **Course Description**

This course includes the topics that help students understand operating system and its functionality along with its types.

### **Course Objectives**

The general objectives of this subject are to provide the basic feature, function and interface with the hardware and application software to run the computer smoothly.

### **Course Contents**

#### **Unit 1 Introduction to Operating System** **2 Hrs.**

History, Introduction and Generation of Operating System, Objectives (Resource Manager and Extended Machine), Types of Operating system, Function of Operating system.

#### **Unit 2 Operating System Structure** **2 Hrs.**

Introduction, Layered System, Kernel, Types of Kernel (Monolithic/Macro Kernel and Micro / Exo-Kernel), Client-Server Model, Virtual Machines, Shell.

#### **Unit 3 Process Management** **15 Hrs.**

**Process Concepts(3 Hrs.):** Definitions of Process, The Process Model, Process States, Process State Transition, The Process Control Block, Operations on Processes (Creation, Termination, Hierarchies, Implementation), Cooperating Processes, System Calls (Process Management, File management, Directory Management).

**Threads (1 Hr):** Definitions of Threads, Types of Thread Process (Single and Multithreaded Process), Benefits of Multithread, Multithreading Models (Many-to-One Model, One-to-One Model, Many-to Many Model).

**Inter-Process Communication and Synchronization(6 Hrs.):** Introduction, Race Condition, Critical Regions, Avoiding Critical Region: Mutual Exclusion And Serializability; Mutual Exclusion Conditions, Proposals for Achieving Mutual Exclusion: Disabling Interrupts, Lock Variable, Strict Alteration (Peterson's Solution), The TSL Instruction, Sleep and Wakeup, Types of Mutual Exclusion (Semaphore, Monitors, Mutexes, Message Passing, Bounded Buffer), Serializability: Locking Protocols and Time Stamp Protocols; Classical IPC Problems (Dining Philosophers Problem, The Readers and Writers Problem, The Sleeping Barber's Problem)

**Process Scheduling(5 Hrs):** Basic Concept, Type of Scheduling (Preemptive Scheduling, Nonpreemptive Scheduling, Batch, Interactive, Real Time Scheduling), Scheduling Criteria or Performance Analysis, Scheduling Algorithm (Round-Robin, First Come First Served, Shortest-Job- First, Shortest Process Next, Shortest Remaining Time Next, Real Time, Priority Fair Share, Guaranteed, Lottery Scheduling, HRN, Multiple Queue, Multilevel Feedback Queue); Some Numerical Examples on Scheduling.

**Unit 4 Deadlocks** 4 Hrs.

System Model, System Resources: Preemptable and Non-Preemptable; Conditions for Resource Deadlocks, Deadlock Modeling, The OSTRICH Algorithm, Method of Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection: Resource Allocation Graph, Recovery from Deadlock.

**Unit 5 Memory Management** 7 Hrs.

**Basic Memory Management (3 Hrs.):** Introduction, Memory Hierarchy, Logical Versus Physical Address Space, Memory Management with Swapping: Memory Management with Bitmaps and with Linked List; Memory Management without Swapping, Contiguous-Memory Allocation: Memory Protection, Memory Allocation, Fragmentation (Inter Fragmentation and External Fragmentation); Non-Contiguous Memory Allocation, Fixed Partitioning Vs. Variable Partitioning, Relocation and Protection, Coalescing and Compaction.

**Virtual Memory (4 Hours):** Background, Paging, Structure of Page Table: Hierarchical Page Table, Hashed Page Table, Inverted Page Table, Shared Page Table; Block Mapping Vs. Direct Mapping, Demand Paging, Page Replacement and Page Faults, Page Replacement Algorithms: FIFO, OPR, LRU, SCP; Some Numerical Examples on Page Replacement, Thrashing, Segmentation, Segmentation With Paging.

**Unit 6 Input/ Output Device Management** 4 Hrs.

Principle of I/O Hardware: I/O Devices, Device Controllers, Memory Mapped I/O, Direct Memory Access; Principle of I/O Software: Goals of I/O Software, Program I/O, Interrupt -Driven I/O, I/O Using DMA; I/O Software Layers: Interrupt Handler, Device Drivers, Device Independent I/O Software, User - Space I/O Software; Disk: Disk Hardware; Disk Scheduling: Seek Time, Rational Delay, Transfer Time; Disk Scheduling Algorithms: FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, Lock Scheduling

**Unit 7 File System Interface Management** 2 Hrs.

File Concept: File Naming, File Structure, File Type, File Access, File Attributes, File Operation and File Descriptors; Directories: Single-Level Directory Systems, Hierarchical Directory Systems, Path Names, Directory Operation; Access

Methods: Sequential, Direct; Protection: Types of Access, Access Control List, Access Control Matrix

**Unit 8 Security Management** 3 Hrs.

Introduction, Security Problems, User Authentication: Passwords, password Vulnerabilities, Encrypted password, One Time Password and Biometrics password; User Authorization, Program Threats: Trojan Horse, Trap Door, Stack and Buffer Overflow; System Threats: Worms, Viruses, Denial of Services.

**Unit 9 Distributed Operating System** 4 Hrs.

Introduction, Advantages of Distributed System over Centralized System, Advantages of Distributed System over Independent PCs, Disadvantages of Distributed System, Hardware and Software Concepts, Communication in Distributed Systems, Message Passing, Remote Procedure Call, Process in Distribution System, Clock Synchronization.

**Unit 10 Case Study** 2 Hrs.

DOS and Windows Operating System, Unix Operating System, Linux Operating System

**Laboratory Works**

Lab works should be done covering all the topics listed above and a small project work should be carried out using the concept learnt in this course. Project should be assigned on Individual Basis.

**Teaching Methods**

The general teaching pedagogy includes class lectures, group discussions, case studies, guest lectures, research work, project work, assignments (theoretical and practical), and examinations (written and verbal), depending upon the nature of the topics. The teaching faculty will determine the choice of teaching pedagogy as per the need of the topics.

**Evaluation**

Examination Scheme					
Internal Assessment		External Assessment		Total	
Theory	Practical	Theory	Practical		
20	20 (3 Hrs.)	60 (3 Hrs.)	-	100	

### **Text Books**

1. Andrew S. Tanenbaum, "Modern Operating System 6/e", PHI, 2011/12
2. Silberschatz, P.B. Galvin, G. Gagne, "Operating System Concepts 8/e ", Wiley India, 2014 ISBN : 9788126520510

### **Reference Books**

1. Andrew S. Tanenbaum, "Distributed Operating System", Pearson
2. D M Dhamdhere, "System Programming and Operating System", Tata McGraw-Hill, 2009
3. P. Pal Choudhury, "Operating Systems Principles and Design", PHI, 2011

