

**MODULE I****Chapter 1 : Operating System Overview****1-1 to 1-23**

1.1	Introduction to Operating System	1-1
1.1.1	Need of Operating System	1-1
1.2	Operating System Objectives and Functions	1-2
1.2.1	Functions of Operating System	1-2
1.3	The Evolution of Operating Systems	1-4
1.4	Types of Operating System.....	1-6
1.5	Operating System Services	1-7
1.6	Operating System Structures.....	1-9
1.6.1	Monolithic Systems	1-9
1.6.2	Layered Systems.....	1-10
1.6.3	Virtual Machines.....	1-12
1.6.4	Client-Server Model.....	1-13
1.6.5	Monolithic Kernel vs. Microkernel	1-14
1.6.6	Difference between Monolithic and Microkernel.....	1-15
1.7	Linux Kernel and Shell.....	1-16
1.7.1	Design Principles of Linux.....	1-16
1.7.2	Linux Kernel Structure	1-17
1.7.3	Shell.....	1-19
1.8	System Calls	1-19
1.9	Types of System Calls.....	1-22

MODULE II**Chapter 2 : Process & Process Scheduling 2-1 to 2-40**

2.1	Introduction.....	2-1
2.1.1	Process	2-1
2.2	Context Switch.....	2-2
2.3	Process States	2-2

2.4	Process Description	2-4
2.4.1	Process Control Structures.....	2-4
2.5	Process Control Block (PCB)	2-5
2.6	Scheduling.....	2-6
2.6.1	Scheduling Queues and Schedulers.....	2-6
2.6.1(A)	Long-term Scheduler	2-7
2.6.1(B)	Short-term Scheduler.....	2-8
2.6.1(C)	Medium-term Scheduler.....	2-8
2.6.1(D)	Comparison of Three Schedulers	2-8
2.6.2	Types of Scheduling.....	2-9
2.7	Uniprocessor Scheduling	2-9
2.7.1	Scheduling Criteria.....	2-9
2.7.2	Scheduling Algorithms	2-10
2.7.2(A)	First in First out (FIFO)	2-10
2.7.2(B)	Shortest Job First (SJF)	2-12
2.7.2(C)	Priority Scheduling	2-13
2.7.2(D)	Round Robin Scheduling	2-14
2.8	Threads.....	2-15
2.8.1	Definition of Thread	2-15
2.8.2	Difference between Process and Thread	2-16
2.9	Types of Threads.....	2-17
2.9.1	User Level Threads	2-17
2.9.2	Kernel Level Threads	2-18
2.10	Concept of Multithreading.....	2-18
2.10.1	Three Types of Multithreading Models.....	2-19
2.11	Examples on Uniprocessor Scheduling Algorithms	2-20

MODULE III

Chapter 3 : Process Synchronization and Deadlocks 3-1 to 3-32

3.1 Concurrency..... 3-1

3.1.1 Principles of Concurrency..... 3-1

3.2 Interprocess Communication..... 3-3

3.3 Process/Thread Synchronization 3-4

3.3.1 Critical Section Problem 3-4

3.3.2 Race Condition 3-6

3.3.3 Role of Operating System..... 3-6

3.4 Mutual Exclusion 3-6

3.4.1 Requirement of Mutual Exclusion..... 3-6

3.4.2 Mutual Exclusion Conditions..... 3-7

3.5 Hardware Support..... 3-7

3.6 Operating System Support..... 3-8

3.6.1 Semaphores and Mutex..... 3-8

3.7 Producer and Consumer Problem 3-10

3.7.1 Producer Consumer Problem Using Semaphore 3-11

3.8 Principles of Deadlock..... 3-12

3.8.1 Deadlock Problem..... 3-12

3.8.2 Conditions..... 3-13

3.8.3 Resource Allocation Graphs..... 3-13

3.9 Deadlock Prevention 3-14

3.10 Deadlock Avoidance 3-16

3.10.1 Deadlock Avoidance Algorithms..... 3-18

3.10.1(A) Resource-Allocation Graph Algorithm..... 3-18

3.10.1(B) Banker’s Algorithm 3-18

3.10.1(C) Resource-Request Algorithm 3-19

3.10.1(D) Safety Algorithm 3-19

3.11 Deadlock Detection 3-27

3.11.1 Single Instance of Each Resource Type 3-27

3.11.2 Many Instances of Each Resource Type 3-27

3.11.3 Algorithm 3-27

3.11.4 Run-Time Complexity : $O(m \times n^2)$ 3-28

3.12 Deadlock Recovery.....3-28

3.12.1 Process Termination (Kill a process).....3-28

3.12.2 Resource Preemption3-29

3.13 Dining Philosopher Problem.....3-30

3.13.1 Solution Using Semaphores3-30

MODULE IV

Chapter 4 : Memory Management 4-1 to 4-40

4.1 Memory Management Requirements 4-1

4.1.1 Relocation..... 4-2

4.1.2 Protection, Logical and Physical Address Space.. 4-2

4.1.3 Sharing 4-3

4.1.4 Logical Organization..... 4-3

4.1.5 Physical Organization 4-3

4.2 Memory Partitioning..... 4-4

4.2.1 Monoprogramming..... 4-4

4.2.2 Multiprogramming..... 4-4

4.2.3 Multiprogramming with Fixed and Variable Partitions (Contiguous Allocation)..... 4-4

4.2.3(A) Difference between Internal and External Fragmentation 4-6

4.2.4 Dynamic Partition Technique 4-6

4.2.5 Compaction 4-7

4.3 Dynamic Loading 4-8

4.4 Overlays..... 4-8

4.5 Swapping..... 4-9

4.6 Memory Allocation Strategies.....4-10

4.7 Relocation.....4-12

4.8 Paging4-12

4.8.1 Basic Operation.....4-13

4.8.2 Memory Protection and Sharing4-15

4.8.3 Translation Look aside Buffer4-15

4.8.4 Effect of Page Size on Performance4-15

4.8.5 Hardware Support for Paging.....4-16

4.9 Segmentation4-17

4.9.1 Difference between Paging and Segmentation..... 4-19

4.10 Segmentation with Paging..... 4-20

4.11 Virtual Memory 4-21

4.12 Demand Paging 4-21

4.13 Page Replacement Strategies 4-23

4.13.1 FIFO Algorithm..... 4-23

4.13.2 Optimal Page Replacement Algorithm..... 4-24

4.13.3 Least Recently Used (LRU) Page Replacement Algorithm 4-24

4.13.4 LRU-Approximation Page Replacement 4-25

4.13.4(A) Additional-Reference-Bits Algorithm 4-26

4.13.4(B) Second-Chance Algorithm..... 4-26

4.13.4(C) Enhanced Second-Chance Algorithm 4-26

4.13.4(D) Clock Page Replacement Algorithm..... 4-27

4.13.5 Counting-Based Page Replacement 4-27

4.13.5(A) Not Frequently Used or Least Frequently Used Page Replacement Algorithm (NFU or LFU) 4-27

4.13.5(B) Most Frequently Used Page Replacement Algorithm (MFU) 4-27

4.14 Examples on Page Replacement Algorithms 4-27

4.15 Allocation of Frames..... 4-38

4.16 Thrashing 4-39

4.17 Locality (Working Set Model) 4-39

MODULE V

Chapter 5 : File Management 5-1 to 5-21

5.1 Overview 5-1

5.1.1 Files and File Systems 5-1

5.2 Files..... 5-2

5.2.1 File Naming 5-2

5.2.2 File Structure..... 5-3

5.2.3 File Types..... 5-4

5.2.4 File Attributes 5-6

5.2.4(A) Attributes and its Meaning..... 5-6

5.2.5 File Operations..... 5-7

5.3 File Organization and Access 5-9

5.3.1 File Access 5-9

5.3.2 File Organizations..... 5-10

5.4 File Directories..... 5-12

5.4.1 Directory Structures..... 5-12

5.4.1(A) Single-Level Directory Systems 5-13

5.4.1(B) Two-Level Directory Systems..... 5-13

5.4.1(C) Hierarchical Directory Systems 5-14

5.4.2 Path Names 5-15

5.4.3 Directory Operations 5-16

5.4.4 Directory Implementation..... 5-17

5.5 File Sharing 5-19

5.5.1 Access Rights..... 5-19

5.5.2 Simultaneous Access 5-20

MODULE VI

Chapter 6 : I/O Management

6-1 to 6-28

6.1 I/O Devices..... 6-1

6.1.1 Differences between I/O Devices..... 6-2

6.2 Organization of the I/O Function 6-2

6.2.1 The Evolution of the I/O Function..... 6-3

6.2.2 Direct Memory Access..... 6-4

6.3 Operating System Design Issues..... 6-5

6.3.1 Design Objectives..... 6-5

6.3.2 Logical Structure of the I/O Function 6-6

6.4 I/O Buffering 6-7

6.4.1 Types of Devices..... 6-8

6.4.2 Single Buffer 6-9

6.4.3 Double Buffer 6-10



6.4.4	Circular Buffer	6-11	6.6.2	Shortest-Seek-Time-First (SSTF) Scheduling Algorithm	6-15
6.4.5	The Utility of Buffering.....	6-11	6.6.3	SCAN Scheduling Algorithm.....	6-16
6.5	RAID Structure	6-11	6.6.4	C-SCAN Scheduling Algorithm	6-17
6.5.1	RAID Levels.....	6-11	6.6.5	LOOK Scheduling Algorithm	6-18
6.6	Disk Scheduling Algorithms.....	6-14	6.7	Examples on Disk Scheduling Algorithms	6-19
6.6.1	FCFS Scheduling Algorithm.....	6-15	6.8	Disk Cache	6-27
				• Lab Manual	L-1 to L-46
