Operating Systems

Course Title: Operating Systems
Course No: BIT204
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers fundamental concepts of operating system as well as, Process management, Memory management, File systems, and I/O Managements and Disk Managements.

Course Objective:
The main objective of this course is to introduce fundamental concepts of operating system and its components and functions.

Detailed Syllabus

Unit	Teaching Methodology	Teaching Hours
Unit 1: Introduction and Evolution (6 Hrs.)		
1.1 Background of operating system, Operating system as Extended Machine and Resource Manager, History of Operating Systems(First, Second, Third and Fourth generation), Hardware review (Processors, Memory, I/O devices, Buses).	Lecture	2
1.2 Evolution of Operating System: batch system, multiprogramming, time-sharing, real-time, mainframe operating systems, multiprocessor operating systems, handheld, embedded, smart-card, distributed and personal computer operating systems		3
1.3 Operating system Concepts: Booting Computer, Address Spaces, Files, Client-Server Model, Security		1
Unit 2: System Structures (5 Hrs.)		
2.1 Operating system Components: Process Managements, Memory Managements, I/O managements, Operating system services, System calls, System calls for Process, File and Directory management	Lecture	2.5
2.2 Operating system structures: Monolithic system, Layered system, Micro Kernels, Exo Kernels, Virtual Machines, Storage Structures, I/O structures, Files structures, and system Protections		2.5

Unit 3: Process Management and Synchronization (10 Hrs.)		
3.1 Processes and Threads : Process model, Process creation, Process termination, Process states and transition, Thread model, Thread usage, Implementing thread in user space and Kernel	Lecture + Laboratory Work	1.5
3.2 Interprocess Communication, Race conditions, , Critical regions, Mutual exclusion with busy waiting, Disabling interrupts, Lock variables, Strict alternation, Peterson's solution, Sleep and wakeup, The producer consumer problem, semaphores, Mutexes, monitors, message passing, classical IPC problems: The dining philosopher problem		3
3.3 Process scheduling and Context Switch, Three level scheduling, Scheduling Algorithms: First Come First Serve, Shortest Job First, Priority, Round Robin, Shortest time Remaining First, Multiple queues		3.5
3.4 Deadlock, Resources, Deadlock characterization, Deadlock modeling, Methods for handling deadlock, Ostrich algorithm, Deadlock prevention and avoidance, Safe and unsafe states, Banker's algorithm for single resource and multiple resources, Deadlock detection and recovery		2
Unit 4: Memory Management and File Systems (13 Hrs.)		
4.1 Memory management: Address spaces, Monoprogramming without swapping, Multiprogramming with fixed partitions, Swapping, Memory management with bitmaps and linked list, Overlays, Memory allocations, First fit, Next fir, Best fit, Worst fit, Fragmentations, Virtual memory, Paging, Page tables, Paging hardware, TLB, Page replacements algorithms: Principle of optimality, First in First Out, LRU, LFU, NRU, Second Chance Page replacement, Clock, Working set page replacement, Belady's anamoly, Stack algorithm, Segmentation, and segmentation with paging	Lecture + Laboratory Work	10
4.2 File systems: File naming, File structure, File types, File access, File attributes, File operations, Access Methods, Directories and Levels, Directories Operations, Single level, two level and hierarchical directory system, File system mounting and sharing, Protection, Access control, File system layout, File system Implementation,		3

Contiguous allocation, Linked list allocation, Linked list allocation using table in memory, I-nodes, File system Examples		
Unit 5: Input / Output Management (12 Hrs.)		
5.1 Input Output management: I/O devices, Devices Controller, Memory Mapped I/O, Direct Memory Access (DMA),Interrupts, I/O software Principles: programmed I/O, Interrupt driven I/O, DMA based I/O, I/O Software Layers, Interrupt handlers, Device drivers, Uniform interface for device drivers, Buffering, Allocating and Releasing dedicated devices	Lecture + Laboratory Work	6
5.2 Disk management: Disk structure, RAID, Disk scheduling, First come first served, Shortest seek time first, SCAN, C-SCAN, LOOK, C-LOOK, Error handling and formatting, Stable storage management		6

Text / Reference Books:

1. Andrew S. Tanenbaum, Modern Operating Systems, 2nd Edition, Prentice-Hall.
2. Silberschatz, Galvin and Gagne, Operating System Concepts, 6th Edition, Addition Wesley.

Model Question

Group A

Attempt any TWO questions. **[2 × 10 = 20]**

1. Define critical section problem. Explain race condition with suitable example.
2. When does interrupt concur? Suppose that a disk drive has the cylinder numbered from 0 to 199. The head is currently at cylinder number 53. The queue for services of cylinders is as 99, 183, 37, 122, 14, 124, 65 and 67. What is the total head movement in each of following disk algorithm to satisfy the requests?

   (a) FCFS

   (b) SSTF

   (c) SCAN
3. What is page fault? Consider the following page reference string, 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1. How many page faults would occur for each of the following page replacement algorithms assuming 3 frames?
   a. FIFO
   b. Second Chance
   c. LRU

Group B

Attempt any EIGHT questions. **[8 × 5 = 40]**

4. Explain about the transition between different states of a process.
5. Why do deadlock occurs? How can you detect and recover from deadlock
6. Consider the following set of processes, with the length of CPU burst time given in milliseconds.

Processes	CPU Burst	Priority
A	8	3
B	13	1(Lowest)
C	19	2
D	3	4(Highest)

   The processed are assumed to have arrived in the order A, B, C and D all at time 0.

   What is the turnaround time and waiting time for the scheduling algorithms, RR(quantum = 5) and Priority Algorithm
7. Define swapping. How does the OS manage the virtual memory?
8. Define system call. Explain operating system as a extended machine.
9. How does process differ with thread? Discuss at least one multithreading model with its advantages and disadvantages.
10. How does DMA help in I/O management? Explain.
11. What does time sharing means in multiprogramming? Explain any three types of operating system structure.
12. Why do we need multiple queues in process scheduling? What is the significance of TLB?

Lab Manual

- Process creation, termination in any operating system
- Simulating process scheduling, Banker algorithm, page replacement algorithm, disk scheduling algorithm