II- Year II- Semester	Name of the Course	L	T	P	C
PC2203	Operating Systems	3	0	0	3

Course Objectives:

1. Study the basic concepts and functions of operating system
2. Learn about Processes, Threads and Scheduling algorithms
3. Understand the principles of concurrency and Deadlocks
4. Learn various memory management schemes
5. Study I/O management and File systems

UNIT-I **10 Hours**

Introduction to Operating System Concepts: What Operating Systems do, Computer System Organization, Functions of Operating systems, Types of Operating Systems, Operating Systems Services, System calls, Types of System calls, Operating System Structures, Distributed Systems, Special purpose systems.

UNIT-II **10 Hours**

Process Management: Process concept, Process State Diagram, Process control block, Process Scheduling- Scheduling Queues, Schedulers, Scheduling Criteria, Scheduling algorithms and their evaluation, Operations on Processes, Inter-process Communication.

Threads: Overview, User and Kernel threads, Multi-threading Models.

UNIT-III **10 Hours**

Concurrency: Process Synchronization, The Critical- Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Monitors, and Classic Problems of Synchronization.

Principles of deadlock: System Model, Deadlock Characterization, Methods for Handling Deadlocks: Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock.

UNIT- IV **10 Hours**

Memory Management: Logical vs physical address space, Swapping, Contiguous Memory Allocation, Paging, Structures of the Page Table, Segmentation.

Virtual Memory Management: Virtual memory overview, Demand Paging, Page-Replacement & its algorithms, Allocation of Frames, Thrashing.

UNIT-V **8 Hours**

File system Interface: The concept of a file, Access Methods, Directory structure, files sharing, protection.

File System implementation: File system structure, Allocation methods, and Free-space management.

Mass-storage structure: overview of Mass-storage structure, Disk scheduling, Swap space management.

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012

2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011

Reference Books:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley.

2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education.

3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata McGraw-Hill Education

e-Resources

1. https://en.wikipedia.org/wiki/Operating_system
2. https://www.tutorialspoint.com/operating_system/

Course Outcomes: By the end the of the course, the student will be able to

CO-1: Understand the structure and functionalities of Operating System
CO-2: Demonstrate the concept of Process, Threads and CPU Scheduling Algorithms
CO-3: Use the principles of Concurrency to solve Synchronization problems
CO-4: Demonstrate various methods for handling Deadlocks
CO-5: Infer various Memory Management Techniques

CO-PO-Mapping

CO / PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**P01 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	2	3	3	-	-	-	-	-	-	-	-	-	3	2
CO 2	3	3	3	1	2	-	-	-	-	-	-	-	3	--
CO 3	2	2	3	-	2	-	-	-	-	-	-	-	2	--
CO 4	2	2	3	-	2	-	-	-	-	-	-	-	2	2
CO 5	3	3	3	-	2	-	-	-	-	-	-	-	3	2

Micro Syllabus of Operating Systems

UNIT I : Introduction to Operating System Concepts: What Operating Systems do, Computer System Organization, Functions of Operating systems, Types of Operating Systems, Operating Systems Services, System calls, Types of System calls, Operating System Structures, Distributed Systems, Special purpose systems.

Unit	**Module**	**Micro Content**
	What Operating Systems do	User View, System View, Defining Operating Systems.
	Computer System Organization	Computer-system operation, Storage structure, i/o structure.

UNIT I	Functions of Operating systems	Process Management, Memory Management, File Management, I/O Management, Protection, Security, Networking.
	Types of Operating Systems	Batch processing, Multiprogramming, Timesharing, Distributed, Real time, Multi user, Multi-tasking, Embedded, Mobile operating system.
	Operating Systems Services	User interface, Program execution, I/O operations, File system manipulation, Communication, Error Detection.
	System calls, Types of System calls	Process control, File management, Device management, Information maintenance, and Communication maintenance, Protection and security maintenance system calls.
	Operating System Structures	Simple Structure Approach, Layered Approach, Microkernel Approach, Modules Approach.
	Distributed Systems	About Distributed Systems.
	Special purpose systems	Real Time Embedded Systems, Multimedia Systems, And Handheld Systems.

UNIT - II

Process Management: Process concept, Process State Diagram, Process control block, Process Scheduling- Scheduling Queues, Schedulers, Scheduling Criteria, Scheduling algorithms and their evaluation, Operations on Processes, Inter-process Communication.

Threads: Overview, User and Kernel threads, Multi-threading Models.

Unit	Module	Micro Content
UNIT II	Process concept	Define process, process in memory.
	Process State Diagram	Process states, diagram of process states.
	Process control block	Process state, process number, program counter, CPU registers, CPU switch from process to process, memory management information, accounting information, I/O status information.
	Process Scheduling	Introduction to process scheduler.
	Scheduling Queues	Job queue, ready queue, device queue, queueing diagram.
	Schedulers	Importance of scheduler, long term scheduler, short term scheduler, medium term scheduler, degree of multiprogramming, i/o bound process, cpu-bound process, swapping.
	Scheduling Criteria	Throughput, Turnaround time, Waiting Time, Response time.
	Scheduling algorithms	First-Come First-Served (FCFS) Scheduling, Shortest-Job-First(SJF) Scheduling, Priority Scheduling, Round Robin(RR) Scheduling, Multiple-Level Queue Scheduling, Multilevel Feedback Queue Scheduling.
	Evaluation of Scheduling algorithms	Deterministic modelling, Queueing models, Simulations and Implementation.
	Operations on Processes	Process creation, Process termination.
	Inter-process Communication	Shared memory systems, Message passing systems.
	Threads: Overview	Definition of thread, single threaded process, multithreaded process, benefits.
	Multi-threading Models	User and Kernel threads, many-to-one model, one-to-one model, many-to-many model.

UNIT-III

Concurrency: Process Synchronization, The Critical- Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Monitors, and Classic Problems of Synchronization.

Principles of deadlock: System Model, Deadlock Characterization, Methods for Handling Deadlocks: Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock.

Unit	Module	Micro Content
UNIT III	Process Synchronization	What is synchronization, why is it required, cooperating processes, race condition.
	Critical- Section Problem	Critical section, entry section, remainder section, mutual exclusion, progress, bounded waiting.
	Peterson's Solution	Software based solution to critical section between two processes.
	Synchronization Hardware	Locking, test and set instructions, mutual exclusion implementation with test and set, compare and swap instructions, mutual exclusion implementation with compare and swap.
	Semaphores	Semaphore usage, counting and binary semaphore, semaphore implementation, deadlock and starvation.
	Monitors	Structure of monitors, monitors vs semaphores, monitor usage, implementing a monitor using semaphores, dining-philosophers solution using monitors.
	Classic Problems of Synchronization	Bounded-buffer problem, reader-writer problem, dining-philosophers problem.
	Principles of deadlock: System Model	Deadlock definition, resources, request-use-release of resources.
	Deadlock Characterization	Necessary conditions for occurrence of deadlock, Resource allocation graph.
	Deadlock Prevention	Mutual exclusion, hold and wait, no-preemption, circular wait.
	Deadlock Detection	Graph algorithm, Banker's algorithm.
	Deadlock Avoidance	Safe state, Graph algorithm, Banker's algorithm.
	Recovery form Deadlock	Process termination, resource pre-emption.

UNIT- IV

Memory Management: Logical vs physical address space, Swapping, Contiguous Memory Allocation, Paging, Structures of the Page Table, Segmentation.

Virtual Memory Management: Virtual memory overview, Demand Paging, Page-Replacement & its algorithms, Allocation of Frames, Thrashing

Unit	Module	Micro Content
	Memory Management	Base register, limit register, protection with base and limit register.
	Logical vs physical address space	Logical address, memory address register, physical address, dynamic relocation using relocation register.
	Swapping	Swapping of two processes using a disk as backing store, swapping on mobile systems.
	Contiguous Memory Allocation	Memory protection, memory allocation, fragmentation.
	Paging	Basic method for implementing paging, paging hardware, TLB, protection, shared pages.
	Structure of the Page Table	Hierarchical paging, hashed page tables, inverted page tables.
	Segmentation	Basic method, segmentation hardware.
	Virtual memory overview	Virtual memory, virtual address space.

UNIT IV	Demand Paging	Demand paging technique, basic concepts, steps in handling page fault, locality of reference.
	Page-Replacement & its algorithms	Need for page replacement, page replacement techniques: FIFO, Optimal, LRU, LRU Approximation, Counting based.
	Allocation of Frames	Minimum number of frames, allocation algorithms: equal, proportional, global vs local allocation, non-uniform memory access,
	Thrashing	Cause of thrashing, working set model.

UNIT-V

File system Interface: The concept of a file, Access Methods, Directory structure, files sharing, protection.

File System implementation: File system structure, Allocation methods, and Free-space management.

Mass-storage structure: overview of Mass-storage structure, Disk scheduling, Swap space management.

Unit	Module	Micro Content
UNIT V	File Concept	File - attributes, operations, types, structure.
	Access Methods	Sequential, Direct, other access methods.
	Directory structure	Typical file system organization, storage structure, single level directory, two-level, tree-structured, acyclic-graph, general graph directory.
	Files sharing	Multiple users, remote file system, Consistency semantics.
	Protection	Types of access, access control.
	File system structure	File systems, basic file system, layered file system, file organization module, logical file system, FCB.
	Allocation methods	Contiguous, linked, indexed, efficiency of these methods.
	Free-space management	Free-space list, bit vector, linked list, grouping, counting.
	Overview of Mass-storage structure	Magnetic disks, solid state disks.
	Disk scheduling	FCFS, SSTF, SCAN,C-SCAN, LOOK,C-LOOK.
	Swap space management	Swap-space use, location

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