25UCST302	OPERATING SYSTEMS	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course provides a comprehensive understanding of the overall functioning of a computer system, the trade-offs between performance and functionality, and how responsibilities are divided between hardware and software. It introduces key concepts such as memory management, device management, process management and file management within an operating system. It enables learners to grasp the fundamental principles of operating system design, empowering them to analyze issues, enhance system features, resolve operating system problems, and manage computer resources effectively.

Prerequisite: PIC204 Programming in C

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

CO	Course Outcomes	Knowledge Level
CO1	Illustrate the concepts of process management and process scheduling in Operating systems	K3 Apply
CO2	Illustrate process synchronization mechanisms and deadlock prevention, avoidance and detection mechanisms	K3 Apply
CO3	Apply various memory management techniques in Operating Systems to manage system resources efficiently.	K3 Apply
CO4	Apply various file management techniques in Operating Systems.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	–	–	–	–	–	–	1	3	1
CO2	3	3	2	2	–	–	–	–	–	–	1	3	1
CO3	3	3	2	2	–	–	–	–	–	–	1	3	1
CO4	3	3	2	2	–	–	–	–	–	–	1	3	1
AVG	3	3	2	2	–	–	–	–	–	–	1	3	1

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*			*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment Test : 20 marks

Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 hrs)

Operating system overview – Functions and Services - Operating systems structures - Systems calls - Kernel approaches Building and booting an OS - Operating-System Debugging. Process Overview - Process states - Process control block - Context-switching - Processes operations - Process scheduling - CPU scheduling: Non-preemptive, preemptive - Multi-queue scheduling - Multi-level feedback queue scheduling.

Module 2 (15 hrs)

Inter Process Communication - Shared memory, message passing, examples of IPC systems. Race condition Critical section problem, Hardware support for synchronization, Mutex locks. Semaphores - Classical synchronization problems. Concept of a thread, Multithreading benefits, Multi-threading Models. Deadlocks - Resource allocation graphs Deadlock: prevention, avoidance, detection and recovery.

Module 3 (14 hrs)

Concept of address spaces, Swapping, Contiguous memory allocation, Address Translation and TLB. Segmentation – Address translation in segmentation, TLBs, TLB hits and misses, Handling TLB misses, TLB structure, Reducing the page table size. Virtual Memory - Paging, Demand paging, Copy-on-write, Page replacement algorithms, Thrashing, Allocating Kernel Memory.

Module 4 (13 hrs)

File concept - Attributes, Operations, types, structure – Access methods, Protection. File-system implementation, Directory implementation. Allocation methods. Hard disk: Geometry, Magnetic disks, Solid State Devices, Disk scheduling, Disk formatting. Modern System architecture, Programmed I/O, Interrupts, DMA, Device interaction methods, The Device Driver.

Text Books:

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (2015). Operating system concepts (9th ed.). Wiley India.

2. Tanenbaum, A. S. (2015). Modern operating systems (4th ed.). Prentice Hall.

3. Arpaci-Dusseau, A. C., & Arpaci-Dusseau, R. H. (2018). Operating systems: Three easy pieces (1st ed.). CreateSpace.

Reference Books:

1. Stallings, W. (2015). Operating systems (6th ed., Global ed.). Pearson.

2. Nutt, G., Chaki, N., & Neogy, S. (n.d.). Operating systems (3rd ed.). Pearson Education.

3. Dhamdhere, D. M. (2011). Operating systems (2nd ed.). Tata McGraw Hill.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	**25UCST302**
Course Name	**OPERATING SYSTEMS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1.	Explain process states and the transitions between them with a state transition diagram.	3	CO1	L2
2.	Compare preemptive and non-preemptive CPU scheduling. Apply Round Robin scheduling (time quantum = 2) to processes P1(burst=4), P2(burst=3), P3(burst=5) arriving at t=0.	3	CO1	L3
3.	Explain the Critical Section problem and the three conditions that must be satisfied by any solution.	3	CO2	L2
4.	Describe the Banker's Algorithm for deadlock avoidance with a suitable example.	3	CO2	L2
5.	Explain paging and segmentation. Compare their memory utilization and external fragmentation.	3	CO3	L2
6.	Apply the LRU page replacement algorithm to the reference string 7,0,1,2,0,3,0,4,2,3 with 3 page frames and compute the number of page faults.	3	CO3	L3
7.	Explain the various file allocation methods: contiguous, linked, and indexed allocation.	3	CO4	L2
8.	Describe the SCAN and C-SCAN disk scheduling algorithms. Apply SCAN on the request queue [98, 183, 37, 122, 14, 124, 65, 67] starting from head position 53.	3	CO4	L3

Part B (Answer any one full question from each Module. Each carry 9 marks)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.1	Explain the different CPU scheduling algorithms: FCFS, SJF, Priority Scheduling, and Round Robin. Compare their performance using the following process table: P1(AT=0, BT=6), P2(AT=2, BT=4), P3(AT=4, BT=2), P4(AT=6, BT=8).	5	CO1	L3
9.2	Describe the process control block (PCB) and context switching mechanism in detail.	4	CO1	L2
OR				
10.1	Illustrate multi-level feedback queue scheduling with a diagram. Discuss its advantages over multi-level queue scheduling.	5	CO1	L3
10.2	Describe the various types of OS structures: monolithic, layered, microkernel, and modular. Compare their advantages and disadvantages.	4	CO1	L2
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.1	Demonstrate semaphores and their use in solving classical synchronization problems: Producer-Consumer, Reader-Writer, and Dining Philosopher problems.	5	CO2	L3
11.2	Interprete the four necessary conditions for deadlock (Coffman conditions).	4	CO2	L2
OR				
12.1	Illustrate multithreading benefits and models: Many-to-One, One-to-One, and Many-to-Many. Discuss the differences between user threads and kernel threads.	5	CO2	L3
12.2	Describe the hardware support for synchronization: TestAndSet and Swap instructions. Explain how mutex locks are implemented.	4	CO2	L2
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.1	Describe virtual memory management with demand paging. Illustrate the working of page replacement algorithms: FIFO, Optimal, and LRU with the reference string 3,2,1,0,3,2,4,3,2,1,0,4 and 4 frames.	5	CO3	L3

13.2	Explain TLB (Translation Lookaside Buffer) and its role in address translation. Describe TLB hits and misses and methods to handle TLB misses.	4	CO3	L2
OR				
14.1	Illustrate segmentation with paging (combined). Describe address translation in segmentation and how it differs from pure paging.	5	CO3	L3
14.2	Explain thrashing and its causes. Describe the working set model and how it is used to prevent thrashing.	4	CO3	L2
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.1	Illustrate the inode-based file system implementation.	5	CO4	L3
15.2	Describe DMA (Direct Memory Access) and its role in I/O management. Explain the device driver architecture and interrupt handling.	4	CO4	L2
OR				
16.1	Apply FCFS, SCAN, and C-SCAN disk scheduling algorithms to the disk request queue [82, 170, 43, 140, 24, 16, 190] with head starting at 50. Calculate total head movement for each.	5	CO4	L3
16.2	Compare solid-state devices (SSD) with magnetic disk drives in terms of access time, seek time, and latency. Describe disk formatting and its types.	4	CO4	L2