A. Course Handout (Version 1.2)

Institute/School Name	Chitkara University Institute of Engineering and Technology		
Department Name	Computer Science & Engineering		
Programme Name	Bachelor of Engineering (B.E) - Computer Science & Engineering		
Course Name	Operating System	Session	2022-2023
Course Code	22CS005	Semester/Batch	2nd /2022
L-T-P (Per Week)	4-0-6	Course Credits	4
Course Coordinator	Dr. Prabhjot Chahal		

1. Scope and Objectives of the Course

This course focuses on fundamental design and implementation ideas in the engineering of operating systems. Topics include virtual memory, threads, context switches, kernels, interrupts, system calls, interprocess communication, coordination, and the interaction between software and hardware. The main objectives of the course are to:

- Impart a structured approach to understand the concepts of operating system.
- Expose students to concurrent programming issues in the management of resources like processor, memory and input-output
- Provide skills required as a foundation to build solutions for real-world engineering problems.
- Enable learners to understand different Linux operating commands along with their usage.

2. Course Learning Outcomes

After completion of the course, students will be able to do the following:

	Course Outcome	POs	CL	KC	Sessions
CLO01	Compare different types of Operating System and identify their components.	PO1, PO3, PO11	K2	Factual Conceptual	**6**
CLO02	Comprehend the concept of process, principle of concurrency.	PO1, PO3,PO11	K2,K4	Fundamental Conceptual	**6**
CLO03	Appraise various scheduling algorithms and deadlock handling techniques.	PO1,PO4, PO5,PO11	K3,K5	Conceptual Procedural	**8**
CLO04	Epitomize memory management techniques.	PO3,PO4,PO5,PO11	K3,K5	Conceptual Procedural	**6**
CLO05	Understand the concept of disk scheduling, file system and I/O devices.	PO3,PO5,PO11	K3,K5	Conceptual Procedural	**6**
Total Contact Hours					**60**

Revised Bloom's Taxonomy Terminology

*Cognitive Level =CL

*Knowledge Categories = KC

CLO-PO mapping grid

Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO1		H	H									H
CLO2		H	H		H							
CLO3	M	H	H				M					
CLO4		H		M	H				H			
CLO5	M	H	M			M		M		M	M	

3. ERISE Grid Mapping

Feature Enablemnet	Level(1-5, 5 being highest)
Entrepreneurship	2
Research	4
Innovation	3
Skills	5
Employability	4

4. Recommended Books (Reference Books/Text Books):

B01: Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, 9th Edition, 2018, Wiley.
B02: System Programming and Operating Systems, D.M. Dhamdhere, 2nd Edition, 2009, Tata McGraw Hill.
B03: Operating Systems: Internals and Design Principles, William Stallings, 9th Edition, 2018, Pearson.
B04: Modern Operating Systems, Andrew S. Tanenbaum, 4th Edition, 2016, Pearson.
B05: Advanced Linux Programming, Mark Mitchell, Jeffrey Oldham, and Alex Samuel, 1st Edition, 2001 Germany: New Riders.
B06: Linux Command Line and Shell Scripting Bible, Richard Blum and Christine Bresnahan, 3rd Edition, 2015, Wiley.

5. Other readings and relevant websites:

S.No.	Link of Journals, Magazines, websites and Research Papers
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/download-course-materials/
2	http://nptel.ac.in/courses/106108101/
3	http://www.ics.uci.edu/~ics143/lectures.html
4	http://www.cs.kent.edu/~farrell/osf03/oldnotes/index.html
5	http://williamstallings.com/OS/OS6e.html

6	https://learning.edx.org/course/course-v1:LinuxFoundationX+LFS101x+1T2017
7	https://nptel.ac.in/courses/106/105/106105214/

6. Recommended Tools and Platforms

VirtualBox 6.1.22, Ubuntu 21.04, GCC Compiler

7. Course Plan

Sessions	Topics	Recommended Book / Other reading material	Page numbers of Text Book(s)
1	**Introduction:** Introduction to Operating systems, Operating System role, Computer system architecture: Single processor, Multiprocessor Systems, Clustered Systems, OS structure, OS operations, Components of OS: Process management, memory management, storage management, I/O management	B01 Link 1	3-5, 12-18 19-31
2*	Operating System Services, User and OS interface, System Calls/API, Types of System Call, System Program	B01	53-73
3	**Process Concept:** Process Scheduling, Operations On Processes, Inter-process Communication	B01 B03 B04 Link 2	103-128 320-326, 447-453 108-140-150
4	**Threads**: Overview of Threads, Multicore Programming, Multithreading Models, Threading issues	B01 B04 Link 5	161-169, 181-188, 144-145 161-174, 195-198
5*	**CPU Scheduling:** Basic Concepts, Scheduling Criteria Scheduling Algorithms-, First In first Out Scheduling Algorithms (FIFO), Shortest Job First Scheduling Algorithms (SJF),	B01 B03 B04, Link 7	201-208 343-347, 406-416
6*	Priority Scheduling Algorithms, Scheduling Algorithms-Round-robin Scheduling Algorithms, Multilevel Queue Scheduling	B01 B04	209 417-432,
7	**Process Synchronization**: Background, The Critical-Section Problem, Two process solution, Multiple Process solution, Synchronization Hardware.	B01 RB2 Link 3 Link 2	253-259 189-197
8	Semaphores, Classic problems of Synchronization, Critical regions, Monitors	B01 B02 B03	259-263 281 197-222 396-432
9-10	**Deadlock:** System Model Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock detection, Recovery From Deadlocks	B01 B02 B03 B05, Link 7	311-318 143-250 371-395 168-173 320-344
11-12	**Memory Management:** Basics, Swapping, Contiguous memory allocation, Segmentation, Paging, Segmentation, Segmentation with paging	B01 B02 B04	345-360 273-308 326-331 360-365

13-14	Introduction to Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of frames, Thrashing	B01 B02 B05	389-401 317-330 202-222
15-16	**Mass Storage structure:** Overview, Disk Structure, Disk attachment, Disk Scheduling, Disk Management	B01 B02 B05	539-556 491-504 269-324

***The session number 2, 5 and 6 to be covered during the Lab sessions only. The topics are the part of theory as well as Lab, therefore for efficient time management respective lab faculty will be responsible for the coverage of the topic.**

Lab Plan

Sessions	Experiments	Learning Resource
1	**Installation**: Configuration & Customizations of Linux **Introduction to GCC compiler:** Basics of GCC, Compilation of program, Execution of program, Time stamping, Automating the execution using Make file.	https://ubuntu.com/tutorials/install-ubuntu-server#1-overview
2-3	Implement Process concepts using C language by Printing process Id, Execute Linux command as sub process, Creating and executing process using fork and exec system calls.	https://linuxhint.com/fork-system-call-linux/ https://www.geeksforgeeks.org/linux-system-call-in-detail/
4-5	Implement FCFS, SJF, priority scheduling, and RR scheduling algorithms in C language.	https://www.tutorialspoint.com/c-program-for-fcfs-scheduling https://www.javatpoint.com/round-robin-program-in-c
6-7	Implement the basic and user status commands like: su, sudo, man, help, history, who, whoami, id, uname, uptime, free, tty, cal, date, hostname, reboot, clear	https://techlog360.com/basic-ubuntu-commands-terminal-shortcuts-linux-beginner/
8	Implement deadlock in C by using shared variable.	https://www.codingninjas.com/codestudio/library/deadlock-detection-algorithm
9-10	File system: Introduction to File system, File system Architecture and File Types.	https://tldp.org/LDP/intro-linux/html/sect_03_01.html
11-12	Implement the commands that is used for Creating and Manipulating files: cat, cp, mv, rm, ls and its options, touch and their options, which is, where is, what is	http://tldp.org/LDP/abs/html/basic.html
13-14	Implement Directory oriented commands: cd, pwd, mkdir, rmdir	http://litux.nl/Reference/Books/7213/ddu0082.html
15-16	Implement File system commands:	https://www.geeksforgeeks.org/cmp-command-in-linux-with-

	Comparing Files using diff, cmp, comm	examples/ https://www.geeksforgeeks.org/diff-command-linux-examples/

8. Delivery/Instructional Resources

Lecture Number	Topics	PPT *(link of ppts on the central server)*	Industry Expert Session*(If **yes**: link of ppts on the central server)*	Web References	Audio-Video
1	**Introduction:** Introduction to Operating systems, Operating System role, Computer system architecture: Single processor, Multiprocessor Systems, Clustered Systems, OS structure, OS operations, Components of OS: Process management, memory management, storage management, I/O management.	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
2	Operating System Services, User and OS interface, System Calls/API, Types of System Call, System Program	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
3	**Process Concept:** Process Scheduling, Operations On Processes, Inter-process Communication	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
4	**Threads**: Overview of Threads, Multicore Programming, Multithreading Models, Threading issues	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
5	**CPU Scheduling:** Basic Concepts, Scheduling Criteria Scheduling Algorithms-, First In first Out Scheduling Algorithms (FIFO), Shortest Job First Scheduling Algorithms (SJF)	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/

6	Priority Scheduling Algorithms, Scheduling Algorithms- Round-robin Scheduling Algorithms, Multilevel Queue Scheduling	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
7	**Process Synchronization**: Background, The Critical-Section Problem, Two process solution, Multiple Process solution, Synchronization Hardware.	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
8	Semaphores, Classic problems of Synchronization, Critical regions, Monitors	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
9-10	**Deadlock:** System Model Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock detection, Recovery From Deadlocks	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
11-12	**Memory Management:** Basics, Swapping, Contiguous memory allocation, Segmentation, Paging, Segmentation, Segmentation with paging	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
13-14	Introduction to Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of frames, Thrashing	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/
15-16	**Mass Storage structure:** Overview, Disk Structure, Disk attachment, Disk Scheduling, Disk Management	https://drive.google.com/drive/folders/1i2ljJeEZ81t9FFWzh_qvr4feJiEKw1LZ?usp=share_link		https://nptel.ac.in/courses/106/108/106108101/	https://nptel.ac.in/courses/106/105/106105214/

9. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 1	Lab Evaluations	02*	20%	Offline
Component 2	Sessional Tests (STs)	02**	30%	Offline
Component 3	End Term Examinations	01	50%	Offline
Total			**100%**	

*Out of 02 FAs, the ERP system automatically picks the best 01 FAs marks for evaluation of the FAs as final marks.

**Out of 02 STs, the ERP system automatically picks the best 01 STs marks for evaluation of the STs as final marks. ST to be held in Lab of ST week as per Academic Schedule.

*As per Academic Guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

10. Syllabus of the Course:

Topics	No of Lectures	Weightage
Introduction: Introduction to Operating systems, Operating System role, Computer system architecture: Single processor, Multiprocessor Systems, Clustered Systems. OS structure, OS operations, Components of OS: Process management, memory management, storage management, I/O management, Protection and security. Computing Environment. Operating System Services, User and OS interface, System Calls/API, Types of System Call, System Program	5	21.8%
Process Concept: Process Scheduling, Operations On Processes, Inter-process Communication	2	
Threads: Multithreading Models, Overview, Threading issues, Linux Threads	1	12.6%
CPU Scheduling: Basic Concepts, Scheduling Criteria Scheduling Algorithms Multiple-Processor	3	
Process Synchronization: Background, The Critical-Section Problem , Two process solution, Multiple Process solution, Synchronization Hardware, Semaphores	2	18.8%
Classic problems of Synchronization, Critical regions, Monitors	1	
Deadlock:	3	

System Model Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock detection, Recovery From Deadlocks		
Memory Management: Basics, Swapping, Contiguous memory allocation, Segmentation. Paging, Segmentation with paging.	4	25%
Introduction to Virtual Memory, Demand Paging, Process creation: Copy- on write, Page Replacement Algorithms, Allocation of frames, Thrashing.	4	
File Concept: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection, **Implementing File System:** File System Structure, File System. Implementation, Directory implementation, Allocation Methods, Free-space Management	3	21.8%
Mass Storage structure: Overview, Disk Structure, Disk attachment, Disk Scheduling, Disk Management, Swap-Space Management.	4	

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Dr. Prabhjot Chahal	
Head Academic Delivery	Dr. Navjeet Kaur	
Dean	Dr. Monit Kapoor	
Date	06.04.2023	